CREDIT AVAILABILITY AND PROPENSITY TO INNOVATE OF SMALL AND MEDIUM ENTERPRISES°

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Abstract

We aim to analyze the impact of credit availability on firms' probability to innovate. Using detailed information on more than five thousand five hundred credit lines to small and medium enterprises (SMEs), we find that innovative activities are positively affected by measures of bank loan availability. Further, estimates also show that firms located in an industrial district have higher probability to be innovative than other firms. Our results support the idea that Italian institutions should undertake and reinforce an economic policy oriented to sustain the access to credit of SMEs as a key element for the growth and development of innovative firms.

Keywords: innovative firms, probability to innovate, credit access

Parole chiave: imprese innovative, probabilità di innovazione, credito d'accesso

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Introduction

The access to credit plays a crucial role for all firms, by extending or undermining their profits and growth opportunities (Calcagnini, Ferrando and Giombini, 2014). Particularly, financial resources are vital to foster the start-up and development of innovative firm projects (Canepa and Stoneman, 2002), and the financing of innovation is acknowledged to be a key factor to substantially increase firms' competitiveness and performances. Notwithstanding this, R&D expenses have a number of characteristics that make them different from fixed investment (Hall, 2009), and the empirical literature has mainly focused on which financial models are more suitable for innovative firms (Brierley, 2001; OECD, 2006; Robb, 2010). Generally, it is argued that debt financing is less suitable than other sources (internal resources and equity issues) to finance innovative firms, due to the presence of tougher moral hazard problems, riskier activity, lower collateral, and therefore to potential investors' difficulties in valuing their investment projects (Guiso, 1998).

By contrast, the impact of bank loans on firm propensity to innovate, i.e. whether firms' investment in innovation is affected by credit availability, remains an open question, especially if referred to small- and medium-sized enterprises (SMEs).

In this paper we aim to fill in the informative gap about the causal effect of external debt, i.e. bank loans, on the firm's propensity to innovate using a combination of information obtained by two datasets on firms operating in an Italian context. The first dataset contains the entire portfolio on more than five thousand five hundred credit lines granted to SMEs by a major inter-regional Italian bank. The second dataset identifies innovative firms that carry out a narrow set of innovative activities, such as registration of patents to the Italian Patent Office (IPO), to the European Patent Office (EPO) or to the United States Patent and Trademark Office (USPTO), or participation to National research projects.

Previous empirical evidence shows that the financial development of a country may considerably influence the adoption of innovative processes both for small-sized firms as well as for those operating in high-intensity sectors (Benfratello, Schiantarelli and Sembenelli, 2008). Other studies point out that public R&D subsidies have a positive effect on innovation (Almus and Czarnitzki, 2003; Gorg and Strobl, 2007), and there is evidence on the role of finance in the specialization of the Italian industrial districts (Ferri and Rotondi, 2006). Finally there is some empirical evidence that issuing equity increases the probability that the firm has R&D expenditures for small, young, and more leveraged high-tech firms (Magri, 2013), while the evidence on the role of external debt financing in determining firms' investment in innovation is scanty.

Thus, the aim of our paper is to identify whether bank loans provide support to the adoption of investments in innovative activities undertaken by SMEs. The focus of the analysis is on SMEs for a twofold argument. Firstly, Italian SMEs account for over 99% of firms and about 80% of employment (Istat, 2007). Secondly, SMEs and large firms differ significantly in terms of financial structure (ECB, 2009), and SMEs largely rely on banks when selecting sources of external financing.[1] Indeed, for small- and medium-sized firms market-based and equity financing play a minor role[2] to finance investment projects.[3]

Finally, there is recent empirical evidence on the real-side implications of credit access, i.e. the use of credit lines, both in periods of easier credit and during the financial crises. Campello *et al*. (2010) find that firms use available credit lines when the internal sources of financing are limited easing the process of corporate spending, even during a credit crunch. In a similar vein, Lins, Servaes and Tufano (2010) find that credit lines provide firms with the ability to explore future business opportunities.

As a preview of the results, we show that the probability to innovate of SMEs is positively influenced by many factors. Firstly, by the access to credit captured by a measure of credit availability and a measure of credit tightness; secondly by the loan size, i.e. the amount of granted credit by the bank for such investments. Thirdly, by the firm size, and lastly, by the firm location, i.e. being inside an industrial district fosters firm propensity to innovate.

The paper is organized as follows. Section one reviews the empirical literature on innovative firms' financial problems. Section two describes the dataset employed, while section three analyzes the empirical strategy, and section four discusses the main empirical findings. The last section concludes.

1. According to ECB (2009), the 32% of SMEs used a bank loan in the previous six months, and the 30% used a bank over-draft or credit line. Leasing, hire purchase and factoring (used by 27%), and trade credit (15%) also played a relatively important role.
2. Following the ECB (2009) only the 0.9% of small- and medium-sized firms issued debt securities and 1.3% issued equity or relied on external equity investors.
3. Giudici and Paleari (2000), analyzing a sample of small- and medium-sized innovative Italian firms, find support for the pecking order theory. Indeed, a firm owner's wealth is the main source of funds, followed by short-term bank debt, whereas outside equity finance is used only if the new investors also provide new financial skills. Colombo and Grilli (2007) studying the determinants of financing sources of small-sized innovative Italian firms confirmed the pecking order hypothesis. Indeed, only a small share of firms finances investment projects by using external equity and the main financing source is the entrepreneur's personal wealth, followed by bank loans. Calcagnini, Favaretto and Giombini (2011) empirically analyze financial models of innovative firms in Italy, and find that only a small number of interviewed firms have faced problems in raising external funds for innovation, even during the period of the economic and financial crisis.

1. A short literature review

The financing of innovative investments has attracted great interest in the economic literature, and recently, some studies have started to analyze the link between sources of financing and the firm's propensity to innovate. From these works it emerges that firms experience problems that prevent them from investing in innovation activities, and one of the more severe constraint they face is, among others, the lack of appropriate financial sources (Canepa and Stoneman, 2002; Mohnen and Röller 2005; Savignac, 2006).

More closely related to our idea on the importance of the banking channel to finance innovative investments, some recent studies investigate the effect of the development of the local banking system and of the credit availability on the probability of adoption of innovation by firms (Alessandrini, Presbitero and Zazzaro, 2010; Benfratello, Schiantarelli and Sembenelli, 2008; Ferri and Rotondi, 2006; Herrera and Minetti, 2007). Using survey data on "Community Innovation Survey" and looking at the probability to introduce both process and product innovation, Benfratello, Schiantarelli and Sembenelli (2008) find a positive effect of the bank branch density on the probability of introducing innovations. The latter is significantly higher for firms located in areas with higher bank branch density, and this effect is larger for small and high-tech firms than for the others. However, this evidence seems to be stronger for product innovation, while it is weaker for process innovation. In a similar vein, Herrera and Minetti (2007) using eighth Capitalia Survey find a positive relationship between the probability of introducing innovation and the length of credit relationship with referred bank. Using a more recent version of data provided by Capitalia Survey, Ferri and Rotondi (2006) confirm the previous study, corroborating the importance of the relationship with referred bank on the probability to introduce innovation processes. Alessandrini, Presbitero and Zazzaro (2010) analyse the effect of bank-size and bank-branch distance on the probability of small- and medium-sized firms to adopt innovative processes at provincial level. Their results show that the distance between banks decisional headquarters and local economies, as a measure of banks organizational structure, impacts negatively on the probability of innovation. In particular, an increasing distance between bank's headquarter and local branches significantly reduce the likelihood of local small- and medium-sized firms to introduce innovation, while the bank's size on the adoption of process innovation seems to have a weak effect. Recently, Giannetti (2012) shows that relationship lending has negligible impact on the innovative activity of SMEs while plays an important role for firms operating in high-tech industries. Brancati (2014) using the MET survey on Italian firms performed in 2008, 2009 and 2011 finds that financial constraints strongly hamper firms' probability of introducing innovations.

Finally, Amore, Schneider and Zaldokas (2013) present evidence that banking development plays a key role in technological progress. Focusing on manufacturing firms' innovative performance, the authors find that the deregulation of banking activities across US states during the 1980s and 1990s had significant beneficial effects on the quantity and quality of innovation activities, especially for firms highly dependent on external capital and located closer to entering banks.

2. Dataset

2.1. Dataset description

To analyze whether firm's probability to innovate depends on bank loans we combine information from two distinct datasets. The first proprietary dataset collects information on credit lines granted mainly to SMEs, by a large Italian bank belonging 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.[4] The provinces are also representative of the Italian economic structure, characterized by the presence of a large number of SMEs.[5] During the timeframe of our study, the bank operates with sixty branches in both provinces.

Firms operate in more than twenty-three industry sectors defined at the 2-digit level according to the Italian National Institute of Statistics (Istat). The dataset contains information on loan contract terms (e.g. credit limit, interest rate), bank-borrower relationship (e.g. length and exclusivity, whether the borrower uses other services offered by the bank, rating, collateral, portfolio, 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.).

The latter dataset provides information on firms, which engaged in innovative activities in 2004 and 2006 collected by the Regional Government Agency.

4. For the sake of confidentiality, we cannot reveal the Bank identity or the Region for which the data are available. Less than 4% of the credit lines are granted to firms located in other two neighboring provinces.

5. Using GDP per capita in Italy in 2006 as a base of one hundred, 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).

Firms are listed in this dataset if they carried out a series of innovative activities such as: registration of patents, project funded and involvement and development of R&D projects (table 1). However, the information contained in the dataset does not identify the specific activity undertaken by each firm. Thus, we construct an indicator *Innovation*, which assumes the value of 1 if the firm pursued at least one of the activities reported in table 1, and 0 otherwise.

Table 1 – List of innovative activities

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 European Patent Office (EPO) by firms located in our referred provinces.
UIB P 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	Firm projects' financed by regional funds to incentive R&D with regional law 73, 73b/2003.

Source: Favaretto and Zanfei (2007).

Following the above-mentioned criteria, we identify overall three hundred one innovative firms operating in these provinces.[6] Matching information on

6. A previous research project on innovation identified three hundred forty-six innovative firms located in this region in the year 2007. These firms emerged to carry out, in the year 2007, 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 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 (one hindred ninety-two over three hundred forty-six, that is 55% of all firms) were included in the sample because they were registered with the national register of research projects.

bank's portfolio and firm innovation activities, we identify one hundred twenty-four bank-innovative firm relationships in 2006.

As our focus is on small business lending, we follow the EU definition of small business enterprises and exclude from our dataset fifteen innovative borrowers with sales exceeding fifty million euros.[7] Finally, other firms were dropped from the sample because of missing values in key explanatory variables. Thus, our final sample contains ninety innovative and five thousand four hundred forty-four non-innovative firms in 2006. In table 2 we report the descriptive statistics of innovative and non-innovative firms while in the Appendix we report the construction and definition of our variables.

Table 2 – Summary statistics. Innovative firms vs non-innovative firms

Variable	*Observations*	*Mean*	*Dev. st.*	*Min.*	*Max.*
Innovative firms					
Credit availability	90	0.97	0.18	0	1
Credit tightness	90	0.53	0.31	0	1.09
Interest rate	90	7.08	1.95	3.97	13.50
Multilending	90	0.96	0.21	0.00	1.00
Other services	90	0.98	0.14	0	1
Turnover (millions of euro)	90	12.6	11,900,000	0.12	37.5
Portfolio	90	0.51	0.50	0	1
Leverage	90	0.23	0.74	0	6.52
Total accorded (euro)	90	275,381	661,275	20	3,364,670
Industrial district	90	0.81	0.39	0	1
HHI	90	0.15	0.10	0.07	0.56
Corporation	90	0.91	0.29	0	1
Sales	90	4.42	1.17	1.00	6.00
Distance	90	6,542.44	6,851.34	0	44,998
Non-innovative firms					
Credit availability	5,444	0.80	0.40	0	1
Credit tightness	5,444	0.73	0.44	0	9
Interest rate	5,444	7.34	2.18	3.70	13.50
Multilending	5,444	0.94	0.24	0	1
Other services	5,444	0.92	0.27	0	1
Turnover (millions of euro)	5,444	2.60	6,314,637	0.12	37.5
Portfolio	5,444	0.09	0.28	0	1
Leverage	5,444	0.23	0.47	0.0003	14.40
Total accorded (euro)	5,444	88,946.50	309,857.20	2.03	8,193,811
Industrial district	5,444	0.60	0.49	0	1
HHI	5,444	0.19	0.14	0.07	1
Corporation	5,444	0.33	0.47	0	1
Sales	5,444	2.19	1.47	1	6
Distance	5,444	4,889.84	7,034.81	0	138,006

Source: our elaborations on own bank data.

7. The European Commission adopted the definition of small business enterprises in its Recommendation of 6.5.2003 (GUCE L 124/36 of 20.5.2003).

2.2. Explanatory variables

In this study we aim at testing the impact of bank funds on firms' propensity to innovate, and firms are considered innovative if they engage in one of the activities listed in table 1. Thus, we firstly define two variables, *Credit Availability* and *Credit Tightness*, which measure the availability of credit. Secondly, as innovation might depend on various borrower and lender characteristics, we introduce a rich set of control variables related to borrower and lending branch characteristics.

The first explanatory variable we consider is *Credit Availability*, a dichotomous variable taking the value of 1 if a borrower has not experienced a credit restriction and 0 otherwise. Credit restrictions are measured on the basis of the overdraw practice, i.e. whether the borrower uses more than the amount granted on the credit line by the bank.

In the time-lapse of our study, Italian credit lines provide borrowers with a certain degree of flexible use by either allowing them to not fully utilize the committed credit, free of any charge, or overdraw up to a certain amount, subject to fees and penalty interest rates on the overdrawn part. Within our data, the frequency with which traditional firms experience credit restriction in the access to credit is significantly higher respect to innovative ones (20% vs. 3.3%).

Alternatively, we measure firm access to bank credit with the variable *Credit Tightness*, which is a continuous variable that measures the percentage of credit line utilized on total amount granted by the bank, and we assume the higher this percentage is, the higher the probability that the firm is experiencing binding credit limits. Descriptive statistics for this variable show that innovative firms seem to experience less binding credit limits than non-innovative firms: the former use, on average, the 52% of the accorded amount of credit, while the average value of credit tightness for the latter is 72%.

Descriptive statistics of table 2 show relevant differences between innovative and non-innovative firms in other loan characteristics. Thus, in our empirical models we also control for the price of credit (*Interest Rate*) and the loan size (*Total Accorded*), which could reveal other aspects of the contract characteristics. The interest rate paid by innovative borrowers is, on average, approximately twenty-six basis points less than that paid by traditional ones (7.08 vs. 7.34). *Total Accorded* is a continuous variable that measures the total amount accorded by bank to firm. The average amount accorded by the bank is ninety-three thousand seventy-three euros. However, on average this amount is higher for innovative firms than traditional one (three hundred forty-two thousand six hundred seventy-

8. In the empirical analysis we opted to use as explanatory variable the natural logarithm of the total amount accorded to the firm.

eight euros vs. eighty-eight thousand nine hundred forty-six euros).[8]

We also introduce two measures intended to capture the nature of the bank-borrower lending relationship. First *Other Services* considers the scope of the bank-borrower interaction (Cole and Wolken, 1995). This is a dummy variable takes the value of 1 if the firm uses additional services provided by the bank and 0 otherwise. 92,2% of firms utilizes other financial services from this bank. However, innovative firms tend to use more of these services from the bank respect to traditional counterpart (97,8% vs. 92.1%). 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 4,4% of the firms have an exclusive lending relationship with the bank and we do not notice differences between innovative and traditional firms.[9]

Our empirical analysis takes into account firm characteristics. Larger firms usually have more internal resources and are less credit constrained, and have size advantages in terms of internal knowledge, financial resources for innovation, and market power (Cohen and Klepper, 1996).

Thus, we expect that these firms have a higher probability of undertaking investment projects and, more specifically, should show a higher propensity to innovate. Indeed, previous studies find that innovation, measured by R&D, increases with firm size (Scherer, 1965). Vaona and Pianta, (2008) find that product innovation is explained by a growth-oriented strategy, while process innovation is associated to the acquisition of new machinery. The authors argue that these distinct models identify two trajectories for innovation, although some complementarities exist and they are stronger for large firms.

Thus, we use borrower's total sales as a proxy of firm size. The bank only provides sales categories rather than exact sales amounts, and in terms of average *Turnover* innovative firms are significantly greater than the traditional ones, (on average 12.6 vs. 2.6 millions of euro, see table 2).

Thus, we construct a step variable considering six categories of sales, and we measure firm size by means of a set of dummy variables *D (Sale_n)* that take the value of 1 if the firm total sales fall in the *n*-th category and 0 otherwise.

To take in account for the organizational structure and decision making process of the bank (e.g., Liberti and Mian, 2009), we include the variable *Portfolio* that identifies the bank's operating segments in which the borrowers fall. Specifically, the variable 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*

9. This variable is actually dropped from the sample during the estimation procedure.

market. The small business market represents more than 90% of the bank's loan portfolio. 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 portfolio in 55,5% of the cases.

The dichotomous variable *Portfolio* controls for firm size as defined by the bank, i.e. the firm might be identified as belonging to the *corporate market* or to the *small business market*. Indeed, we should expect that the former, being characterized by a better access to credit than the latter, should show a higher propensity to innovate.

As another borrower characteristic, we also consider the legal entity of the firm. *Corporation* is an indicator that takes the value of 1 if the loan recipient is a business corporation and 0 otherwise. The univariate results reported in table 2 show that innovative firms have generally a more structured legal form and are mainly organized as business corporation (91.1% vs. 32.6% of traditional firms). This fact could be due to the industrial sector in which they operate (i.e. secondary sector and manufacture particularly), by the firm's dimension and/or by firm's activity seniority. In the latter case it is possible that younger firms tend to be less structured (Berger and Udell, 1998). The other business entities of innovative firms are partnerships (6.7%) and individual firms (2.2%), while traditional firms are mainly sole proprietorships (42.9%), partnerships (22%) and finally cooperative firms (1.89%).

To control for the presence of other sources of financing we use the variable *Leverage*, which measures the firm total indebtedness. Empirical evidence suggests that indebtedness plays a significant role in explaining firms' innovative activity, both in the Centre-North and in the South of Italy. Highly indebted firms are also more innovative, but more innovative firms are also less capable to sustain their debts out of current profits (Costanzo, Silipo and Succurro, 2013). We control also for industry differences in the cost of credit by adding a set of industry indicators based on the Istat classification discussed earlier. In particular we build twenty-three dummies at the 2-digit Istat level, which roughly corresponds to the 2-digit SIC classification in the US.

Finally, to measure the impact of firm's location on the propensity to innovate, we use a dichotomous variable *D(Province)*, which takes the value of 1 if the firm is located in the "B" Province.

Firm's propensity to innovate might also be related to the characteristics of markets within firm operates. Firstly, we control for the Herfindahl-Hirschman index (HHI), which measures bank branch concentration, to capture local credit market conditions and competition, calculated in September 2006. On average branches are located in contestable markets with an HHI close to 0.21. We control for credit market concentration because we expect that less bank-

ing competition stimulate relation-based lending and facilitates the funding of opaque borrowers/projects (Cetorelli, 1999; Petersen and Rajan, 1995). Furthermore, Alessandrini, Presbitero and Zazzaro (2010) find that small and medium enterprises located in more concentrated credit markets have a higher probability of introducing innovation.

Secondly, to consider for 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 district and 0 otherwise. From table 2 we note that on average the presence of innovative firms within an industrial district is higher than that of traditional ones (81% vs. 60% respectively).

Within the Italian industrial districts, there is a significant level of variety, specialization and selection, and the engine of the introduction of innovation in local firms is typically represented by social and technical interactions (Belussi and Pilotti, 2002). Thus, on the one side, we could expect a positive correlation between the innovative processes and the fact that the firm belongs to the industrial district. However, on the other side, it has been found that firms belonging the industrial district invest in exploiting the networks of creativity to support product innovation, while science-driven innovation seems to be predominant for firms not embedded in districts (Chiarvesio and Di Maria, 2009).

Finally, we also control for the operative distance between the firm and the bank by means of the variable *Distance*. Indeed, firm propensity to innovate could be positively affected by proximity of financial resources. The underline rationale is that the lower the distance, the higher the flow of soft information from the borrower to the bank and the better the access to credit and the terms of loan (Bellucci, Borisov and Zazzaro, 2013). Thus, we should expect a negative estimated coefficient for this variable. Previous studies found a negative impact of the functional distance (i.e. bank-branch distance) on innovation adoption by SMEs (Alessandrini, Presbitero and Zazzaro, 2010).

3. Empirical strategy

3.1. Reverse causation and endogeneity

To deal with our central research question, i.e. whether bank loans can stimulate innovative activities, we need to control for possible endogeneity and reverse causation problems between innovation and credit access.

Indeed, two issues deserve attention. First, is has been shown that the innovative nature of firms might influence firm access to credit (Bellucci, Favaretto and Giombini, 2014; Czarnitzki and Hottenrott, 2011; Freel, 2007) and that

the financing of innovative firms may be particularly difficult and onerous due to the presence of tougher moral hazard problems, riskier activity, lower collateral in innovative firms with respect to traditional ones (Hall, 2009). Thus, debt might be a less suitable source of financing than other sources to finance innovative, small-sized firms, especially during their start-up phase (Jensen and Meckling, 1976).

Indeed, the economic conditions, industry characteristics, and unobserved factors could influence both firms' innovation and credit availability, thus biasing the effect of finance on technological progress (Amore, Schneider and Zaldokas, 2013). Thus, to overcome the potential endogeneity that could affect our estimates, a second argument needs to be addressed.

The second consideration concerns the criteria used by the Regional Government Agency to select firms in the innovation dataset. Basically, a firm is included into the dataset if the innovation activity (e.g., registration of patent) is actually concluded. As there is generally a lapse of time between the stage at which the firm gets the loan and the stage at which the innovation activity is fully undertaken, the firm needs foremost financial resources to fully implement such innovation activities.

Thus, in order to gauge a causal effect of bank credit availability on innovative activity and to control for the timing of the investment in innovative activities, the identification strategy relies on the availability of data for two years, 2004 and 2006. Specifically, the empirical equations test whether the availability of credit in the former year affects firm propensity to innovate in the latter year.

3.2. The models

We estimate two alternative models. The first model assumes that the probability that the firm undertakes innovative activities depends not only on firm- and market-specific characteristics, but also on bank credit availability and on other characteristics of the bank loan, such as its costs. The empirical equation

$$\Pr(Innovation_{i,2006}) = \Phi\Big(c + \alpha Credit\ Availability_{i,2004} + \sum_{v=1}^{l} \beta_v Firm_{i,2006} + \sum_{w=1}^{m} \delta_w Market_{i,2006} + \sum_{z=1}^{n} \gamma_z Bank_{i,2004} + \xi_i \Big) \quad [1]$$

where *i* refers to firms and *Firm, Market*, and *Bank* are vectors of characteristics related to the firm profile (sales, activity sector, organizational form, leverage, etc..), local credit market (concentration, industrial district) the bank-firm relationship (services, exclusivity of relationship, interest rate, loan size,

etc..), as described in section two.

The second model relates firm propensity to innovate to firm-, loan- and market-specific characteristics, and to a measure of credit restrictions, i.e. *Credit Tightness*. The empirical equation of model [2] takes the following

$$\Pr(Innovation_{i,2006}) = \Phi\left(c + \alpha Credit\,Tightness_{i,2004} + \sum_{v=1}^{l} \beta_v Firm_{i,2006} + \sum_{w=1}^{m} \delta_w Market_{i,2006} + \sum_{z=1}^{n} \gamma_z Bank_{i,2004} + \xi_i \right) \quad [2]$$

where *i* refers to firms, and vectors *Firm*, *Market* and *Bank* contain the same set of characteristics as in model [1].

In a limited dependent variable setting, we first assume a linear probability (LP) model, according to which the dichotomous *Innovation* variable is a linear function of the independent variables (i.e.: $\Phi = I$). In large samples, the statistical inference of the LP Model follows the OLS procedures under the normality assumption. Within this framework, the slope coefficient measures directly the change in the probability of undertaking innovative activities (i.e., *Innovation* = 1) as a result of a unit change in the value of a regressor. However, there is a major problem with the OLS estimation of the LP model, i.e. the estimated coefficients do not necessarily lie between the [0, 1] range. Therefore, we in turn show estimated coefficients of model [1] obtained by a probit estimation (i.e.: $\Phi(.)$ is assumed to be the CDF of the standard normal distribution), and a logit estimation (i.e.: $\Phi(.)$ is assumed to be the CDF of the logistic distribution). Within these settings, the relationship between the probability of undertaking innovative activities and the vectors of variates is non-linear. All models are estimated with standard error clustered at bank branch level.

4. Results

4.1. Main findings

Column (1) of table 3 shows the estimates of a baseline version of the linear probability model [1], in which the probability that *Innovation* is equal to 1 depends on *Credit Availability* and by the following firm characteristics: firm size (*D (Sales_n)*), industry (*Industry Dummy*) and location (*Province*). Findings suggest that, as expected, the credit availability affects positively firm propensity to innovate, as the estimated coefficient of *Credit Availability* is positive and statistically significant. The estimated coefficient suggests that a firm, which does not experience overdraw in the year 2004 has, on average, a

1% higher probability of undertaking innovation activities in 2006 than other firms, ceteris paribus. Furthermore, firm size seems to play an important role in firm innovative activities, i.e.: larger sized firms have a higher probability to undertake innovative projects as shown by the estimated coefficients of the dummy variables *D(Sales_n)*. Particularly, we also find that these estimated coefficients are larger in magnitude the higher the size category is.

In column (2) of table 3 we estimate the full LP model [1]. Consistently with the literature, bank concentration (*HHI*) influences positively firm probability to innovate (the marginal effect is equal to 2%), as well as firms that belong to industrial districts benefit from relationships and synergies, which arise inside districts, in terms of a 1% increasing probability to undertake innovation activity. Furthermore, the adoption of a more sophisticated legal form (i.e. *Corporation*) seems to stimulate the innovation activity, likely because of a positive effect of structured legal forms on firm transparency, and costs. Indeed, as it has been pointed out «[…] innovation is fraught with risk and uncertainty which raise transaction costs. If these costs become too high, one would expect firms to refrain from investing in innovation. A major function of law and regulation is to reduce such risk and uncertainty […] A typology of legal systems is introduced, based on two dimensions: an emphasis on regulation or on litigation […] the indirect effects of regulation and litigation on innovation are treated through their influence on organization […]» (van Waarded, 2001, p. 1).

Moreover, estimated coefficients show that firm propensity to innovate is positively affected by loan size, as measured by the log of the *Total Accorded* but it is not affected by the use of *Other Services* or by the price of credit *Interest Rate*. Furthermore, the estimated coefficient of *Portfolio* suggests that firms classified as belonging to the *corporate market* have a 4% increasing probability to undertake innovative activities. While *Leverage* negatively affects *Innovation*, we expect that the proximity of firm to the sources of finance impacts positively on the probability to undertake innovative activities. However, the estimated coefficient of *Distance* is very close to zero and not statistically significant.

Columns (3)-(4) and (5)-(6) of table 3 show the probit and logit estimated coefficients of model [1], respectively. Overall, the findings of columns (1) and (2) are confirmed.[10]

Summing up, estimates provide robust evidence of a positive causal effect of bank credit availability on firm propensity to innovate.

10. Differently from the LP model, estimated coefficients of the probit and logit models cannot be interpreted as marginal effects. Furthermore as the logit and the probit models adopt different scale normalization, the coefficients estimates from the logit model shown in columns (4) and (6) need to be rescaled to be comparable to those from the probit. Specifically, the logit estimates should be multiplied by 0.551 (Xie and Manski, 1989).

Table 3 – The impact of credit availability on firm propensity to innovate. Full sample analysis°

	LP model		*Probit model*		*Logit model*	
Dependent variable: innovation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Credit availability	0.01***	0.01**	0.66***	0.69***	1.38***	1.41***
	(0.002)	(0.002)	(0.198)	(0.200)	(0.510)	(0.478)
Industrial district		0.01**		0.37***		0.63**
		(0.004)		(0.139)		(0.314)
HHI		0.02**		0.53		1.55
		(0.010)		(0.536)		(1.089)
Corporation		0.02***		0.55***		1.42***
		(0.005)		(0.185)		(0.484)
Portfolio		0.04***		0.24		0.50*
		(0.013)		(0.145)		(0.277)
Other services		0.002		0.12		0.13
		(0.004)		(0.290)		(0.740)
Total accorded (log)		0.003**		0.12***		0.27***
		(0.002)		(0.042)		(0.072)
Interest Rate		0.001		0.03*		0.06**
		(0.001)		(0.015)		(0.032)
Leverage		- 0.01**		- 0.01		- 0.01
		(0.002)		(0.058)		(0.115)
Distance		0.0000002		0.0001***		0.0003***
		(0.0000002)	(0.00001)		(0.00001)	
D(Sales_2)-	0.00	- 0.01**	0.52*	0.32	1.52*	0.96
	(0.003)	(0.003)	(0.301)	(0.296)	(0.805)	(0.822)
D(Sales_3)	0.00	- 0.01**	0.69**	0.38	1.91***	1.01
	(0.005)	(0.004)	(0.270)	(0.267)	(0.705)	(0.720)
D(Sales_4)	0.02***	0.00	1.24***	0.69***	3.15***	1.76***
	(0.008)	(0.006)	(0.215)	(0.217)	(0.578)	(0.593)
D(Sales_5)	0.06***	0.02	1.61***	0.82***	3.95***	1.96***
	(0.014)	(0.019)	(0.171)	(0.270)	(0.500)	(0.674)
D(Sales_6)	0.10***	0.03	1.72***	0.80***	4.14***	1.88***
	(0.030)	(0.028)	(0.149)	(0.224)	(0.410)	(0.544)
Province	- 0.02***	- 0.02***	- 1.26***	- 1.44***	- 2.85***	- 3.33***
	(0.003)	(0.004)	(0.209)	(0.235)	(0.577)	(0.679)
Costant	- 0.01**	- 0.06***	- 8.50***	- 10.77	- 20.92***	- 25.96***
	(0.003)	(0.016)	(0.445)	(0.000)	(0.843)	(1.118)
Industry specific effect	yes	yes	yes	yes	yes	yes
Number of observations	5,534	5,534	5,534	5,534	5,534	5,534

° the table presents multivariate analysis of the impact of *Credit Availability* on firm propensity to innovate (model [1]). Columns (1) (3) and (5) shows results from a baseline LP, probit, and logit model, respectively, with dependent variable *Innovation*, which takes the value of 1 if the firm carries on an innovative activity and 0 otherwise. Innovative activities are listed in table 1. Columns (2), (4) and (6) show results from augmented LP, probit, and logit models, respectively. The table reports point estimates of the coefficients, followed in parentheses by robust standard errors, clustered at branch level. The definition and construction of the variables is provided in the Appendix. * = p < 0.1, ** = p < 0.05, *** = p < 0.01.
Source: our elaborations on own bank data.

Table 4 – The impact of credit tightness on firm propensity to innovate. Full sample analysis°

	LP model		*Probit model*		*Logit model*	
Dependent variable: innovation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Credit tightness	- 0.01**	- 0.01**	- 0.35**	- 0.37**	- 0.69**	- 0.72**
	(0.003)	(0.003)	(0.153)	(0.166)	(0.345)	(0.361)
Industrial district		0.01**		0.37***		0.65**
		(0.004)		(0.135)		(0.311)
HHI		0.02**		0.60		1.76
		(0.010)		(0.531)		(1.100)
Corporation		0.02***		0.54***		1.39***
		(0.005)		(0.180)		(0.474)
Portfolio		0.04***		0.19		0.40
		(0.013)		(0.155)		(0.300)
Other services		0.00		0.07		- 0.01
		(0.004)		(0.287)		(0.735)
Total accorded (log)		0.00***		0.15***		0.32***
		(0.002)		(0.042)		(0.073)
Interest rate		0.00		0.02		0.06*
		(0.001)		(0.015)		(0.031)
Leverage		- 0.01**		- 0.02		- 0.02
		(0.002)		(0.058)		(0.119)
Distance		0.00		0.00***		0.00***
		(0.000)		(0.000)		(0.000)
D(Sales_2)-	0.00	- 0.01**	0.51*	0.29	1.53*	0.94
	(0.003)	(0.003)	(0.302)	(0.290)	(0.807)	(0.805)
D(Sales_3)	0.00	- 0.01**	0.68**	0.35	1.94***	1.00
	(0.005)	(0.004)	(0.266)	(0.260)	(0.701)	(0.711)
D(Sales_4)	0.02***	0.00	1.22***	0.63***	3.16***	1.70***
	(0.008)	(0.006)	(0.212)	(0.210)	(0.576)	(0.587)
D(Sales_5)	0.06***	0.01	1.58***	0.77***	3.95***	1.94***
	(0.014)	(0.018)	(0.164)	(0.271)	(0.492)	(0.682)
D(Sales_6)	0.10***	0.03	1.73***	0.79***	4.21***	1.92***
	(0.030)	(0.028)	(0.149)	(0.227)	(0.418)	(0.577)
Province	- 0.02***	- 0.02***	- 1.22***	- 1.39***	- 2.83***	- 3.26***
	(0.003)	(0.004)	(0.212)	(0.238)	(0.582)	(0.677)
Costant	0.00	- 0.05***	- 6.48***	- 9.08***	- 18.51***	- 24.57***
	(0.004)	(0.017)	(0.139)	(0.443)	(0.529)	(0.847)
Industry specific effect	yes	yes	yes	yes		
Number of observations	5,534	5,534	5,534	5,534	5,534	5,534

° the table presents multivariate analysis of the impact of *Credit Tightness* on firm propensity to innovate (model [2]). Columns (1) (3) and (5) shows results from a baseline LP, probit, and logit model, respectively, with dependent variable *Innovation*, which takes the value of 1 if the firm carries on an innovative activity and 0 otherwise. Innovative activities are listed in table 1. Columns (2), (4) and (6) show results from augmented LP, probit, and logit models, respectively. The table reports point estimates of the coefficients, followed in parentheses by robust standard errors, clustered at branch level. The definition and construction of the variables is provided in the Appendix. * = p < 0.1, ** = p < 0.05, *** = p < 0.01.

Source: our elaborations on own bank data.

For robustness checks table 4 shows estimated coefficients of model [2], which relates firm propensity to innovate to credit restrictions, as measured by the variable *Credit Tightness*, and firm-, bank- and contract-specific characteristics. Columns (1)-(2), (3)-(4), and (5)-(6) of table 4 refer to a baseline and a full specification of a LP, probit, and logit model, respectively. Overall, estimates suggest that the higher is the credit tightness the lower the probability that firms innovate. As for the impact of other characteristics, previous findings of table 3 are confirmed, i.e.: firms characterized by larger-sized, and with more structured legal form have a higher propensity to innovation than the others, as well as the firms which operate inside an industrial district or in more concentrated credit markets. Finally, the size of the loan matters, and larger loans affect positively firm propensity to innovate.

4.2. Stratified sample analysis

In this section we provide additional evidence of the causal effect of bank loans on firms' probability to innovate by means of a stratified sample, which aims at addressing two concerns. First, within the original dataset, the number of innovative firms is significantly lower than that of traditional ones (ninety vs five thousand four hundred forty-four). As a consequence, the *Innovation* variable shows a poor variability. Further, it could be argued that the findings of tables 3 and 4 are driven by other firm characteristics, such as firm size, more than credit availability. Indeed, firms that undertake innovative activities tend to be larger, and adopt more often the legal entity of business corporation, as shown in table 2. Thus, to verify the robustness of our inferences and insights we perform additional estimates by using a stratified random sample, obtained as follows. From the original dataset we randomly extract a number of non-innovative firms whose frequency within the two provinces reflects that of innovative firms. Further, within each province, the distribution of non-innovative firms in term of organizational legal structure and, among them firm size (as identified by the variable *Portfolio*) replicates that of innovative ones.

Table 5 – Descriptive statistics of innovative and non-innovative firms. Stratified sample

	Innovative firms		*Non-innovative firms*		*Means differences*
	Mean	*St. dev.*	*Mean*	*St. dev.*	*p-values*
Corporation	0.91	0.29	0.87	0.34	0.369
Portfolio	0.594	(0.492)	0.52	0.50	0.387
Industrial district	0.823	(0.483)	0.823	(0.383)	0.003 ***
Sales	4.44	1.18	3.76	1.61	0.004 ***
Turnover (millions €)	12.8	11,900,000	9.51	11,400,000	0.004***
Province	1.05	(0.230)	1.02	(0.152)	0.261

Source: our elaborations on own bank data.

Table 6 – The impact of credit availability on firm propensity to innovate. Stratified sample analysis°

	LP model		*Probit model*		*Logit model*	
Dependent variable: innovation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Credit availability	0.25***	0.26***	0.96***	1.07***	1.57***	1.86***
	(0.070)	(0.071)	(0.293)	(0.332)	(0.513)	(0.609)
Industrial district		0.12		0.49*		0.89*
		(0.080)		(0.288)		(0.512)
HHI		0.02		0.63		0.74
		(0.233)		(0.801)		(1.430)
Corporation		- 0.08		- 0.41		- 0.61
		(0.118)		(0.423)		(0.835)
Portfolio		- 0.31***		- 1.11***		- 2.08***
		(0.103)		(0.334)		(0.701)
Other services		- 0.04		0.03		0.04
		(0.143)		(0.576)		(0.949)
Total accorded (log)		0.06*		0.24**		0.44**
		(0.031)		(0.114)		(0.192)
Interest rate		0.01		0.02		0.02
		(0.012)		(0.040)		(0.073)
Leverage		- 0.01		- 0.04		- 0.05
		(0.017)		(0.076)		(0.134)
Distance		0.00		0.00		0.00
		(0.000)		(0.000)		(0.000)
D(Sales_2)	0.03	- 0.00	0.20	0.03	0.32	- 0.07
	(0.145)	(0.140)	(0.573)	(0.633)	(1.021)	(1.110)
D(Sales_3)	0.11	0.04	0.50	0.29	0.74	0.25
	(0.130)	(0.142)	(0.509)	(0.536)	(0.911)	(0.950)
D(Sales_4)	0.13	0.12	0.57	0.55	0.93	0.86
	(0.101)	(0.118)	(0.412)	(0.469)	(0.742)	(0.789)
D(Sales_5)	0.14*	0.31***	0.61*	1.20***	0.98	2.00***
	(0.082)	(0.107)	(0.349)	(0.421)	(0.631)	(0.728)
D(Sales_6)	0.08	0.26*	0.39	0.99*	0.57	1.61*
	(0.103)	(0.130)	(0.402)	(0.508)	(0.722)	(0.878)
Province	- 0.28**	- 0.29*	- 0.99**	- 1.27**	- 1.59**	- 2.00**
	(0.134)	(0.150)	(0.475)	(0.518)	(0.811)	(0.876)
Costant	- 0.25***	- 0.91**	- 5.58***	- 8.44***	- 15.12***	- 20.41***
	(0.070)	(0.416)	(0.367)	(1.411)	(1.131)	(2.767)
Industry specific effect	yes	yes	yes	yes	yes	yes
Number of observations	211	211	211	211	211	211

° the table presents multivariate analysis of the impact of *Credit Availability* on firm propensity to innovate (model [1]). Columns (1) (3) and (5) shows results from a baseline LP, probit, and logit model, respectively, with dependent variable *Innovation*, which takes the value of 1 if the firm carries on an innovative activity and 0 otherwise. Innovative activities are listed in table 1. Columns (2), (4) and (6) show results from augmented LP, probit, and logit models, respectively. The table reports point estimates of the coefficients, followed in parentheses by robust standard errors, clustered at branch level. The definition and construction of the variables is provided in the Appendix. * = p < 0.1, ** = p < 0.05, *** = p < 0.01.
Source: our elaborations on own bank data.

Table 7 – The impact of credit availability on firm propensity to innovate. Stratified sample analysis°

	LP model		*Probit model*		*Logit model*	
Dependent variable: innovation	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Credit tightness	- 0.17	- 0.20*	- 0.56	- 0.79**	- 0.91	- 1.29**
	(0.111)	(0.106)	(0.356)	(0.358)	(0.637)	(0.634)
Industrial district		0.11		0.47		0.82
		(0.081)		(0.289)		(0.516)
HHI		0.16		1.12		1.81
		(0.254)		(0.893)		(1.594)
Corporation		- 0.10		- 0.51		- 0.81
		(0.114)		(0.395)		(0.776)
Portfolio		- 0.32***		- 1.18***		- 2.17***
		(0.103)		(0.362)		(0.780)
Other services		- 0.07		- 0.16		- 0.24
		(0.147)		(0.607)		(1.038)
Total accorded (log)		0.07**		0.29***		0.50***
		(0.028)		(0.105)		(0.177)
Interest rate		0.01		0.02		0.03
		(0.012)		(0.043)		(0.079)
Leverage		- 0.00		- 0.04		- 0.04
		(0.017)		(0.075)		(0.130)
Distance		0.00		0.00		0.00
		(0.000)		(0.000)		(0.000)
D(Sales_2)	0.04	- 0.01	0.22	0.07	0.38	0.11
	(0.155)	(0.148)	(0.609)	(0.645)	(1.100)	(1.132)
D(Sales_3)	0.12	0.04	0.51	0.22	0.79	0.22
	(0.137)	(0.146)	(0.529)	(0.552)	(0.937)	(0.996)
D(Sales_4)	0.13	0.11	0.56	0.46	0.93	0.73
	(0.102)	(0.114)	(0.423)	(0.477)	(0.777)	(0.824)
D(Sales_5)	0.14	0.29**	0.56	1.07**	0.94	1.87**
	(0.082)	(0.111)	(0.351)	(0.449)	(0.643)	(0.817)
D(Sales_6)	0.11	0.28**	0.46	1.02**	0.76	1.78*
	(0.102)	(0.125)	(0.405)	(0.514)	(0.738)	(0.936)
Province	- 0.24*	- 0.26*	- 0.79*	- 1.09**	- 1.27	- 1.76**
	(0.130)	(0.145)	(0.472)	(0.521)	(0.817)	(0.885)
Costant	0.17	- 0.57	- 4.06***	- 6.98***	- 13.52***	- 17.73***
	(0.111)	(0.369)	(0.418)	(1.199)	(1.205)	(2.452)
Industry specific effect	yes	yes	yes	yes		
Number of observations	211	211	211	211	211	211

° the table presents multivariate analysis of the impact of *Credit Tightness* on firm propensity to innovate (model [2]). Columns (1) (3) and (5) shows results from a baseline LP, probit, and logit model, respectively, with dependent variable *Innovation*, which takes the value of 1 if the firm carries on an innovative activity and 0 otherwise. Innovative activities are listed in table 1. Columns (2), (4) and (6) show results from augmented LP, probit, and logit models, respectively. The table reports point estimates of the coefficients, followed in parentheses by robust standard errors, clustered at branch level. The definition and construction of the variables is provided in the Appendix. * = p < 0.1, ** = p < 0.05, *** = p < 0.01.
Source: our elaborations on own bank data.

The final stratified random sample contains one hundred twenty-six firms, which do not undertake innovative activities, and eighty-five firms, which are involved in at least one of the activities reported in table 1. Table 5 provides some summary statistics for the stratified random sample: firms that innovate do not show statistically significant differences with respect to non-innovative ones in terms of legal entity type, bank operating segment, and location.

Subsequently we re-estimate models [1] and [2], and the outcomes of these robustness checks are reported in tables 6 and 7, respectively. Our results are qualitatively unchanged: the estimated coefficient of *Credit Availability* is positive and statistically significant in all specifications, while the estimated coefficient of *Industrial District* is statistically significant in the probit and logit specifications (columns (4) and (6) of table 6, respectively). Thus, firms that do not experience overdraw in the year 2004 or firms within the industrial district show higher probabilities of undertaking innovation activities than other firms, ceteris paribus. The propensity to innovate increases with the loan (as measured by the log of *Total Accorded* and with firm's size (*D(Sales_5)*).

Table 7 shows results of model [2]: the estimated coefficient of *Credit Tightness* is statistically significant in all specifications, as well as the coefficient of *Total Accorded*. These finding confirm that better credit conditions foster the probability of firms to undertake innovative activities.

Conclusion

In this paper we empirically addressed a specific research question, i.e. whether the availability of credit affects SME probability of undertaking innovative activities, by means of data available for an Italian region. The motivation for this study is related to the recognition that the innovation activity, one of the key factors for the economic growth of a country, shows in Italy a gap compared with the other main advanced economies, especially in the private sector. The expenditure in R&S, for example, is lower and far away from the target of the 3% over GDP set by the European Commission Europe 2020 strategy. As for the private sector, it is argued that the causes of such a delay are related to characteristics of both the productive and the financial structures of Italian firms (Bank of Italy, 2013).

Furthermore, a survey of the European Central Bank (ECB, 2009) shows that SMEs largely rely on banks, while market-based financing plays a minor role. Thus, it becomes nonetheless crucial to find out the effect of bank loans on the firm propensity to innovate.

This paper provides evidence of a causal effect of credit availability on the firm probability of undertaking innovative activities, showing that the propen-

sity to innovate is higher when firms do not experience credit restrictions. Moreover, the empirical exercise reveals that firms organized in a more structured legal form or firms of larger size have a higher probability to innovate. Further, we also find evidence of a positive correlation between the innovative processes and the fact that the firm belongs to the industrial district.

Keeping in mind that these findings refer to a specific Italian region, we believe that a future research agenda could extend our analysis, so that to obtain policy implications oriented to promote and facilitate firm access to bank credit.

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Appendix

Table A1 – 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.
Credit availability	A dichotomous variable that takes the value of 1 if the borrower uses less than the amount granted on the credit line by the bank and 0 otherwise.
Credit tightness	A continuous variable that measures the percentage of credit line utilized by firm on total amount granted by the bank.
Turnover	A continuous variable that measures firms total sales. It is constructed as mean value of the firm sale category.
Sales	A step variable that takes the value 1 if sales are less than two hundred fifty thousand euros; 2 for sales between two hundred fifty thousand euros and five hundred thousand euros; 3 for sales between five hundred thousand euros and one million five hundred thousand euros; 4 for sales between one million five hundred thousand euros and five million euros, 5 for sales between five million euros and twenty-five million euros; 6 for sales between twenty-five million euros and fifty million euros.
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.
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.
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.
Corporation	A dichotomous variable that takes the value of 1 if the legal entity of the loan recipient is a business corporation and 0 otherwise
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.
Total accorded	A continuous variable that measures the total amount accorded: constructed as the natural logarithm of 1+ total amount accorded to the firm.
Leverage	A continuous variable that captures the total indebtedness of the firm. It is calculated as the ratio between the Total accorded/Turnover.
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.

Source: our elaborations.