Relationship Banking and Firm Entry Dynamics

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Abstract

This paper studies the impact of relationship banking on firm entry dynamics. Exploiting Italian data, we document that relationship-based local credit markets feature lower entry, larger size at entry, and relatively more spin-offs than de novo entries. We interpret the findings through a dynamic general equilibrium model with endogenous entry and credit relationships. Over the course of relationships, banks acquire information on incumbents' managerial capital which is transferable to incumbents' spin-offs. Information accumulated in credit relationships also generates (negative or positive) spillovers on information acquisition about entrants. We characterize conditions under which a relationship-oriented banking structure depresses entry while boosting spin-off creation.

Keywords: Credit Relationships, Firm Entry, Spin-offs.
JEL Codes: E44; G21; O16.

1 Introduction

The forces that shape the dynamics of firms' entry are of fundamental interest for scholars and policy makers. The development of the credit sector is reputed to be important in determining the ease with which new firms can break into markets and survive over time. An aspect that thus far has received little attention is the way the structure of the credit sector shapes firms' dynamics, including the intensity and mode of firm entry. Yet, the literature has extensively documented that a distinctive feature of the credit sector is the importance of banks' business models and lending technologies, such as the strength of bank-firm relationships. In many countries credit mainly flows to firms within long-term bank-firm relationships during which banks garner information about firms' physical assets, workforce and human capital. Credit relationships are predominant in countries such as Germany, Japan and Italy, but are also pervasive in the credit system of the United States. While a broad body of work has studied how bank-firm relationships impact incumbent businesses that engage in such relationships, little is known about the implications of relationship banking for firms' entry dynamics.

Fundamental questions arise from these observations: How does the importance of bank-firm relationships in the credit sector impact the dynamics of firm entry? Does a relationship-based banking structure favor or deter the entry of new firms? And does it promote some entry modes more than others? This paper takes a step towards addressing these questions by investigating theoretically and empirically the impact of relationship banking on firms' entry dynamics in a general equilibrium setting. In the first part of the analysis, we exploit rich information from the Italian local credit markets (provinces) and document how the importance of credit relationships in the local market affects firm entry. To this end, we employ detailed data on the intensity of credit relationships in Italian provinces from a large survey conducted by an Italian banking group, as well as data on the intensity of firm entry from the Italian business registry. We further complement these data sets with unique data on firms' entry modes (de novo entries vs. spin-offs) in the provinces obtained from a survey on Italian start-ups.[1] We uncover the following facts. Local credit markets characterized by stronger intensity of credit relationships feature a lower entry rate of new firms and a larger size of firms at entry. When we break down entrant firms into de novo entrants and spin-offs of incumbent businesses, we obtain that more relationship-based local credit markets exhibit a stronger creation of spin-offs relative to de novo entries. However, we also detect significant sectoral heterogeneity in these effects. In industries characterized by stronger importance of firms' physical capital relative to human capital, credit relationships further reduce firms' entry in the local market.[2] These results are robust across a variety of estimation approaches, including panel estimations with detailed sets of fixed effects and IV estimations. In particular, when running IV estimates, we exploit the Italian historical banking regulation to assuage possible concerns of endogeneity of the importance of relationship lending in the local markets.

Motivated by these findings, we ask to what extent a parsimonious general equi-

[1] To account for possible premature deaths of new entrants, we also construct broader measures of firms' entry using the Orbis database.

[2] A similar sectoral heterogeneity appears when we consider the type of information acquired by the banks.

librium model with endogenous credit relationships and business entry can match the empirical findings. The distinctive feature of the model is the presence of channels through which information acquired by lenders over the course of credit relationships favours (can be re-used for) entrant businesses or, conversely, can harm entrants. The first mechanism is banks' acquisition of information on the skills of managers and employees. This favors the entry of new firms as spin-offs of incumbent ones: managers and employees of incumbent firms may found a business by borrowing from banks that accumulated information on their skills and human capital when employed in incumbent businesses. A second mechanism is (a reduced form of) monitoring spillovers. Information acquired by banks over incumbent businesses boosts or crowds out the information that can be obtained by banks at the funding stage of entrants. These monitoring spillovers capture reduced form of sector or area specific information, or, on the negative side, possible crowding out of the monitoring of new businesses.

We calibrate and quantify the model to match the Italian data used in the empirical analysis. The model can successfully replicate several empirical findings (the negative impact of a relationship-based banking structure on firms' entry rates and the associated increase in firms' size at entry), while it is not able to match the relative importance of firms' entry modes.

The remainder of the paper unfolds as follows. In the next section we relate the paper to prior literature. In Section 3, we present the empirical setting, the data and the measurement of the variables. Section 4 details the empirical methodology and presents the results. In Sections 5 and 6, we propose and simulate parsimonious theoretical model aiming at explaining the empirical facts. Section 7 presents the model calibration and simulation results. Section 8 concludes. Further details on empirical evidence and all formal proofs related to the theoretical model are presented in the Appendix.

2 Prior Literature

The paper relates to three strands of literature. The first strand investigates theoretically and empirically the impact of credit frictions and credit market development on firm entry (see, e.g., Cooley and Quadrini, 2001; Aghion, Fally and Scarpetta, 2007; Aghion, Bergeaud and Cette, 2018; Angelini and Generale, 2008; Bergin, Feng and Lin, 2018). Some studies show empirically that banking competition and efficiency affect firm entry and firm size distribution in local economies (Bertrand, Schoar and Thesmar, 2007; Cetorelli and Gambera, 2001; Cetorelli and Strahan, 2006). Guiso, Sapienza, and Zingales (2004) find empirically that financial development can impact firm entry while Havrylchyk (2012) show that foreign bank presence can also influence firm dynamics. Relative to this strand of literature we stress the role of credit relationships in firm entry. Further, on firms' side, we jointly study the impact of relationship lending on both firm entry and firm entry modes. A sizeable share of new entrants indeed consist of spin-offs of existing businesses rather than de novo entrants founded by new entrepreneurs.[3]

The second strand of literature studies the effects of relationship banking. This literature stresses that, over the course of credit relationships, banks progressively accumulate information on the collateral assets of borrowing firms (Diamond and Rajan, 2001). Relationship banks also acquire information about firms' human capital and employees and establish personal relationships with firm managers. While information on firms' physical capital is inherently tied to incumbent firms, information on employees, their skills, and their trustworthiness may facilitate the creation of spin-offs (Drexler and Schoar, 2014). A large body of literature on relationship lending has looked at its effects on firms' investment decisions (Alessandrini et al., 2010; Degryse et al., 2009b; Sette and Gobbi, 2015; Herrera and Minetti, 2007; Kano et al., 2011). Sette and Gobbi (2015) and Ferri et al. (2001) document that, for firms with stronger credit relationships, outstanding loans and investments plunge less during financial crises. Beck et al. (2018) show that relationship lending alleviates credit constraints during a cyclical downturn, especially for small and informationally opaque firms.

Finally, the literature also speaks to a strand of studies on spillovers in credit markets. We will come to this link below.

3 Empirical Setting

We test the impact of relationship lending on firm entry dynamics using rich data from the Italian local banking markets (provinces).

3.1 Institutional background

Italy represents an ideal setting to investigate the role of credit relationships in firms' entry dynamics. The financial system is dominated by the banking sector, while the

[3]Several empirical studies document that spin-offs account from 20% to 35% of new firm entries (Klapper and Sleeper, 2005). Klapper and Thompson (2007) argue that financial factors play a role in the decision to create firms' spin-offs.

stock market has a relatively low capitalization.[4] Moreover, the banking sector is characterized by marked heterogeneity in the intensity of credit relationships in local markets. This is due to two main factors. The first is the heterogeneous presence in local credit markets of banks with different propensity to engage in relationship lending. Local credit markets (which roughly coincide with provinces) feature pronounced differences in the presence of local and cooperative banks relative to banks with a national scope. For example, local and cooperative banks have a strong presence in the northern regions of Veneto and Emilia Romagna, while they exhibit a weaker presence in southern provinces. The banking literature has documented that local and cooperative banks are inclined to establish long-term credit relationships with firms which entail local ties between loan officers and firm managers. By contrast, banks with a national scope tend to resort to transactional-based lending technologies based on the usage of hard (verifiable and codified) information about firms. Importantly, we expect that the heterogenous presence of different categories of banks across provinces mostly reflects the impact of the Italian banking regulation which remained in place from 1936 to the early 1990s, effectively freezing the structure of local banking markets for several decades. The second aspect that we expect to induce variation in the importance of credit relationships in local markets is the broader effect of the 1936 banking regulation on the geography and structure of provincial banking markets.

Italian provinces also feature substantial variation in firm dynamics (see, e.g., King, 2015; Carree, Santarelli and Verheul, 2009; and regional reports of the Bank of Italy). This is also evident from our data, as we will see below.

3.2 Data and measurement

In this section, we detail data sources and measurement of the variables.

3.2.1 Data sources and variables definitions

The Italian banking system is segmented across local credit markets (provinces). As a geographical and administrative unit, a province can be compared with a U.S. county.

[4]The strong importance of the banking sector makes the Italian financial system close to that of other countries of continental Europe and of Japan. In 2000, in Italy the ratio of bank credit over the GDP equalled 70.33 percent, a figure similar to that of France (81.29 percent), Belgium (77.34) and Finland (51.38). Most importantly, the high dependence of Italian firms on banks is analogous to that observed in other countries of continental Europe (see, e.g., De Bonis et al., 2012, for a detailed overview of the Italian banking system). Thus, although the lessons from Italy are not necessarily transferable to other countries, the analysis can also provide useful insights for the banking development-inequality nexus in other countries.

Provinces constitute the appropriate measure of local banking markets in Italy also according to regulatory authorities. For example, the Italian Antitrust Authority considers the province as the relevant market for banking activities. And, at the time of deregulation of the banking sector in the 1990s, the Bank of Italy defined the local market as the provincial one. In Italy, a strong local presence of bank branches is crucial for access to credit because it is difficult for firms to borrow in a market other than the local one (Petersen and Rajan, 2002; Guiso et al., 2004, 2013; Bofondi and Gobbi, 2006).

Our main data sources are: the "Indagine sulle Imprese Manifatturiere", a survey carried out by the Italian banking group Capitalia; the Register of Firms of the Italian Chambers of Commerce; the Orbis database of Bureau van Dijk; and the "Rilevazione sul sistema delle Start-up innovative", a survey of start-ups carried out by the Italian Ministry of Economic Development. We complement these main data sources with other databases, including data of the Italian National Institute of Statistics (ISTAT) on institutional and economic characteristics of provinces; Bank of Italy data on the structure of Italian local banking sectors; and prior studies that provide industry-level measures of physical and human capital intensity, asset tangibility, and product information complexity.

Information on credit relationships comes from four waves of the Capitalia survey, which cover three-year periods ending respectively in 1997, 2000, 2003, and 2006. The Capitalia survey, which targets manufacturing firms within Italy, includes a representative sample of manufacturing firms with 10–500 employees (about 94% of the firms in the sample) and the universe of manufacturing firms with more than 500 employees. Approximately 4,500 firms were interviewed in each survey wave, for a total of 18,333 observations. The firms in the survey represent about 9% of the population in terms of employees and 10% in terms of value added. Collected data include details about balance sheets, company characteristics and demographics, relationships with banks and mechanisms of information acquisition by banks, and sources of finance.[5]

Information on firm entry dynamics in the provinces comes predominantly from the Register of the Italian Chambers of Commerce[6], which provides details on the number of newly registered firms in a province in a year (entrants), the number of firms exiting

[5] Some of these variables are available for each year covered by the survey; some refer to the time of interview; others refer to the three-year period covered by the survey.

[6] The Italian Business Register can be defined as the register of company details: it in fact contains information (incorporation, amendments, cessation of trading) for all companies with any legal status and within any sector of economic activity, with headquarters or local branches within the country, as well as any other subjects as required by law.

in a year (exiters), and the total number of registered firms (incumbents). As detailed below, we also construct alternative indicators of firm entry using the Orbis database of Bureau Van Dick. In all cases, we focus on manufacturing firms.

Finally, to study firms' mode of entry we use the survey of the Italian Ministry of Economic Development (2017). This is the first national survey on startups based in Italy. It was sent to startup founders between March and May 2016 and its primary aim was to expand the evidence on startup firms with information that is not easily obtained through Business Register data.[7] This information includes the personal background of startup founders (family, studies, experience, skills), which will be a component of our analysis of firm entry.

3.2.2 Banking relationships and firm dynamics

To measure the pervasiveness of relationship lending in a province, we use the four waves of the Capitalia survey and construct two indicators: the average length of credit relationships in the province and, as an inverse measure, the average number of banks from which a firm borrows in the province. These indicators are based on two survey questions that, respectively, ask each firm the number of years it has been doing business with its main bank; and the number of banks from which the firm borrows. Petersen and Rajan (1994) show that the length of the credit relationship is a suitable measure of the information garnered by the main bank; multiple credit relationships can instead dilute the relationship with the main bank. In what follows, we will primarily focus on the length of credit relationships.

To capture firms' entry dynamics in a province and (two digit ATECO) manufacturing sector in the time frame of the survey waves, we use the Register of the Italian Chambers of Commerce and construct two measures of firms' entry rate in local markets. We compute the ratio of newly registered firms over total registered firms in the province and sector, and the ratio of newly registered firms in the province over the provincial population. In all cases, for each survey wave, we take the average over the years of the survey wave. We complement these indicators of firm entry in local markets with alternative proxies of firms' entry rate. Using Orbis data, we compute the share of firms in a province and sector with no more than 2 years or no more than 4 years of activity. Due to data availability, when using these alternative proxies we restrict attention to the period of the last Capitalia survey wave (2004-2006).

In the analysis, we also look at the modes of firm entry (whether the firm is a de

[7] The questionnaire was filled in by 2,250 firms, 44% of startups on the records at the reference date.

novo entrant or a spin-off/spin-out of an existing firm). Using the Capitalia Survey, we construct an indicator variable equal to one if a firm in the survey generated a spin-out during the years of the survey. The Capitalia indicator is based on the following survey question: "In the last three years did the firm generate a (partial) spin-out"? Using the survey on startups of the Italian Ministry of Economic Development, we also compute the share of new firms in the province that are founded by former employees of firms in the same sector (relative to the total number of entrants). This information is available for the 2010-2015 period.

3.2.3 Controls and instruments

In the regressions, we insert a broad battery of controls that may explain firms' entry. We include the unemployment rate as a measure of local economic conditions and development, proxies for the quality of provincial material infrastructures in the province, the degree of trade openness of the province, the population growth rate of the province, a measure of local financial development (branches over population), a proxy for local banking concentration, and a measure of judicial efficiency. The material infrastructure proxy, trade openness, and judicial efficiency are measured at the mid-point of the sample (2001). The unemployment rate, population growth and local financial development are computed as the average for each survey wave. We also experiment with including the average age of firms in the province and sector among the controls. In all the regressions, we also saturate the empirical model with a full set of sectoral, time (survey wave) and broad geographical area fixed effects. In alternate tests, we drop time-invariant province-level controls and broad geographical area fixed effects and insert province fixed effects.

In addition to running regressions with a broad set of controls and fixed effects, we also present estimates from an instrumental variables approach. We construct instruments that capture exogenous regulatory restrictions on the presence of banks in local credit markets. To this end, we exploit information on the 1936 Italian regulation of local banking markets. In response to the 1930–1931 banking crisis, in 1936 the Italian Government approved a Banking Law with the goal of enhancing bank stability through severe restrictions on bank entry. The Banking Law imposed strict limits on the ability of different types of banking institutions to open new branches. In particular the Comitato Interministeriale per il Credito e il Risparmio (CICR) imposed that from 1938 each credit institution could open branches only in an area of competence (one or multiple provinces) determined on the basis of its presence in 1936. Banks were also required to shut down branches outside their area of competence. While the regulatory prescriptions were uniform across Italy, the constrictiveness of regulation varied across provinces and depended on the relative importance of different types of banks in the local market in 1936. For example, savings banks were less constrained by the regulation, while cooperative banks were more constrained. Guiso et al. (2003, 2004) demonstrate empirically that the 1936 regulation had a profound impact on local banking markets (creation and location of new branches) in the decades that followed. Entry into the provincial banking markets was liberalized during the 1990s, following also the introduction of European directives about the coordination of banking regulations across the European Union. We expect that the 1936 regulation had a long-lasting impact on the ability and incentive of banks to establish long-term credit relationships with firms, leading to substantial variation in the incidence of credit relationships across Italian provinces. Following Guiso et al. (2003, 2004) and Herrera and Minetti (2007), our set of instruments for the intensity of credit relationships consist of provincial data on the number of savings banks in 1936 (per 1000 inhabitants) and the number of new branches opened by incumbent banks in 1991-1998, during the deregulation period.

3.2.4 Measures of information and spillovers

We are interested in capturing the presence of information spillovers, such that information acquired by banks over the course of credit relationships is reusable when extending credit to entrant firms, or, alternatively, crowds out the acquisition of information on new entrants. The banking literature stresses that over the course of credit relationships banks accumulate information on firms' technology, their market and sector, the physical and collateralizable assets of the firms and (the trustworthiness of) firms' managers and employees (Diamond and Rajan, 2001).

The last wave of the Capitalia survey asks each firm questions regarding the type of information acquired and used by their main bank, and the criteria adopted by the main bank when granting credit to the firm. Using these questions, we code two dummies: the first (technological spillover) takes the value of one if the bank heavily relies on information about the firm's market and sector and about the technology of the firm. The second dummy (embodied spillover) takes the value of one if the bank heavily relies on information about the ability and trustworthiness of the managers running the firm. To measure the relative importance attributed by banks to these two dimensions of information in a sector, we compute the average of these two variables across the firms in the sector.

In addition to the above measures, we also employ data about sectorial characteristics. We consider indicators for the relative importance of human and physical capital in the sector. The indicator of human capital intensity is from Ciccone and Papaioannou (2009). To measure the importance of physical capital, we consider a proxy for asset specificity and (lack of) asset redeployability. For asset specificity, we use the degree of co-movement between the value added of the firm and that of other firms in the same industry. As Shleifer and Vishny (1992) argue, when the conditions of the firms in an industry are positively correlated, the redeployability of the assets of the firms in that industry is likely to be low. The highest value second-hand users of a firm's assets are probably its industry peers, since they have the experience and know how to use these assets most effectively. If these second-hand users themselves face financial problems, they will be willing to buy, if at all, at low prices; otherwise, the firm will have to sell to less efficient, out-of-industry users whose willingness to pay is low. We borrow the measure of the co-movement of sales from Guiso and Minetti (2010), who compute is using data from Compustat firms over the period 1950-2000 for a total of 251,782 firm-year observations (see the Appendix). A second proxy for the relevance of physical capital in the sector is taken by the last survey of Capitalia survey. The 2006 wave of the Capitalia survey asks the firms whether their banks especially value information about the physical, collateralizable assets of the firms. We code a dummy variable equal to one if the bank relies on collateral and then we compute the average of this variable across the firms in the sector.

4 Methodology and Results

4.1 The empirical model

To investigate the impact of credit relationships on firm entry dynamics in local (provincial) credit markets, we estimate the following model

$$FirmDynamic_{ijt} = \alpha_1 + \alpha_2 Relation_{it} + \boldsymbol{\alpha}_3 \mathbf{Z}_i + \boldsymbol{\alpha}_4 \mathbf{C}_{it} + \gamma_j + \gamma_t + \varepsilon_{itj} \quad (1)$$

where $FirmDynamic_{ijt}$ is the measure of entry of businesses in province i, sector j, period t (where periods are three-year windows based on the survey waves); $Relation_{it}$ is the measure of credit relationship intensity in province i and period t; Z_i is a vector of time-invariant province-level control variables measured in year 2001, the mid-point of the sample; C_{it} is a vector of time varying province-level control variables; γ_j is a vector of sector fixed effects; γ_t is a vector of time (survey wave) fixed effects; and ε_{itj} denotes the residual. In a tighter specification, we saturate the model with province fixed effects and drop time-invariant, province-level controls and macro-area dummies.

Considering the local entities (provinces) of a country reduces the risk of omitted variable bias and implicitly controls for differences in formal institutions. Further, we saturate the model with a rich set of fixed effects. Nevertheless, there remains the possibility that in a local credit market banking relationships and firm entry are jointly determined and that unobserved factors are correlated with both. To further assuage possible endogeneity concerns, we complement the OLS estimates with an instrumental variable (IV) approach. Let I_i be a vector of instruments that are correlated with the local structure of credit relationships but affect firm dynamics only through the banking channel. The effect of these instruments on $Relation_{it}$ is captured by β_2 in the local banking equation

$$Relation_{it} = \boldsymbol{\beta}_1 \mathbf{Z}_i + \boldsymbol{\beta}_2 \mathbf{C}_{it} + \gamma'_t + \beta_3 Ip + u_{it} \tag{2}$$

where Z_i and C_{it} refer to the control variables in the second stage equation, Ip is the vector of instruments and u_{it} is the residual. As noted, as instruments we employ the indicators of banking regulation in 1936, namely the number of savings banks in the province in 1936, normalized by the population of the province, and the number of new branches created in the province in the deregulation period, per 1,000 inhabitants.

4.2 Summary statistics

Table 1 displays summary statistics for the variables used in the analysis. Across the four survey waves, the average length of credit relationships in a province equals about 16 years (for almost 60% of firms the length exceeds 10 years). The mean number of banks funding a firm in a province is 5. There is substantial heterogeneity in the intensity of credit relationships across provinces. Figure 1 reveals that on average relationship lending is more pervasive in some northern provinces, especially in the regions of Veneto, Emilia Romagna and Trentino. By contrast, credit relationships appear to be weaker in some southern provinces.

On average, in a province the ratio of entrant firms over total firms equals 4.99% while the ratio of entrants over population is 3.2 firms per 100,000 inhabitants. There is substantial heterogeneity in firm entry rates: over the 1995-2006 period, in an average year the ratio of entrant firms over incumbent firms ranges from little more than 2% for some provinces to 10% in other provinces. The share of firms with no more than two years of activity is about 17%; the share of firms with no more than four years of activity is about 27%. In a province, approximately 26% of entrant firms consist of spin-offs of incumbent firms (where spinoffs are identified by the majority of managers being previously employed in a firm of the same sector). The probability that an incumbent firm voluntarily generates a spinout equals 3.5%. Table 1 also reports summary statistics for the control variables used in the analysis.

4.3 Main results

Table 2 displays the baseline results. As noted, we regress firms' entry rates in a sector and province on the province-level indicator of the intensity of relationship lending (average length of credit relationships in the province). The OLS estimates suggest that, after controlling for macro-area, sector, and time fixed effects and for relevant province-level characteristics, in provinces where credit relationships are tighter the rate of entry of firms is lower. This holds regardless of the entry rate measure (columns 1-4). The results are confirmed when we drop time-invariant province-level controls in favor of province fixed effects (columns 5-6).[8] They are also robust to using an instrumental variable approach (columns 7-8). In the first stage, the instruments perform well in explaining the intensity of relationship lending in a province (the F-test statistic is well above the threshold values for weak instruments). The second stage estimates confirm the OLS ones.

In Table 3, we conduct a variety of robustness checks. In columns 1-2, we adopt alternative definitions of the dependent variable, and measure entry with the share of firms with no more than 2 years of age. We also consider the probability that a firm generates a spinout. We again find evidence of a negative impact of relationship lending intensity on firm entry and also on the probability of spinout creation. We elaborate below on the effects of relationship lending on entry modes. In columns 3-6, we find that the results carry through when using alternative measures of relationship lending, the average number of banks funding a firm, and the share of firms with a relationship length above 10 years. Further, columns 7-8 show that the results are robust to winsorizing province-sector observations at the 1% tail of the relationship length distribution (the results obtained by trimming the data are virtually identical).

We next explore the impact of credit relationships on firms' entry mode. In Table 4, using information from the Italian Ministry of Economic Development survey on

[8]The results for the controls are overall in line with expectations. Higher unemployment appears to be associated with higher entry, suggesting that self-employment and entrepreneurship might effectively substitute for lower employment. Population growth also appears to positively affect the entry rate of new firms. Somewhat more surprisingly, material infrastructures appear to drive down firms' entry rates.

startups, we test the impact of the province-level indicators of the intensity of credit relationships on the share of firms that enter the provincial market as spin-offs rather than de novo entrants. The results in columns 1-2 of Table 3 indicate that the intensity of credit relationships tends to increase the incidence of firms that enter as spin-offs relative to de novo entrants. This result is robust across definitions of spin-offs: new firms in which the majority of managers and directors were previously employed in a firm of the same sector; and new firms in which all managers and directors were previously employed in a firm of the same sector.

4.4 Information spillovers

In Table 5, we explore the role that banks' information spillovers in the baseline results. In Panel A, we exploit information in the survey on the way banks acquire and reuse information about firms. The results reveal that when technological spillovers of banks' information are more pervasive, relationship lending is more likely to depress the entry of new firms and to reduce the importance of firms' spinoffs relative to de novo entries. By contrast, the estimates point to a positive effect of embodied information spillovers on both the probability that firms engage in a spinout and on the relative importance of spinoffs in a province.

In Panel B of Table 5, we assess the impact of possible information spillovers by exploiting sectoral information on the relevance of human and physical capital in the sector. In particular, we insert in the regressions interaction terms between the measures of the intensity of relationship lending and sectoral indicators of the intensity of human capital and of the asset specificity and (lack of) asset redeployability in the sector. We obtain evidence that credit relationships especially reduce firms' entry rate in sectors that exhibit a lower incidence of human capital (columns 1-2) and a stronger redeployability and liquidity of assets (columns 3-4). When looking at product specificity, as captured by the Nunn indicator, we find that in sectors where information about products is more specific, relationship banks tend to reduce the share of entrant firms. Thus, in sectors where the importance of (banks' information on) firms' human capital is stronger, credit relationships better promote entrant firms relative to incumbent ones. By contrast, in sectors where the relative importance of information on firms' specific assets is stronger, relationship lending appears to promote incumbent firms relatively more.

Columns 5-10 of Table 5 show the results. Consistent across regressions, the intensity of credit relationships has a more favorable impact on incumbents relative to entrants in sectors where banks especially rely on information about physical capital. By contract, when information on human capital is more relevant, relationship lending tends to be relatively more favorable to entrant firms.

5 The Model

Motivated by the findings of the empirical analysis, we study an infinite horizon model with firm entry and credit relationships. The key component of the model is the presence of channels through which information acquired by lenders over incumbent firms can be transferred to entrant firms, or crowd out information over entrants. Our goal is to determine to what extent this parsimonious model can rationalize qualitatively and quantitatively the empirical findings.

Time is discrete and indexed by $t = 0, 1, 2....$ There is a final good which can be invested and consumed. The economy is populated by (potential) entrepreneurs and households, who can act as lenders or managers. Agents' discount factor is assumed equal to 1.

5.1 Entrepreneurs

At each t, a unit measure of new entrepreneurs enters the economy. In each period of her life, an entrepreneur (indexed by i) can undertake an investment of size $i_{i,t}$ and earn a gross return $\bar{R} > 1$ per unit of investment with probability π. An entrepreneur dies with probability $(1 - \pi)$ in each period, in which case she does not consume but transfers her remaining wealth (after repayment to lenders, if any) to future generations. If she has invested and then dies before the project comes to fruition, each unit of the project is liquidated at value $L_{i,t} \equiv \overline{L} l_{i,t}$, where $l_{i,t}$ is an $i.i.d.$ process across entrepreneurs and time, distributed according to G in the support $\left[\underline{l}, \bar{l}\right]$ (with $\bar{l} < \bar{R}/\overline{L}$) and $\overline{L} \in R_+$ is a common component measuring the asset liquidity of all projects.

When entrepreneur i enters the economy in period t, she has initial wealth $w_{i,t-1}$, which depends on bequests from entrepreneurs who died in the previous period. To invest an amount $i_{i,t}$, she needs a loan of size $(i_{i,t} - w_{i,t-1})$, and a manager to work with. If an entrepreneur does not invest, she retires permanently and has access to a storage technology with gross return of 1 until she dies.

A surviving entrepreneur in period t can consume $x_{i,t}$ with log utility $\log(x_{i,t})$. Transfers to future generations do not enter entrepreneurs' utility. Investing entrepreneurs also incur a fixed utility (effort) cost ζ for implementing investments. Entrepreneurs' utility function reads:

$$U_t = \sum_{j=0}^{\infty} \pi^j \left[\log(x_{i,t+j}) - 1_{i,t+j}(invest)\zeta\right]. \tag{3}$$

We also posit that all bequests are pooled together through a mutual fund. Each new entrant in period $t+1$ receives an equal share of all bequests made in period t.

5.2 Lenders and managers

A measure larger than 1 of infinitely-lived risk-neutral households can act as lenders or managers (randomly assigned to each task every period) and share consumption risks perfectly. The managerial and credit markets are competitive. Households have access to the same storage technology as entrepreneurs.

In period t, the contract between a lender and an entrepreneur specifies a payment in case of project success (π) and the liquidation value accruing to the lender in case of failure ($1-\pi$). We consider a standard debt contract under which lenders are entitled to appropriate all the liquidation value L_{it}. The credit market features limited output pledgeability of output and liquidation returns. A lender can mitigate the limited pledgeability by acquiring information about a firm's managerial and human capital (e.g., the manager's skills and trustworthiness) and about the firm's physical capital. The information acquired on the manager ($\lambda_{i,t}^H$) allows the lender to verify the manager's output. It also turns into relational capital of the manager that is transferable to any investment the manager starts. The information acquired on the assets of the firm ($\lambda_{i,t}^A$) allows the lender to recover value in case of project failure and liquidation and is specific to the firm's assets (that is, non-transferable to other investment projects).

The monitoring effort choices of a lender solve the following problem:

$$\max_{\lambda_{i,t}^A, \lambda_{i,t}^H} \Pi \equiv \pi \bar{R} i_{i,t} \lambda_{i,t}^H + (1-\pi)\,\overline{L} l_{i,t} i_{i,t} \lambda_{i,t}^A - \pi \frac{c^H \cdot \bar{R} i_{i,t} \left(\lambda_{i,t}^H\right)^2}{2} - (1-\pi)\,\frac{c^A \cdot \overline{L} l_{i,t} i_{i,t} \left(\lambda_{i,t}^A\right)^2}{2}, \tag{4}$$

where $c^H, c^A > 1$ govern the costs of monitoring the firm's managerial (human) capital and assets, respectively. The optimal monitoring efforts, obtained as solution to problem (4), are $\lambda_{i,t}^J = 1/c^J \ \forall i, t$, for $J = A, H$. Our hypothesis $c^H, c^A > 1$ ensures that $\lambda_{i,t}^A, \lambda_{i,t}^H < 1$, which can then be interpreted as fractions: when the project yields $\bar{R} i_{i,t}$ in case of success (or the project is liquidated at $\overline{L} l_{i,t}$ in case of failure), the lender receives $\bar{R}i_{i,t}\lambda_{i,t}^{H}$ (or $\overline{L}l_{i,t}i_{i,t}\lambda_{i,t}^{A}$).[9]

The lender's participation constraint (LPC) reads

$$\pi\bar{R}i_{i,t}\lambda_{i,t}^{H}+(1-\pi)\,\overline{L}l_{i,t}i_{i,t}\lambda_{i,t}^{A}-\pi\frac{c^{H}\cdot\bar{R}i_{i,t}\left(\lambda_{i,t}^{H}\right)^{2}}{2}-(1-\pi)\,\frac{c^{A}\cdot\overline{L}l_{i,t}i_{i,t}\left(\lambda_{i,t}^{A}\right)^{2}}{2}\geq i_{i,t}-w_{i,t-1}. \tag{5}$$

Using $\lambda_{i,t}^{H}=1/c^{H}$ and $\lambda_{i,t}^{A}=1/c^{A}$, the constraint becomes

$$\frac{\pi\bar{R}i_{i,t}}{2c^{H}}+\frac{(1-\pi)\bar{L}l_{i,t}i_{i,t}}{2c^{A}}\geq i_{i,t}-w_{i,t-1}. \tag{6}$$

5.3 Information and spillovers

At the beginning of period t, there are three types of agents who can start a new investment: (i) entrepreneurs who just entered in period t. These are potential, de novo entrants in t (denoted by the superscript N); (ii) entrepreneurs who invested already in $t-1$. These are incumbent entrepreneurs (denoted by the superscript I); (iii) potential spin-off entrants. These are managers employed in incumbent firms who can start themselves a new investment (denoted by the superscript S). The three types differ in terms of monitoring costs to be sustained by lenders. In particular, we assume that (i) the cost of acquiring information on the managerial and physical capital of entrants (whether de novos or spin-offs) is higher than that for incumbents, as the latter are already known to lenders; (ii) among entrants, the cost of acquiring information on the managerial capital of de-novos is higher than that of spin-offs, as the latter can rely on the relational capital of managers accumulated during their previous activity in incumbent firms.

We posit $c^{J}\equiv c\Psi^{J}$ for $J=A,H$, where c measures the overall efficiency of lenders' monitoring (e.g., reflecting financial development) and Ψ^{J} depends on the type of agent. We set $\Psi^{J}=\overline{\Psi}\psi^{J}<1,\ J=A,H$, for incumbents. $\overline{\Psi}\in(0,1)$ captures the cost advantage in monitoring the managerial and physical capital of an incumbent and, hence, the intensity of relationship lending. Given that, in reality, not all incumbents will immediately benefit from relationship lending, we break the mechanical equivalence between incumbents and relationship borrowers by assuming that, after entering, a de novo entrant or a spin-off entrant has a probability $\rho\in(0,1)$ to have low costs ($\Psi^{J}=\overline{\Psi}\psi^{J}<1,\ J=A,H$). With probability $1-\rho$, instead, the entrant keeps the

[9] In case of success, the entrepreneur receives $\bar{R}i_{i,t}(1-\lambda_{i,t}^{H})$; in case of failure, the entrepreneur receives 0, and $\overline{L}l_{i,t}i_{i,t}(1-\lambda_{i,t}^{A})$ is wasted, which is to capture costs for lenders to acquire collaterals in borrowers' bankruptcies.

same cost as in the previous period (which, as we see below, is strictly higher).[10]

In the model, information acquired by relationship lenders on incumbent entrepreneurs spills over to entrants through two distinct mechanisms. The first runs through the creation of spin-offs: the stock of information (or relational capital) is "embodied" and carried by the manager who leaves an incumbent firm to found a spin-off. The second mechanism acts through the reusability of the lenders' information on incumbents and/or through the "rivalry" of the lenders' effort in their monitoring activity of entrants. On the positive side (reusability), this monitoring spillover can capture, in reduced form, sectoral information acquired by lenders over incumbents that can be reused in the monitoring of entrants. On the negative side (rivalry), it can capture limited monitoring capacity of lenders: concentrating on acquiring information over incumbents crowds out monitoring of entrants. We formally represent these channels through the following assumptions. We set (i) $\Psi^J = F(L^I_{R,t}),\ J = A, H$ for de novo entrants, where $L^I_{R,t}$ is the aggregate stock of loans extended by lenders to incumbents; if the monitoring spillover is positive (because the sectoral reusability in the monitoring activity prevails over the rivalry of the monitoring effort), then $F'(L^I_{R,t}) < 0$; if it is negative, then $F'(L^I_{R,t}) > 0$; in any case, we restrict the attention to the case in which $F(L^I_{R,t}) > \overline{\Psi}\psi^J$ for $j = A, H$, that is, in which monitoring costs for entrants are strictly higher than those of incumbents.[11](ii) $\Psi^A = F(L^I_{R,t}),\ \Psi^H = \overline{\Psi}\psi^H_s F(L^I_{R,t})$ for spin-off entrants, where $\psi^H < \psi^H_s < 1$. $\psi^H_s < 1$ for a spin-off manager reflects the (positive) spillover "embodied" in the relational capital of the manager.

Later we show how this set of assumptions is equivalent to assuming a distinct "production function" of loans for the three categories of borrowers (in the spirit of Goodfriend, 2005 and Goodfriend and McCallum, 2007). We come back to this issue in the next section.

6 Agents' Decisions and Equilibrium

We now study the investment decisions of the three categories of agents (incumbents, de novos and spin-offs) along both the intensive and the extensive margin. In particular, we show that, for each of them, there exists a threshold value of the liquidation value

[10] This assumption implies that, in steady state, in addition to "relationship incumbents" (that is, those who benefit from relationship lending), also "high-cost" incumbents exist, whose monitoring costs are identical to entrants'. We come back to this issue in subsection 6.4.

[11] We pose the two following sufficient conditions for that inequality to be fulfilled: (i) $\lim_{L_{R,t}\to\infty} F\left(L^I_{R,t}\right) > \bar{\Psi}\psi^j$ (for $j = A, H$) if spillovers are positive ($dF/dL_{R,t} < 0$); (ii) $\lim_{L_{R,t}\to 0} F\left(L^I_{R,t}\right) = 1 > \bar{\Psi}\psi^j$ (for $j = A, H$) if spillovers are negative ($dF/dL_{R,t} > 0$).

($l_{i,t}$) below which it is not worth it to start the project, and we find the optimal level of the investment for those who do start the project.

6.1 Incumbents

Conditional on retiring (R) and using the storage technology, an entrepreneur with initial wealth $w_{i,t-1}$ solves the following problem:

$$\begin{aligned} V^R(w_{i,t-1}) &= \max_{x_{i,t},w_{i,t}} \pi \left[\log(x_{i,t}) + V^R(w_{i,t}) \right], \\ \text{s.t.} \quad x_{i,t} + w_{i,t} &= w_{i,t-1}. \end{aligned} \tag{7}$$

V^R is the value function before the idiosyncratic death shock realizes. It can be easily shown that $x_{i,t} = (1-\pi)w_{i,t-1}$ and

$$V^R(w_{i,t-1}) = \frac{\pi \log(w_{i,t-1})}{1-\pi} + \frac{\pi \log(1-\pi)}{1-\pi} + \frac{\pi^2 \log(\pi)}{(1-\pi)^2}. \tag{8}$$

Conditional on investing, an incumbent (I) with initial wealth $w_{i,t-1}$ solves

$$V^I(w_{i,t-1}, l_{i,t}) = \max_{x_{i,t},w_{i,t},i_{i,t}} \pi \left[\log(x_{i,t}) - \zeta + \int_{\underline{l}}^{\bar{l}} \max\{V^R(w_{i,t}), V^I(w_{i,t}, l_{i,t+1})\} dG(l_{i,t+1}) \right] \tag{9}$$

$$\text{s.t.} \quad x_{i,t} + w_{i,t} = \left(1 - \frac{1}{c\bar{\Psi}\psi^H}\right) \bar{R} i_{i,t},$$

$$\frac{\pi \bar{R} i_{i,t}}{2c\bar{\Psi}\psi^H} + \frac{(1-\pi)\bar{L} l_{i,t} i_{i,t}}{2c\bar{\Psi}\psi^A} \geq i_{i,t} - w_{i,t-1}, \tag{10}$$

where we use the fact that $c^H = c\bar{\Psi}\psi^H$ and $c^A = c\bar{\Psi}\psi^A$ for incumbents, as well as the fact that incumbents retain a fraction $1 - \lambda_{i,t}^H = 1 - 1/\left(c\bar{\Psi}\psi^H\right)$ of output in case of investment success.

Given that the credit market is competitive, constraint (10) binds. Solving it by $i_{i,t}$ we obtain

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \frac{\pi \bar{R}}{2c\bar{\Psi}\psi^H} - \frac{(1-\pi)\bar{L} l_{i,t}}{2c\bar{\Psi}\psi^A}}. \tag{11}$$

The project payoff to an incumbent can then be expressed as

$$\left(1 - \frac{1}{c\bar{\Psi}\psi^H}\right)\bar{R}i_{i,t} = R^I(l_{i,t})w_{i,t-1}. \tag{12}$$

where

$$R^I(l_{i,t}) \equiv \frac{(1 - \frac{1}{c\bar{\Psi}\psi^H})\bar{R}}{1 - \frac{\pi\bar{R}}{2c\bar{\Psi}\psi^H} - \frac{(1-\pi)\bar{L}l_{i,t}}{2c\bar{\Psi}\psi^A}}. \tag{13}$$

It is possible to prove that the expression for $R^I(l_{i,t})$, as given in (13), is decreasing in $\bar{\Psi}$.[12] Moreover, to ensure that incumbents need a downpayment to borrow ($i_{i,t} - w_{i,t-1} > 0$), we posit that $1 - \frac{\pi\bar{R}}{2c\bar{\Psi}\psi^H} - \frac{(1-\pi)\bar{L}l_{i,t}}{2c\bar{\Psi}\psi^A} > 0$ for all $l_{i,t}$. As a sufficient condition for this inequality to hold, we pose the following

$$\text{Assumption: } 1 - \frac{\pi\bar{R}}{2c\bar{\Psi}\psi^H} - \frac{(1-\pi)\bar{L}\bar{l}}{2c\bar{\Psi}\psi^A} > 0. \tag{15}$$

Given her net worth, the incumbent maximizes her value subject to the constraint

$$x_{i,t} + w_{i,t} = R^I(l_{i,t})w_{i,t-1}. \tag{16}$$

We guess that the investment decision follows a threshold strategy:

$$V^I(w_{i,t-1}, l_{i,t}) > V^R(w_{i,t-1}) \quad \text{if} \quad l_{i,t} > \hat{l}_t^I. \tag{17}$$

where $\hat{l}_t^I$ is independent of individual incumbent's wealth $w_{i,t-1}$. We will later verify this guess. Then the value function becomes

$$\begin{aligned} V^I(w_{i,t-1}, l_{i,t}) \quad = \quad & \max_{x_{i,t}, w_{i,t}, i_{i,t}} \pi \left[\log(x_{i,t}) - \zeta + \int_{\underline{l}}^{\hat{l}_{t+1}^I} V^R(w_{i,t}) dG(l_{i,t+1}) + \right. \\ & \left. + \int_{\hat{l}_{t+1}^I}^{\bar{l}} V^I(w_{i,t}, l_{i,t+1}) dG(l_{i,t+1}) \right]. \end{aligned} \tag{18}$$

[12] $\bar{\Psi}$ affects $R^I(l_{i,t})$ through two distinct channels. On the one hand, a lower $\bar{\Psi}$ implies a lower monitoring cost (as in the denominator of (13)). On the other hand, a lower $\bar{\Psi}$ implies a smaller share of output for the entrepreneur (as in the numerator of (13)). One can show that the former effect dominates the latter whenever

$$c\bar{\Psi}\psi^H \left(\frac{\pi\bar{R}_t}{2c\bar{\Psi}\psi^H} + \frac{(1-\pi)\bar{L}l_{i,t}}{2c\bar{\Psi}\psi^A} \right) > 1, \tag{14}$$

which is always true as long as (10) is satisfied for any value of $w_{i,t-1} \geq 0$.

We can now state the following.

Lemma 1 *Conditional on investing, an incumbent's consumption function and value function satisfy*

$$x_{i,t} = (1-\pi)R^I(l_{i,t})w_{i,t-1}, \tag{19}$$

$$V^I(w_{i,t-1}, l_{i,t}) = \frac{\pi \log(w_{i,t-1})}{1-\pi} + \frac{\pi \log(1-\pi)}{1-\pi} + \frac{\pi^2 \log(\pi)}{(1-\pi)^2} + \Gamma_t^I(l_{i,t}) = V^R(w_{i,t-1}) + \Gamma_t^I(l_{i,t}), \tag{20}$$

where $\Gamma_t^I(l_{i,t})$ *is the gap between incumbent value and retiree value. It follows*

$$\Gamma_t^I(l_{i,t}) = \pi \left[\frac{\log R^I(l_{i,t})}{1-\pi} - \zeta + \int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1}) \right]. \tag{21}$$

In the last expression, $\pi \left(\frac{\log R^I(l_{i,t})}{1-\pi} - \zeta \right)$ measures the direct utility gain of investing: an incumbent pays utility cost ζ and earns a higher return $R^I(l_{i,t})$ on her wealth than using storage (a gross return of 1). The second term $\int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1})$ is the option value of being an incumbent. An incumbent invests if and only if $V^I(w_{i,t-1}, l_{i,t}) > V^R(w_{i,t-1})$, that is, if $\Gamma^I(l_{i,t}) > 0$. The lemma below verifies our previous guess on $\hat{l}_t^I$.

Lemma 2 *The threshold* $\hat{l}_t^I$ *is determined by the following recursive equation*

$$\frac{\log R^I(\hat{l}_t^I)}{1-\pi} - \zeta + \int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1}) = 0. \tag{22}$$

Because $\int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1}) \geq 0$, it must be that $\frac{\log R^I(\hat{l}_t^I)}{1-\pi} - \zeta \leq 0$. Moreover, the gap $\Gamma_t(l_{i,t})$ between incumbent value and retiree value is decreasing in the monitoring cost parameters $\bar{\Psi}$, ψ^A and ψ^H because the return $R_t^I(l_{i,t})$ from investing is decreasing in $\bar{\Psi}$, ψ^A and ψ^H. This implies that, in steady state, the threshold $\hat{l}_t^I$ above which an incumbent invests is increasing in $\bar{\Psi}$, ψ^A and ψ^H.

Let us now turn to define the aggregate stock of relationship loans extended to incumbent firms ($L_{R,t}^I$). We have $L_{R,t}^I \equiv \int_{\hat{l}_t^I}^{\bar{l}} (i_{i,t} - w_{i,t-1}) \, dG(l_{i,t})$. Substituting for $i_{i,t}$ as given in (11), we can write $L_{R,t}$ as

$$L_{R,t}^I = W_t^I \int_{\hat{l}_t^I}^{\bar{l}} \frac{\frac{\pi}{2}\bar{R}\lambda^H + \frac{(1-\pi)}{2}\bar{L}l_{i,t}\lambda^A}{1 - \frac{\pi}{2}\bar{R}\lambda^H - \frac{(1-\pi)}{2}\bar{L}l_{i,t}\lambda^A} dG(l_{i,t}), \tag{23}$$

where $\lambda^J = 1/\left(c\bar{\Psi}\psi^J\right)$ for $J = H, A$ and W_t^I is the aggregate wealth of incumbents.

Expression (23) can be interpreted as a "production function" of loans to incumbents: as in Goodfriend and McCallum (2007), the amount of produced loans is an increasing function of the two inputs, the (optimal) monitoring efforts (λ^H, λ^A) and the collateral provided by the borrowers ($\bar{L}l_{i,t}$).

6.2 De novo entrants

We now consider a de novo entrant with wealth $w_{i,t-1}$. Conditional on retiring, a de novo entrant has the same value function as a retiring incumbent. Conditional on investing, a de novo entrant solves a problem isomorphic to that of an incumbent with the difference that $F\left(L^I_{R,t}\right)$ replaces $\bar{\Psi}\psi^j$ (for $j = A, H$). We then use the fact that, in this case, $c^H = c^A = cF\left(L_{R,t}\right)$. If she invests, an entrant becomes incumbent in the following period with probability ρ and therefore her future value is $V^I(\cdot)$.

When the lender's participation constraint (6) binds, we have

$$i_{i,t}\left(\cdot\right) = \frac{w_{i,t-1}}{1 - \frac{\pi\bar{R}}{2cF\left(L^I_{R,t}\right)} - \frac{(1-\pi)\bar{L}l_{i,t}}{2cF\left(L^I_{R,t}\right)}}. \tag{24}$$

Note that $\hat{l}^I_t$ affects the "scale" of de novo entrants' investments through its effect on the incumbents' aggregate amount of loans ($L^I_{R,t}$). Moreover, our assumptions on monitoring costs ensure that, given the same $l_{i,t}$, de novo entrants' investments are lower than incumbents' investments. We can then write the de novos' project payoff as

$$\left(1 - \frac{1}{cF\left(L^I_{R,t}\right)}\right)\bar{R}i_{i,t} = R^N_t(l_{i,t})w_{i,t-1}, \tag{25}$$

where

$$R^N_t(l_{i,t}) \equiv \frac{\left(1 - \frac{1}{cF\left(L^I_{R,t}\right)}\right)\bar{R}}{1 - \frac{\pi\bar{R}}{2cF\left(L^I_{R,t}\right)} - \frac{(1-\pi)\bar{L}l_{i,t}}{2cF\left(L^I_{R,t}\right)}}w_{i,t-1}. \tag{26}$$

It is immediate to prove that $R^N_t(l_{i,t}) < R^I(l_{i,t})$. De novo entrants with wealth $w_{i,t-1}$

solve

$$V^N(w_{i,t-1},l_{i,t}) = \max_{x_{i,t},w_{i,t},i_{i,t}} \pi\log(x_{i,t}) - \zeta + \rho\left[\int_{\underline{l}}^{\hat{l}^I_{t+1}} V^R(w_{i,t})dG(l_{i,t+1}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} V^I(w_{i,t},l_{i,t+1})dG(l_{i,t+1})\right] \quad (27)$$

$$+ (1-\rho)\left[\int_{\underline{l}}^{\hat{l}^N_{t+1}} V^R(w_{i,t})dG(l_{i,t+1}) + \int_{\hat{l}^N_{t+1}}^{\bar{l}} V^N(w_{i,t},l_{i,t+1})dG(l_{i,t+1})\right].$$

Assumption 1 ensures that de novo entrants need downpayment to borrow. A de novo entrant solves a consumption-saving problem.

Lemma 3 *Conditional on investing, a de novo entrant's consumption function and value function satisfy*

$$x_{i,t} = (1-\pi)R^N_t(l_{i,t})w_{i,t-1}, \quad (28)$$

$$V^N(w_{i,t-1},l_{i,t}) = V^R(w_{i,t-1}) + \Gamma^N_t(l_{i,t}), \quad (29)$$

where $\Gamma^N_t(l_{i,t})$ *is the gap between de novo entrant value and retiree value and is given by*

$$\Gamma^N_t(l_{i,t}) = \pi\left[\frac{\log R^N_t(l_{i,t})}{1-\pi} - \zeta + \rho\int_{\hat{l}^I_{t+1}}^{\bar{l}} \Gamma^I_{t+1}(l_{i,t+1})dG(l_{i,t+1}) + (1-\rho)\int_{\hat{l}^N_{t+1}}^{\bar{l}} \Gamma^N_{t+1}(l_{i,t+1})dG(l_{i,t+1})\right]. \quad (30)$$

A de novo entrant invests if and only if $V^N(w_{i,t-1},l_{i,t}) > V^R(w_{i,t-1})$. We are now ready for the following

Lemma 4 *Threshold* $\hat{l}^N_t$ *is determined by the following recursive equation:*

$$\frac{\log R^N_t(\hat{l}^N_t)}{1-\pi} - \zeta + \rho\int_{\hat{l}^I_{t+1}}^{\bar{l}} \Gamma^I_{t+1}(l_{i,t+1})dG(l_{i,t+1}) + (1-\rho)\int_{\hat{l}^N_{t+1}}^{\bar{l}} \Gamma^N_{t+1}(l_{i,t+1})dG(l_{i,t+1}) = 0. \quad (31)$$

The aggregate loan production function for de novos can then be expressed as

$$L^N_{R,t} = W^N_t \int_{\hat{l}^N_t}^{\bar{l}} \frac{\frac{\pi}{2}\bar{R}\lambda^H_t + \frac{(1-\pi)}{2}\bar{L}l_{i,t}\lambda^A_t}{1 - \frac{\pi}{2}\bar{R}\lambda^H_t - \frac{(1-\pi)}{2}\bar{L}l_{i,t}\lambda^A_t} dG(l_{i,t}), \quad (32)$$

where $\lambda^J = 1/cF(L^I_{R,t})$ for $J = A, H$. Notice also that, because of the incumbents' monitoring spillovers, the amount of loans to de novos also depends on the amount of loans to incumbents.

6.3 Spin-offs

Finally, consider a manager with wealth $w_{i,t-1}$. Conditional on retiring, a manager has the same value function as a retiring incumbent. Conditional on investing, the manager solves a problem isomorphic to that of an incumbent with the difference that $\psi_s^H F\left(L_{R,t}^I\right)$ replaces ψ^H and that $F\left(L_{R,t}^I\right)$ replaces $\bar{\Psi}\psi^A$.

Conditional on investing, a spin-off becomes incumbent in the following period with probability ρ and therefore her future value is $V^I(\cdot)$. When the lender's participation constraint binds, we have

$$i_{i,t}\left(l_{i,t}\right) = \frac{w_{i,t-1}}{1 - \frac{\pi \bar{R}}{2c\bar{\Psi}\psi^H F\left(L_{R,t}^I\right)} - \frac{(1-\pi)\bar{L}l_{i,t}}{2cF\left(L_{R,t}^I\right)}}, \tag{33}$$

while the spin-offs' project payoff is given by

$$\left(1 - \frac{1}{c\bar{\Psi}\psi^H F\left(L_{R,t}^I\right)}\right)\bar{R}i_{i,t} = R_t^S(l_{i,t})w_{i,t-1}, \tag{34}$$

where

$$R_t^S(l_{i,t}) \equiv \frac{\left(1 - \frac{1}{c\bar{\Psi}\psi^H F\left(L_{R,t}^I\right)}\right)\bar{R}}{1 - \frac{\pi \bar{R}_t}{2c\bar{\Psi}\psi^H F\left(L_{R,t}^I\right)} - \frac{(1-\pi)\bar{L}l_{i,t}}{2cF\left(L_{R,t}^I\right)}} w_{i,t-1}. \tag{35}$$

It is immediate to prove that $R_t^S(l_{i,t}) < R^I(l_{i,t})$. The Bellman equation of spin-offs is

$$\begin{aligned} V^S(w_{i,t-1}, l_{i,t}) = \max_{x_{i,t}, w_{i,t}, i_{i,t}} \pi \log(x_{i,t}) - \zeta + \rho\left[\int_{\underline{l}}^{\hat{l}_{t+1}^I} V^R(w_{i,t})dG(l_{i,t+1}) + \int_{\hat{l}_{t+1}^I}^{\bar{l}} V^I(w_{i,t}, l_{i,t+1})dG(l_{i,t+1})\right] \\ + (1-\rho)\left[\int_{\underline{l}}^{\hat{l}_{t+1}^S} V^R(w_{i,t})dG(l_{i,t+1}) + \int_{\hat{l}_{t+1}^S}^{\bar{l}} V^S(w_{i,t}, l_{i,t+1})dG(l_{i,t+1})\right]. \end{aligned}$$

We are now ready for the following

Lemma 5 *Conditional on investing, a spin-off entrant's value function and consumption function satisfy*

$$x_{i,t} = (1-\pi)R_t^S(l_{i,t})w_{i,t-1}, \tag{36}$$

$$V^S(w_{i,t-1}, l_{i,t}) = V^R(w_{i,t-1}) + \Gamma_t^S(l_{i,t}), \tag{37}$$

where $\Gamma_t^S(l_{i,t})$ is the gap between spin-off entrant value and retiree value. It follows

$$\Gamma_t^S(l_{i,t}) = \pi \left[\frac{\log R_t^S(l_{i,t})}{1-\pi} - \zeta + \rho \int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1}) + (1-\rho) \int_{\hat{l}_{t+1}^S}^{\bar{l}} \Gamma_{t+1}^S(l_{i,t+1}) dG(l_{i,t+1}) \right]. \tag{38}$$

A manager invests if and only if $V^S(w_{i,t-1}, l_{i,t}) > V^R(w_{i,t-1})$. The following lemma determines the spin-offs' threshold for project investment.

Lemma 6 *Threshold $\hat{l}_t^S$ is determined by the following recursive equation:*

$$\frac{\log R_t^S(\hat{l}_t^N)}{1-\pi} - \zeta + \rho \int_{\hat{l}_{t+1}^I}^{\bar{l}} \Gamma_{t+1}^I(l_{i,t+1}) dG(l_{i,t+1}) + (1-\rho) \int_{\hat{l}_{t+1}^S}^{\bar{l}} \Gamma_{t+1}^S(l_{i,t+1}) dG(l_{i,t+1}) = 0. \tag{39}$$

$\bar{\Psi}$ and ψ^H affect both directly and indirectly (through $L_{R,t}^I$) the value of $\hat{l}_t^S$, so that the total effect of $\bar{\Psi}$ and ψ^H on $\hat{l}_t^S$ is ambiguous. The effect of ψ^A on $\hat{l}_t^S$ is, instead, unambiguously positive.

6.4 Aggregation

We are now ready to compare the entry conditions of the three agents and to study the aggregate behavior of the economy. For any given $l_{i,t}$, it is immediate to show that $R_t^N(l_{i,t}) < R_t^S(l_{i,t}) < R^I(l_{i,t})$. Comparing Lemma 2, Lemma 4 and Lemma 6, the following lemma then follows directly.

Lemma 7 $\hat{l}_t^N > \hat{l}_t^S > \hat{l}_t^I$ *for all* t*.*

Lemma 7 tells us that the project investment conditions are more restrictive for de-novos than for spin-offs, which are in turn more restrictive than for incumbents. This result clearly reflects the comparative advantages in the lenders' monitoring activities across the three categories of agents.

Let us now characterize the measures of de novos (M_t^N), spin-offs (M_t^S) and incumbents (M_t^I). Recall that in every period there is a unit measure of potential entrants. Thus, the measure of de novo entrants in period t is

$$M_t^N = 1 - G(\hat{l}_t^N). \tag{40}$$

Note also that all measures are defined before the realization of the entrepreneurs' death shock. In period $t-1$, the measure of managers equals the measure of entrepreneurs (including de novos, incumbents, and spin-offs), which is $\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right)$.

In period t, with a probability σ these managers have the opportunity to create a spin-off. Thus, the measure of spin-offs in period t is

$$M_t^S = \left[1 - G(\hat{l}_t^S)\right] \sigma \left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right). \tag{41}$$

To define the measure of incumbents in period t, we must take into account that, with probability $1-\rho$, entrants of period $t-1$ keep their high monitoring costs in the subsequent period. As a result, in period t, we have a measure of low-cost incumbents (M_t^{IL}) who benefit from relationship lending and a measure of high-cost incumbents (M_t^{IH}), with $M_t^I = M_t^{IH} + M_t^{IL}$. Let us define them in order.

In period $t-1$, the measure of "low-cost" surviving entrepreneurs is $\pi \left[M_{t-1}^{IL} + \rho \left(M_{t-1}^{IH} + M_{t-1}^N + M_{t-1}^S\right)\right]$. When these entrepreneurs invest in period t, they become incumbents in period t. Thus, the measure of low-cost incumbents is given by

$$M_t^{IL} = \left[1 - G(\hat{l}_t^I)\right] \pi \left[M_{t-1}^{IL} + \rho \left(M_{t-1}^{IH} + M_{t-1}^N + M_{t-1}^S\right)\right]. \tag{42}$$

On the other hand, in period $t-1$, the measure of "high-cost" surviving entrepreneurs is $\pi(1-\rho)\left(M_{t-1}^{IH} + M_{t-1}^N + M_{t-1}^S\right)$. High-cost incumbents are then given by

$$M_t^{IH} = \left[1 - G(\hat{l}_t^N)\right] \pi(1-\rho) \left(M_{t-1}^{IH} + M_{t-1}^N + M_{t-1}^S\right). \tag{43}$$

Guided by the empirical analysis, we focus on the steady state values of the following three aggregates. The first is the ratio of entrants over incumbents and is given by

$$\frac{M_N + M_S}{M_I} = \frac{1 - \pi\left[1 - G(\hat{l}^N)\right](1-\rho)}{\pi\left[1 - G(\hat{l}^N)\right](1-\rho) + \frac{\pi\rho\left[1-G(\hat{l}^I)\right]}{1-\pi\left[1-G(\hat{l}^I)\right]}}. \tag{44}$$

This ratio is increasing in $\hat{l}^I$; it is also increasing in $\hat{l}^N$ (because a larger fraction of high-cost incumbents dies every period), and it is decreasing in ρ. The second measure is the ratio spin-offs over de novo entrants and is given by

$$\frac{M_S}{M_N} = \sigma\left[1 - G(\hat{l}^S)\right]\left(1 + \frac{M_S}{M_N}\right) \frac{1 + \frac{\pi\rho\left[1-G(\hat{l}^I)\right]}{1-\pi\left[1-G(\hat{l}^I)\right]}}{1 - \pi\left[1 - G(\hat{l}^N)\right](1-\rho)}. \tag{45}$$

This ratio is decreasing in $\hat{l}^I$, $\hat{l}^S$ and $\hat{l}^N$ and increasing in ρ (as this implies more incumbents relative to entrants, and thus more spin-offs relative to de novos).

The third measure of interest is the absolute measure of entrants, which can be expressed as

$$M_S + M_N = M_N\left(1+\frac{M_S}{M_N}\right) = \left[1-G(\hat{l}^N)\right]\left(1+\frac{M_S}{M_N}\right). \tag{46}$$

This measure is decreasing in $\hat{l}^N$ and $\hat{l}^S$, and increasing in ρ.

Finally, let us specify the law governing the evolution of wealth over time for low-cost incumbents (W_t^{IL}), high-cost incumbents (W_t^{IH}), spin-offs (W_t^S), de novos (W_t^N) and retirees (W_t^R). Low-cost incumbents' wealth evolves according to

$$\begin{aligned} W_t^{IL} &= \pi^2\int_{\hat{l}_t^I}^{\bar{l}} R_t^I(l_{i,t})dG(l_{i,t})W_{t-1}^{IL} + \pi^2\rho\int_{\hat{l}_t^N}^{\bar{l}} R_t^N(l_{i,t})dG(l_{i,t})W_{t-1}^{IH} \\ &\quad +\pi^2\rho\int_{\hat{l}_t^N}^{\bar{l}} R_t^N(l_{i,t})dG(l_{i,t})W_{t-1}^{N} + \pi^2\rho\int_{\hat{l}_t^S}^{\bar{l}} R_t^S(l_{i,t})dG(l_{i,t})W_{t-1}^{S}. \end{aligned}$$

The evolution of wealth for a high-cost incumbent, instead, follows

$$W_t^{IH} = \pi^2(1-\rho)\int_{\hat{l}_t^N}^{\bar{l}} R_t^I(l_{i,t})dG(l_{i,t})W_{t-1}^{IH} + \pi^2(1-\rho)\int_{\hat{l}_t^N}^{\bar{l}} R_t^N(l_{i,t})dG(l_{i,t})W_{t-1}^{N}$$

$$+\pi^2(1-\rho)\int_{\hat{l}_t^S}^{\bar{l}} R_t^S(l_{i,t})dG(l_{i,t})W_{t-1}^{S}.$$

Finally, let the total amount of bequest made at the end of period $t-1$ be

$$\begin{aligned} B_{t-1} &= (1-\pi)W_{t-1}^R + (1-\pi)G(\hat{l}_t^N)W_{t-1}^{IH} + (1-\pi)G(\hat{l}_t^I)W_{t-1}^{IL} && (47) \\ &\quad +(1-\pi)G(\hat{l}_t^N)W_{t-1}^{N} + (1-\pi)G(\hat{l}_t^S)W_{t-1}^{S}. && (48) \end{aligned}$$

Then we have

$$\begin{aligned} W_t^N &= B_{t-1}\frac{1}{1+\sigma\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right)}, \\ W_t^S &= B_{t-1}\frac{\sigma\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right)}{1+\sigma\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right)}, \\ W_t^R &= \pi^2 W_{t-1}^R + \pi^2 G(\hat{l}_t^N)W_{t-1}^{IH} + \pi^2 G(\hat{l}_t^I)W_{t-1}^{IL} + \pi^2 G(\hat{l}_t^N)W_{t-1}^{N} + \pi^2 G(\hat{l}_t^S)W_{t-1}^{S}. \end{aligned}$$

Note that once investing incumbents or entrants die, they transfer their entire liquidation value to lenders. Therefore, only retirees who use storage technologies can leave a bequest to de novo entrants. At the beginning of period $t+1$, all available bequests from the previous period amount to $(1-\pi)W_{t-1}^{R}$. They are shared among all potential entrants (measure of 1) and all potential spin-offs ($\sigma\left(M_t^I + M_t^N + M_t^S\right)$).

7 Numerical Results

We numerically solve for the model's steady state. Parameters are shown in Table 6. We assume that the pledgeability $l_{i,t}$ of firms' assets follows a truncated normal distribution on $[\underline{l}, \bar{l}]$, with a mean of 1 and standard deviation of 1/2. $\underline{l}$ and $\bar{l}$ are two standard deviations away from the mean. We normalize the monitoring cost $\bar{\Psi}$ and the common liquidation value $\bar{L}$ to 1. We calibrate the parameters of the investment technology $\{\pi,\ \zeta, \sigma\}$ and of the monitoring technology $\{\Psi^A,\ \Psi^H,\ \Psi_s^H\}$ to match the share of de novo entrants and spin-offs, as well as the leverages of incumbents, de novo entrants and spin-offs. Results are displayed in Table 7.

Figure 2 shows the investment thresholds and the leverage ratios of the three types of entrepreneurs. Due to the low monitoring costs of both physical and managerial capital, incumbents have a much lower investment threshold than de novo entrants and spin-offs, as well as a significantly higher leverage, as in the data.

We then consider an experiment that lowers $\bar{\Psi}$, the overall cost advantage of monitoring the managerial and physical capital of an incumbent. Once again, this shock is interpreted as an increase in the intensity of relationship lending which brings in the monitoring technology. A smaller $\bar{\Psi}$ reduces the probability of incumbents' exiting by lowering the threshold $\hat{l}^I$ and, hence, it increases the expected life span of incumbents. We set the magnitude of the decrease in $\bar{\Psi}$ such that the expected life span of incumbents, and hence the duration of credit relationships, increases by 3%. The results are shown in the last column of Table 7.

The reduction in $\bar{\Psi}$ reduces the share of entrants relative to incumbents, from 4.90% to 4.74%. At the same time, it increases the stock of relationship loans L_R, imposing a negative technological spillover on de novo entrants and spin-offs. This reduces the overall measure of entrants (on top of the reduction in the ratio of entrants over incumbents). Interestingly, the share of spin-offs over de novo entrants is lower for lower $\bar{\Psi}$. Not surprisingly, the average leverage increases for incumbents and drops for de novo entrants and spin-offs.

Overall these results are consistent with the empirical findings of a drop in firms' entry rates following a strengthening of relationship lending. On the other hand, the model predicts a decrease of the ratio of spin-offs over de novo entrants, which contrasts with the finding in the empirical analysis.

8 Conclusions

This paper has studied the impact of relationship lending on the dynamics of firms' entry. Using rich data from the Italian local credit markets, we have found that an increase in the intensity of relationship lending reduces firms' entry rate, whether this is measured relative to incumbent firms or to the local population. Further, stronger relationship lending tends to boost firm entry through spin-offs more than de novo entries. To rationalize these findings, we have developed a parsimonious model in which information accumulated by lenders over the course of credit relationships is transferrable to new entries. The model satisfactorily matches the impact of credit relationships on firms' entry rate while it cannot replicate the effect of credit relationships on the relative importance of firms' modes of entry (through spin-offs or de novo firm creation).

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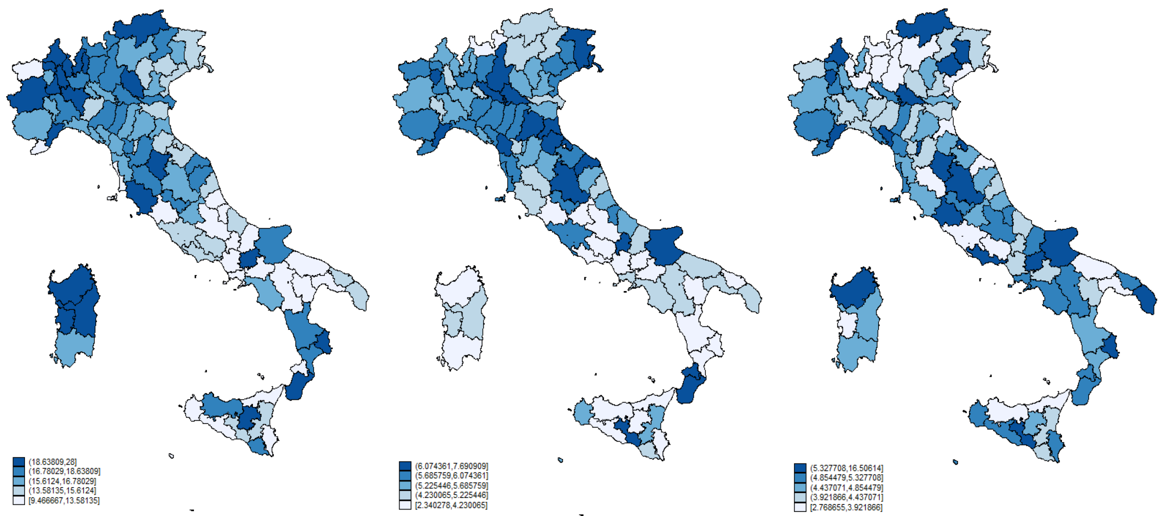

Figure 1: Relationship length, number of banks and Entrants over Incumbents by province.This figure plots the average relationship length (left), number of banks (center) and the ratio of entrants over incumbents (right) in the provinces over the years 1995-2006.

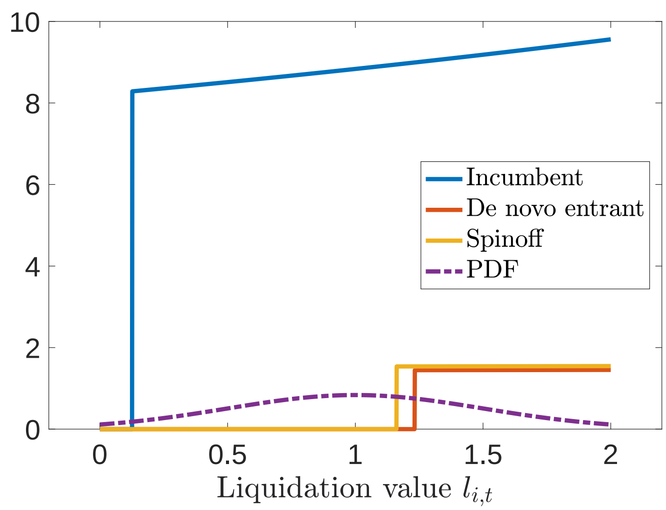

Figure 2: Leverage of active entrepreneurs as a function of liquidation value $l_{i,t}$

Table 1. Summary statistics

Variable	Obs	Mean	Std dev	Min	Max
Entrants/Incumbents (%)	9407	4.990	6.705	0.000	191.966
Entrants/Population (1000 inhab.)	9407	0.032	0.114	0.000	5.551
Share of firms with ≤ 2yrs (%)	2745	17.085	16.792	0.000	100.000
Share of firms with ≤ 4yrs (%)	2745	27.737	20.916	0.000	100.000
Spin-off (all)	2246	0.162	0.368	0.000	1.000
Spin-off (majority)	2246	0.264	0.441	0.000	1.000
Corporate Spin-out probability	18176	0.035	0.184	0.000	1.000
Relationship length	9384	16.142	4.555	2.000	42.750
Relationship length (over 10 y.)	9384	0.566	0.174	0.000	1.000
Number of banks	9407	5.325	1.427	1.750	11.000
Unemployment rate (log)	9407	2.047	0.623	0.550	3.415
Trade openess (log)	9407	-1.158	0.878	-3.777	0.433
Material infrastracture (log)	9407	4.516	0.409	3.523	5.984
Population growth	9407	0.003	0.005	0.028	0.021
Judicial inefficiency	9324	3.792	1.400	1.440	8.323
Branches/Population (1000 inhab.)	9407	0.522	0.181	0.154	1.036
Herfindhal-Hirschmann Index	9407	0.088	0.039	0.027	0.272
Average firms' age in the province	9407	23.298	6.239	6.333	52.333

Note: This table reports summary statistics and correlation for the main variables used in the analysis.

Table 2: Baseline estimations

VARIABLES	(1) Entrants/Incumbents OLS	(2) Entrants/Population OLS	(3) Entrants/Incumbents OLS	(4) Entrants/Population OLS	(5) Entrants/Incumbents OLS	(6) Entrants/Population OLS	(7) Entrants/Incumbents 2SLS	(8) Entrants/Population 2SLS
Relationship length	-0.042***	-0.001**	-0.036***	-0.000**	-0.047***	-0.000**	-0.524***	-0.003*
	(0.015)	(0.000)	(0.014)	(0.000)	(0.017)	(0.000)	(0.091)	(0.001)
Provincial economic and banking conditions								
Unemployment rate (log)	2.009***	0.007*	2.032***	0.008**	0.819**	0.016***	1.547***	0.005
	(0.226)	(0.004)	(0.230)	(0.004)	(0.397)	(0.006)	(0.231)	(0.003)
Population growth	23.640**	0.687***	23.182**	0.676***	131.095***	0.855*	16.221	0.650***
	(10.156)	(0.215)	(9.991)	(0.212)	(21.955)	(0.474)	(11.300)	(0.224)
Branches/population	-0.514	-0.017**	-0.505	-0.016**	5.544**	-0.056	-0.540	-0.017**
	(0.636)	(0.008)	(0.635)	(0.008)	(2.362)	(0.038)	(0.685)	(0.008)
Herfindhal-Hirschmann Index	-8.619***	-0.093***	-8.535***	-0.091***	-61.608***	-0.503***	0.602	-0.048*
	(1.764)	(0.026)	(1.738)	(0.026)	(6.995)	(0.156)	(2.384)	(0.028)
Structural provincial characteristics								
Trade openess (log)	-0.025	0.002	-0.029	0.002			-0.473***	-0.000
	(0.112)	(0.002)	(0.114)	(0.002)			(0.151)	(0.002)
Material infrastracture (log)	-1.990***	-0.016***	-1.984***	-0.016***			-2.558***	-0.019***
	(0.242)	(0.004)	(0.241)	(0.004)			(0.281)	(0.005)
Judicial inefficiency	0.038	0.001**	0.037	0.001*			0.076	0.002**
	(0.047)	(0.001)	(0.047)	(0.001)			(0.054)	(0.001)
Average firms' age in the province			-0.009	-0.000				
			(0.011)	(0.000)				
Instrumental variables								
Saving banks 1936							-0.855***	-0.855***
							(0.116)	(0.116)
New branches incumbent							0.027***	0.027***
							(0.003)	(0.003)
Area dummies	Y	Y	Y	Y	N	N	Y	Y
Provincial dummies	N	N	N	N	Y	Y	N	N
Time and industry dummies	Y	Y	Y	Y	Y	Y	Y	Y
Observations	9,292	9,292	9,292	9,292	9,384	9,384	9,292	9,292
R-squared	0.158	0.108	0.158	0.108	0.264	0.156	0.067	0.100
F instruments							117.7	117.7
Overid p value							0.505	0.125

Table 3: Robustness checks

Panel A: OLS Estimations								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Using alternative dependent variables		Using alternative independent variables				Winsorizing Relationship Length	
VARIABLES	Share of firms with ≤ 2yrs (Orbis)	Corporate Spin-out probability	Entrants/Incumbents	Entrants/Population	Entrants/Incumbents	Entrants/Population	Entrants/Incumbents	Entrants/Population
Relationship length	-0.217**	-0.003*					-0.047***	-0.001**
	(0.103)	(0.002)					(0.016)	(0.000)
Relationship length (over 10 y.)			-1.226***	-0.011*				
			(0.398)	(0.006)				
Number of Banks					0.341***	0.003***		
					(0.052)	(0.001)		
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Area, time and industry dummies	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,688	11,372	9,292	9,292	9,315	9,315	9,292	9,292
R-squared	0.119	0.043	0.158	0.107	0.161	0.108	0.158	0.108
Panel B: 2SLS Estimations								
VARIABLES	Share of firms with ≤ 2yrs (Orbis)	Corporate Spin-out probability	Entrants/Incumbents	Entrants/Population	Entrants/Incumbents	Entrants/Population	Entrants/Incumbents	Entrants/Population
Relationship length	-0.496	-0.013					-0.517***	-0.003**
	(0.688)	(0.018)					(0.089)	(0.001)
Relationship length (over 10 y.)			-10.827***	-0.020				
			(2.145)	(0.021)				
Number of Banks					2.218***	0.017*		
					(0.493)	(0.009)		
Instrumental variables								
Saving banks 1936	0.198	-0.461	0.003	0.003	0.309***	0.309***	-0.833***	-0.833***
	(0.184)	(0.507)	(0.005)	(0.005)	(0.028)	(0.028)	(0.114)	(0.114)
New branches incumbent	0.032***	-0.002	0.001***	0.001***	-0.003***	-0.003***	0.028***	0.028***
	(0.004)	(0.005)	(0.000)	(0.000)	(0.001)	(0.001)	(0.003)	(0.003)
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Area, time and industry dummies	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,688	11,399	9,292	9,292	9,315	9,315	9,292	9,292
R-squared	0.115	0.197	0.104	0.107	0.052	0.088	0.083	0.102
F instruments	28.55	2.935	99.81	99.81	89.15	89.15	124	124
Overid p value	0.087	0.829	0.005	0.078	0.245	0.245	0.448	0.122

Table 4: Mode of entry and size at entry

VARIABLES	*Panel A: Mode of entry*		*Panel B: Size (no. employees) at entry*				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Ratio Spin-off (all owners) / De novo entrants	Ratio Spin-off (majority owners) / De novo entrants	All entrants	Spin-off (all)	Spin-offs (majority)	De novo (all)	De novo (majority)
Relationship length	0.005*	0.007**	0.097**	0.166*	0.234**	0.075	0.030
	(0.003)	(0.003)	(0.045)	(0.097)	(0.132)	(0.051)	(0.028)
+ controls	Y	Y	Y	Y	Y	Y	Y
Industry and Area dummies	N	N	Y	Y	Y	Y	Y
Time dummies	N	N	N	N	N	N	N
Observations	252	252	1,877	362	590	1,515	1,287
R-squared	0.156	0.087	0.082	0.273	0.186	0.085	0.098

Table 5: Spillover mechanisms

						Panel A: Bank information						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Entrants/Incumbents	Entrants/Population	Entrants/Incumbents	Entrants/Population	Ratio Spin-off (all owners) / De novo entrants	Ratio Spin-off (all owners) / De novo entrants	Corporate Spin-out probability	Corporate Spin-out probability	No. of employees	No. of employees	No. of employees	No. of employees
									Spin-off (all)	Spin-off (all)	De novo (all)	De novo (all)
Relationship length	0.023	0.001***	0.012	0.000**	0.006***	-0.001	0.009	-0.010	-0.101*	-0.254***	0.388	0.551
	(0.015)	(0.000)	(0.024)	(0.000)	(0.003)	(0.004)	(0.007)	(0.008)	(0.060)	(0.075)	(0.257)	(0.387)
Rel length * Technological spillover	-0.114	-0.002***			-0.159***		-0.279*		-0.637		-4.075	
	(0.124)	(0.001)			(0.056)		(0.162)		(1.620)		(9.000)	
Rel length * Embodied spillover			0.066	0.001		0.015		0.116*		0.703***		2.848
			(0.247)	(0.001)		(0.016)		(0.069)		(0.214)		(2.079)
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area and industry dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	2,121	2,121	2,121	2,121	252	252	1,693	1,693	404	404	231	231
R-squared	0.313	0.215	0.313	0.215	0.131	0.114	0.038	0.039	0.220	0.232	0.228	0.235
						Panel B: Industry characteristics						
VARIABLES	Entrants/Incumbents	Entrants/Population	Share of firms with ≤ 2yrs	Share of firms with ≤ 4yrs	Entrants/Incumbents	Entrants/Population	Share of firms with ≤ 2yrs	Share of firms with ≤ 4yrs	Entrants/Incumbents	Entrants/Population	Share of firms with ≤ 2yrs	Share of firms with ≤ 4yrs
Relationship length	-0.011	-0.000	-0.919***	-1.029***	0.095	0.001*	0.466	0.618	-0.403**	-0.006*	-3.542**	-4.091**
	(0.043)	(0.000)	(0.285)	(0.321)	(0.067)	(0.001)	(0.542)	(0.585)	(0.187)	(0.003)	(1.513)	(1.765)
Rel length * Commovement	-0.144	-0.002	3.297**	3.645**								
	(0.189)	(0.002)	(1.326)	(1.513)								
Rel length * Collateral emphasis					-0.507**	-0.006**	-1.620	-2.186				
					(0.249)	(0.003)	(1.337)	(1.449)				
Rel length * Human capital intensity									0.031**	0.000*	0.286**	0.323**
									(0.016)	(0.000)	(0.131)	(0.151)
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area and industry dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time dummies	Y	Y	N	N	Y	Y	N	N	Y	Y	N	N
Observations	9,292	9,292	2,604	2,604	8,484	8,484	2,331	2,331	9,292	9,292	2,331	2,058
R-squared	0.158	0.108	0.120	0.184	0.158	0.106	0.108	0.148	0.159	0.108	0.108	0.151

Table 6: Parameters

Parameter	Symbol	Value	Target
Probability of survival	π	0.971	Measure of incumbents
Aggregate liquidation value	$\bar{L}$	1.000	Normalized
Distribution of liquidation value		$N(1, 1/4)$	Truncated normal
Upper bound on idiosyncratic liquidation value	$\bar{l}$	2.000	
Lower bound on idiosyncratic liquidation value	$\underline{l}$	0	
Highest information cost	c	3.300	
Overall information advantage	$\bar{\Psi}$	1	Normalized
Information advantage on physical capital	Ψ^A	0.520	
Information advantage on human capital (spinoff)	Ψ^H_s	0.880	
Information advantage on human capital (incumbent)	Ψ^H	0.345	
Probability of spin-off	σ	0.037	Measure of spin-offs
Utility cost of investing	ζ	2.400	Measure of incumbents
Technological spillover	γ	1.000	

Table 7: Steady State Results

Variable	Symbol	Data	Baseline Model	Lower $\bar{\Psi}$
Share of entrants	$\frac{M^N+M^S}{M^I}$	4.99%	4.98%	4.71%
Share of spin-offs	$\frac{M^S}{M^N}$	39.4%	39.46%	24.74%
Ratio of wealth	$\frac{W^N+W^S}{W^I}$	1.49%	1.30%	1.30%
Ratio of wealth per firm	$\frac{(W^N+W^S)/(M^N+M^S)}{W^I/M^I}$	23.52%	26.13%	27.66%
Average leverage:				
Incumbents		8.80	8.856	8.859
De novo entrants		1.44	1.448	1.313
Spin-offs		1.54	1.540	1.538
Expected life span			22.10	23.22

A Appendix

A.1 Additional Data Information

They classify into 64 industries using a two-digit classification and then, for each industry, regress the standardized annual rate of growth of firms' sales on a full set of year dummies. If firms within an industry co-move significantly, the year dummies will explain a large part of sales variability. They thus retain the R2 of these regressions and use it as a measure of co-movement of firms in the industry. Industries with high R2 will be high co-movement industries. We then impute this measure to the firms in our sample using the industry code.

A.2 Proofs of Lemmas 1, 3 and 5

We first prove Lemma 1. Guess that the investment decision follows the threshold strategy

$$V^I(w_{i,t-1}, l_{i,t}) > V^R(w_{i,t-1}) \quad \text{if} \quad l_{i,t} > \hat{l}^I_t.$$

Then the maximization problem for incumbents becomes a consumption-saving problem:

$$V^I(w_{i,t-1}, l_{i,t}) = \max_{x_{i,t}, w_{i,t}} \pi \left[\log(x_{i,t}) - \zeta + \int_{\underline{l}}^{\hat{l}^I_{t+1}} V^R(w_{i,t}) dG(l_{i,t+1}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} V^I(w_{i,t}, l_{i,t+1}) dG(l_{i,t+1}) \right],$$

$$\text{s.t.} \quad x_{i,t} + w_{i,t} = R^I(l_{i,t}) w_{i,t-1}.$$

Combining the first order conditions of $x_{i,t}$ and $w_{i,t}$, we get

$$\frac{1}{x_{i,t}} = \int_{\underline{l}}^{\hat{l}^I_{t+1}} \frac{\partial V^R(w_{i,t})}{\partial w_{i,t}} dG(l_{i,t+1}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} \frac{\partial V^I(w_{i,t}, l_{i,t+1})}{\partial w_{i,t}} dG(l_{i,t+1}).$$

Using the equation above, the envelope condition

$$\frac{\partial V^I(w_{i,t-1}, l_{i,t})}{\partial w_{i,t-1}} = \frac{\pi R^I(l_{i,t})}{x_{i,t}},$$

and the fact that

$$\frac{\partial V^R(w_{i,t-1})}{\partial w_{i,t-1}} = \frac{\pi}{(1-\pi) w_{i,t-1}},$$

we can derive the Euler equation

$$\frac{1}{x_{i,t}} = \int_{\underline{l}}^{\hat{l}^I_{t+1}} \frac{\pi}{(1-\pi) w_{i,t}} dG(l_{i,t+1}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} \frac{\pi R^I(l_{i,t+1})}{x_{i,t+1}} dG(l_{i,t+1}). \tag{49}$$

We now use Equation (49) to verify that $x_{i,t} = (1-\pi)R^I(l_{i,t})w_{i,t-1}$ and $w_{i,t} = \pi R^I(l_{i,t})w_{i,t-1}$ for incumbents. Under this guess, the right-hand-side of Equation (49) becomes

$$\int_{\underline{l}}^{\hat{l}^I_{t+1}} \frac{\pi}{(1-\pi)w_{i,t}} dG(l_{i,t+1}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} \frac{\pi R^I(l_{i,t+1})}{(1-\pi)R^I(l_{i,t+1})w_{i,t}} dG(l_{i,t+1})$$
$$= \frac{\pi}{(1-\pi)w_{i,t}} = \frac{1}{(1-\pi)R^I(l_{i,t})w_{i,t-1}} = \frac{1}{x_{i,t}},$$

so the guess is verified.

We then prove the solution to the value function $V^I(w_{i,t-1}, l_{i,t})$ in Lemma 1. The Bellman equation for the incumbents can be written as

$$V^I(w_{i,t-1}, l_{i,t}) = \max_{x_{i,t}, w_{i,t}} \pi \left[\log(x_{i,t}) - \zeta + V^R(w_{i,t}) + \int_{\hat{l}^I_{t+1}}^{\bar{l}} V^I(w_{i,t}, l_{i,t+1}) - V^R(w_{i,t}) dG(l_{i,t+1}) \right].$$

Using the verified policy functions $x_{i,t} = (1-\pi)R^I(l_{i,t})w_{i,t-1}$ and $w_{i,t} = \pi R^I(l_{i,t})w_{i,t-1}$, as well as the fact that

$$V^R(w_{i,t-1}) = \frac{\pi \log(w_{i,t-1})}{1-\pi} + \frac{\pi \log(1-\pi)}{1-\pi} + \frac{\pi^2 \log(\pi)}{(1-\pi)^2},$$

we can show that

$$V^I(w_{i,t-1}, l_{i,t}) - V^R(w_{i,t-1}) = \pi \left[\frac{\log R^I(l_{i,t})}{1-\pi} - \zeta + \int_{\hat{l}^I_{t+1}}^{\bar{l}} V^I(w_{i,t}, l_{i,t+1}) - V^R(w_{i,t}) dG(l_{i,t+1}) \right],$$

which completes the proof for Lemma 1. Proofs of Lemmas 3 and 5 are very similar.

Data Appendix

Four main data sources are used in the empirical analysis: four waves of the Capitalia Survey of Italian Manufacturing Firms (SIMF), which cover three-year periods ending respectively in 1997, 2000, 2003 and 2006; the Register of the Italian Chambers of Commerce (Register); the Orbis database of Bureau van Dick (Orbis); the "Rilevazione sul sistema delle Start-up innovative", a survey of start-ups carried out by the Italian Ministry of Economic Development (MED). We complement these data sources with other databases, including Istat data on characteristics of provinces; Bank of Italy data on the structure of Italian banking sectors; data on provincial infrastructure (GEOWEB) and previous studies to construct measures of asset tangibility, human capital intensity and product information complexity, by industries. The variables used in the empirical analysis are:

Variable	Definition and source (in parentheses)
Dependent Variables	
Entrants/Incumbents	The ratio of newly registered firms in a province, sector and year (entrants) and the total number of registered firms in the same province, sector and year. We take the average over the years of the survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Register)
Entrants/Population	The ratio of newly registered firms in a province, sector and year (entrants) and the population in the same province and year. We take the average over the years of the survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Register and ISTAT)
Share of firms with ≤ 2yrs	The share of manufacturing firms with no more than 2 years of activity in a province and sector in 2008. (Orbis)
Share of firms with ≤ 4yrs	The share of manufacturing firms with no more than 4 years of activity in a province and sector in 2008. (Orbis)
Average firms' Age	The average age of the firms in a province and sector in 2008. (Orbis)
Ratio Spin-off (all owners) / De novo entrants	Ratio in the province between spin-off (having all the owners with experience in the same industry) and de novo entrants. (MED)
Ratio Spin-off (majority owners) / De novo entrants	Ratio in the province between spin-off (having the majority of the owners with experience in the same industry) and de novo entrants. (MED)
Spin-off (all)	A dummy equals to one if the start-up have all the owners with experience in the same industry; zero otherwise. (MED)
Spin-off (majority)	A dummy equals to one if the start-up have the majority of the owners with experience in the same industry; zero otherwise. (MED)
Corporate Spin-out probability	A dummy equals to one if the firm have done divestiture operations in the three years of the survey; zero otherwise. (SIMF)
Endogenous Variables	
Relationship length	The average length of credit relationships in the province, in the survey. (SIMF)
Relationship length (over 10 y.)	The share of firms in the province with a length of credit relationships larger than 10 years, in the survey. (SIMF)
Number of banks	The average number of banks of a firm in the province, in the survey. (SIMF)
Comovement in value	Comovement between the sales of the firm and those of other firms in the same industry. (Guiso and Minetti, 2010)
Human capital intensity	Average years of schooling at the industry level in 1980. (Ciccone and Papaioannou, 2009)
Collateral emphasis	The last survey asks each firm: "In your view, which criteria does your bank follow in granting loans to you?" Our measure of collateral emphasis is a dummy variable equal to one if the firms answer collateral, zero otherwise. (SIMF)
Technological spillover	The last survey asks each firm: "Which of these characteristics are key in selecting your main bank?". We use two of these characteristics: 1) The bank knows your relevant market; 2) Frequent contacts with the credit officer at the bank. For each firm we construct a dummy variable equal to one if the firms answer very much for each of these characteristics. Then we construct an average index for each industry. (SIMF)
Embodied spillover	The last survey ask each firm: "Which of these characteristics are key in selecting your main bank?" and "In your view, which criteria does your bank follow in granting loans to you?" We use two of these characteristics: 1) The bank knows you and your business; 2) Managerial ability on the part of those running the firm's business. For each firm we construct a dummy variable equal to one if the firms answer very much for each of these characteristics. Then we construct an average index for each industry. (SIMF)
Control Variables	
Unemployment rate (log)	Logarithm of provincial unemployment rate. We take the average over the years of the survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (ISTAT)
Trade openness (log)	Logarithm of the ratio of trade on GDP in the province in 2001. (ISTAT)
Material infrastructure (log)	Synthetic index of material infrastructure in the province. This data contains informations about: Road Network, Railways, Ports, Airports, Environmental Energy Networks, Broadband Services, Business Structure. (GEOWEB)
Population growth	Growth rate of the population in the province. We take the average over the years of the survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (ISTAT)
Efficiency of the court system	We considered the number of civil suits pending in each of the 27 district courts of Italy, scaled by the population of the district. We imputed this variable to the firms according to the districts where they are headquartered. (ISTAT)
Branches per 1,000 inhabitants	Number of bank branches in the province, per 1,000 inhabitants. We take the average over the years of the SIMF survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Bank of Italy)
Herfindahl-Hirschman index (HHI)	Herfindahl-Hirschman index of bank branches in the province. We take the average over the years of the SIMF survey (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Bank of Italy)
Center, South	Dummy variables that take the value of one if the firm is located in a central or southern province; zero otherwise. (ISTAT)
Industry dummies	Two-digit Ateco sector dummies. (Register)
Instrumental Variables	
Saving banks in 1936	Number of savings banks in the year 1936 in the province, per 100,000 inhabitants. (Bank of Italy)
New branches incumbent	For each province and year we calculate the number of branches created minus those closed by incumbent banks per 100,000 inhabitants. Then we compute the average over the years 1991-1998. (Bank of Italy)