Credit Markets, Relationship Lending, and the Dynamics of Firm Entry

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Abstract

We study the impact of credit relationships on firm entry, and the implications for aggregate investment and output. Exploiting Italian data, we find that relationship-oriented local credit markets feature fewer, larger entrants, and relatively more spinoff entrants. Relationship lending discourages de novo entry when banks' knowledge is incumbent-specific but promotes knowledge transfers to spinoffs. We explain these patterns in a dynamic general equilibrium model where banks accumulate information in credit relationships and can reuse information when financing entrants. Relationship lending raises output, as the larger investments and the credit reallocation from de novos to spinoffs outweigh the entry slowdown.

Keywords: Credit Relationships, Banks, Entry Dynamics, Aggregate Investment
JEL Codes: E44; G21; O16

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Abstract

We study the impact of credit relationships on firm entry, and the implications for aggregate investment and output. Exploiting Italian data, we find that relationship-oriented local credit markets feature fewer, larger entrants, and relatively more spinoff entrants. Relationship lending discourages de novo entry when banks' knowledge is incumbent-specific but promotes knowledge transfers to spinoffs. We explain these patterns in a dynamic general equilibrium model where banks accumulate information in credit relationships and can reuse information when financing entrants. Relationship lending raises output, as the larger investments and the credit reallocation from de novos to spinoffs outweigh the entry slowdown.

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1 Introduction

Firm entry is a driving force of entrepreneurship, investment and output. The credit sector is reputed to be important in determining the ease with which new firms enter markets. An aspect that has instead received little attention is the way banks' business models and lending technologies, such as relationship lending, shape intensity and modes of firm entry. In many countries, credit mainly flows to firms through long-term credit relationships over the course of which banks accumulate knowledge about firms' assets, workforce and human capital (Ongena and Smith, 2001).[1] Fundamental questions arise from these observations: does the diffusion of relationship banking in the credit market promote or slow down the dynamics of firm entry? And does it favor the entry of

[1]Credit relationships are predominant in countries like Germany, Japan and Italy, but are also pervasive in the U.S. credit system. A broad body of works have studied their implications for the allocation of credit across incumbent businesses, sectors and regions (Degryse et al., 2009).

new entrepreneurs or the creation of spinoff firms by managers or employees of incumbent firms?[2] What implications do the effects of relationship banking on entry intensity and modes yield for aggregate investment and for the design of policies aimed at promoting business dynamism and aggregate investment? This paper takes a step towards addressing these questions theoretically and empirically. The analysis uncovers a critical role of banks' continuous accumulation of information in credit relationships and reuse of information in entrants' financing in the credit market.

We motivate the analysis empirically using the Italian local credit markets (provinces) as a testing ground and examining how the strength of credit relationships in the local markets affects the dynamics (intensity and modes) of firm entry. To this end, we employ granular survey data on the length of credit relationships in the provinces and on their degree of exclusivity (number of banks of a firm).[3] We complement these data with business registry data on the intensity of manufacturing firms' entry and with information on entry modes, whether firms are created by new entrepreneurs (de novo entry) or by managers or employees of incumbent firms (spinoff entry). Further, we have access to unique survey data on the type of information generally accumulated by banks in credit relationships, whether information specific to incumbents and their assets or information that can instead be reused by banks when financing de novo and spinoff entrants, including knowledge about managers and about incumbents' sector of activity and local economy.

We find that local credit markets characterized by stronger (e.g., longer) relationships between banks and incumbent businesses feature a lower entry rate of firms and a larger size of firms at entry. They also feature relatively more spinoffs than de novo entrants. We detect a role of banks' information in these effects. Relationship-oriented local credit markets slow down firm entry, especially de novo entry, when banks' information is specific to incumbents and, hence, not reusable in the financing of entrants. By contrast, a stronger local intensity of credit relationships promotes spinoff entry when banks accumulate information that is transferable from incumbents to spinoffs. These findings are robust across estimation methods, including instrumental variables (IV) estimations. When performing IV estimations, we exploit indicators of the constrictiveness of the historical regulation of the Italian banking sector to assuage possible concerns of endogeneity of the importance of relationship banking in local credit markets. The 1936 Italian banking

[2]Spinoffs are a sizeable share of entrants. They represent more than 25% of entries in Italy, as documented below, and from 20% to 35% of entries in the United States, Brazil, Netherlands, Sweden, Norway, and Portugal (see Klepper and Sleeper, 2005, Andersson and Klepper, 2013, and references therein).

[3]The survey data are drawn from the Capitalia survey on Italian manufacturing firms.

regulation imposed strict limits on the ability of different types of banks to open new branches. While its prescriptions were uniform across Italy, its constrictiveness varied across provinces and depended on the relative importance of different types of banks in the provinces in 1936. The constrictiveness of the 1936 regulation has been demonstrated to have significantly affected firms' tendency to engage in stable, long-term credit relationships through its impact on the fluidity of local credit markets (firms' opportunities to switch banks) and its profound effects on the types of banks operating in the local markets (e.g., local banks or banks with a national scope) (Herrera and Minetti, 2007; Guiso et al., 2004; Guiso, 2003).[4]

The effects estimated in the empirical tests are economically sizeable. Looking for example at the entry rate, the instrumented regressions suggest that credit relationships longer by 1 year (about 5% of the average credit relationship length) imply a ratio of entrants to incumbents about 0.6 percentage points lower. And the non-instrumented regressions suggest a lower but still sizeable effect of the local intensity of credit relationships on firms' entry rate.

We rationalize the empirical patterns qualitatively and quantitatively through a dynamic general equilibrium model with credit relationships and firm entry, and use the model to evaluate the implications for aggregate investment and output. As in a broad class of models (e.g., Kiyotaki and Moore, 1997; Perri and Quadrini, 2018; Bassetto et al., 2015; Iacoviello, 2015), firms' access to credit is hindered by limited pledgeability of investment returns. Banks' information reduces firms' ability to divert investment returns, raising the pledgeability of returns and, hence, incumbents' and entrants' access to credit.[5] Motivated by the evidence, the characterizing features of the economy are the distinction between de novo and spinoff entrants and the accumulation of banks' information in credit relationships and reuse of this information in the credit market. The first information channel in the credit market - "embedded information flows" - consists of relationship banks' accumulation of information on employees (managers) of incumbent firms. This favors spinoff entry: managers of incumbent firms can start a business by pledging investment returns to banks with which they interacted in parent companies. The second channel - "non-embedded information spillovers" - captures in reduced form mechanisms through which relationship banks' information accumulation on incumbents' technology, sector or local economy affects entry. On the positive side, such information can be reused by banks when entrants pledge investment re-

[4]We return to this point below (see Section 3).

[5]Building on prior studies, in the paper we elaborate on the microfoundation of these features of the model.

turns. On the negative side, relationship banks' accumulation of knowledge on incumbents crowds out their information acquisition on entrants (e.g., due to banks' limited information capacity), especially when banks' information is incumbent-specific.[6]

We calibrate the model to the Italian data. We choose the parameters for the investment technology and for the pledgeability of incumbents' and entrants' returns by targeting the following data moments: the ratios of entrants to incumbents and of spinoffs to total entrants; the leverage of incumbents, de novos and spinoffs; the aggregate turnover of entrants over that of incumbents; and the effect of the average credit relationship length on the stock of relationship loans. In the calibrated model, through the accumulation of information in credit relationships, stronger relationship banking (i.e., longer relationships) crowds out the production of information and loans for de novo entrants, but spurs the entry of spinoffs from incumbents, to which banks can transfer information accumulated in credit relationships. Spinoff entry, however, takes a hit from the slowdown in de novo entry and its adverse impact on the number of incumbents, from which spinoffs originate. The interaction between the information channels and firms' compositional dynamics thus exerts conflicting effects on the overall pace of entry.

The calibrated model can replicate the negative impact of a relationship-oriented banking structure on the overall entry rate. It can also match its positive association with the spinoff rate (spinoffs to total entrants) and with the size of firms at entry. The effects are in line with the estimates on the Italian local credit markets and economically sizeable. A permanent increase of 1 year in the average credit relationship length (about 5% of the average relationship length) reduces entry by 0.23 percentage points (about 5% of the average entry rate), hinting at a 1-to-1 negative relation between relationship intensity and entry intensity. This effect on the entry rate is in between the non-instrumented estimates and the IV estimates on the Italian local credit markets. Among the fewer entrants, the reallocation of credit from de novos to spinoffs is significant: a permanent increase of 5% of the average relationship length raises the spinoff rate by 0.7 percentage points (about 2% of the average spinoff rate), which is again consistent with the estimates. The average investment size of firms at entry rises by 6%.

We then evaluate implications for aggregate output. In the quantitative analysis stronger

[6] As discussed later in the paper, we formalize these information channels following a broad literature in macroeconomics on knowledge and information spillovers (e.g., Aghion and Jaravel, 2015; Jones, 1995).

relationship lending leads to larger total output:[7] a permanent increase of 5% of the average credit relationship length raises output by 4.8%. First, there is a larger investment scale of entrants, which contributes to an even larger investment scale of incumbents. Second, among entrants, the reallocation of credit from de novo to spinoff entrants enhances aggregate investment and output. Spinoffs, in fact, can use higher leverage when investing due to the higher pledgeability of their investments. Together these effects outweigh the output effect of the overall slowdown in entry and of the resulting long-run contraction in the number of active firms.

Before we proceed, a caveat is in order. In the analysis we will refer to the effects of policies, such as banking regulations, on entry dynamics and aggregate investment through relationship lending. As we further elaborate below, it is important to bear in mind that these effects do not constitute the only channels of possible influence of the policies and regulations on the aggregate outcomes of interest. The paper unfolds as follows. In the next section we relate the paper to prior literature. Section 3 presents the motivating empirical evidence. In Section 4, we lay out and solve the model. Section 5 presents calibration and simulations. Section 6 concludes. Details on the data, technical derivations and additional results are relegated to the online Appendices.

2 Prior Literature

Related studies The paper relates to three strands of literature. The first strand of literature investigates the determinants of firm entry. In this strand we especially relate to the studies on the impact of the credit sector on entry dynamics (see, e.g., Cooley and Quadrini, 2001; Angelini and Generale, 2008). Some studies find that entry dynamics is affected by banking efficiency and competition (Cetorelli and Strahan, 2006) and by financial development (Guiso et al., 2004). Relative to these studies, we focus on the relationship structure of the credit sector and stress the core feature of relationship lending, banks' continuous accumulation and reuse of information in the credit market. We find that, through these channels, relationship lending is a driver of the intensity of entry and of its de novo or spinoff mode. This also uncovers novel mechanisms whereby relationship lending can affect aggregate investment and output, including the reallocation of credit from de novo to spinoff entrants, to which banks can transfer information previously accumulated. Clearly, relationship lending and information channels are consistent with, and can complement,

[7] In additional empirical tests, we find that this is also true in the data.

the mechanisms investigated by prior studies.

More broadly, in this first strand of literature the paper also relates to a recent body of studies on the structural determinants of firm entry and its macroeconomic implications. Using Census microdata from the United States, Pugsley, Sedlacek and Sterk (2021) find a prominent role for ex-ante firm heterogeneity (as opposed to ex-post shocks) in explaining firms' survival after entry, as well as firms' growth and exit. In a structural model of firm dynamics, they also show that ex-ante heterogeneity strongly affects the impact of firm-level frictions (e.g., financial frictions) on the aggregate economy. Mahone (2021) studies empirically and theoretically the impact of secondary markets on firm entry dynamics. After documenting the presence of significant frictions in the resale operations in the United States, he estimates a structural search and matching model of business ownership and resale. The estimated model highlights the quantitative importance of secondary markets and a trade-off between business entry and continuation: disappearance of the secondary market would lead to a sizable increase in firm entry but a sharp decline in output.

The second strand of related literature examines theoretically and empirically the effects of relationship banking on the real sector (see, e.g., Degryse et al., 2009, and Braggion and Ongena, 2019, for empirical works; and Hachem, 2021, 2011, Boualam, 2020, Howes, 2022, and den Haan et al., 2003, for theoretical studies). In Diamond and Rajan (2001a), relationship banks acquire information on firm-specific assets, while in Boot and Thakor (2000) they accumulate information on firms' sector of activity. Drexler and Schoar (2014) and Uzzi and Lancaster (2003) find that firms' owners and managers develop personal ties with loan officers. Studies in this literature focus on the implications of relationship banking for incumbent firms' investment and output (Alessandrini et al., 2010; Giannetti and Ongena, 2012; Sette and Gobbi, 2015).

Finally, the paper also relates to an extensive literature on the production and reuse of information in credit markets, and, more broadly, in labor and product markets (Goodfriend and McCallum, 2007; Burks et al., 2015; Cingano and Rosolia, 2012; Guiso and Schivardi, 2007, 2011; Michelacci and Silva, 2007). The production of information in credit relationships has been shown to drive the allocation of credit across incumbent firms, sectors, and regions (see, e.g., De Jonghe et al., 2020; Hachem, 2021). We discuss these underpinnings below.

Theoretical and empirical underpinnings We consider two information channels in the credit market. "Embedded" information flows consist of knowledge that banks have accumu-

lated on managers and employees of incumbent firms and that banks can reuse when managers found spinoffs (Drexler and Schoar, 2014; Uzzi and Lancaster, 2003). We can also interpret this as managers' relational capital.

"Non-embedded" information spillovers, on the other hand, capture mechanisms through which information accumulated by banks on characteristics of incumbents, their sector and their local economy is transferable to entrants or crowds out information acquisition on entrants. On the positive side, information accumulated on incumbents' sector and local economy can be exploited when financing entrants. In Boot and Thakor (2000) relationship banks acquire information not only on specific assets of the firm but also on its sector (see also De Jonghe et al., 2020). On the negative side, the information acquisition effort of relationship banks can crowd out their incentive and ability to acquire information on entrants. In a context without firm entry, Hachem (2021) studies how the information acquisition effort of banks "crowds out" their ability to finance new borrowers because of a "rivalry" between matching and screening. In Michelacci and Suarez (2004), financiers (e.g., venture capitalists or banks) allocate scarce monitoring experience between young businesses not yet publicly listed and potential startups. Banks may also conceal information from potential entrants to preserve the position of incumbents with which they established relationships (Bhattacharya and Chiesa, 1995).

3 Empirical Motivation

This section presents the setting, the data and empirical methodology, and the empirical results.

3.1 Institutional setting

Italy is an ideal setting to investigate the role of credit relationships in firm entry dynamics. Banks dominate the financial system, while the stock market has relatively low capitalization. The banking sector is segmented across provinces, geographical units similar to U.S. counties, and it is traditionally difficult to borrow outside the local (provincial) market (Guiso et al., 2003, 2004). Alessandrini et al. (2010) document that distance matters in the Italian credit sector and firms borrow predominantly from banks located in their own provinces (see also Alessandrini et al., 2009, and Bofondi and Gobbi, 2006).

Provinces feature pronounced heterogeneity in the intensity of credit relationships (see Appendix Figure 1). This mostly stems from the banking regulation which was in place from 1936 to the 1990s, freezing the structure of provincial markets for several decades (see Herrera and Minetti, 2007, Guiso et al., 2004, and the discussion in Section 3.3). Herrera and Minetti (2007) and Minetti (2011), for example, show that the 1936 regulation had a strong impact on the length and stability of credit relationships. The constrictiveness of the regulation can have affected the local intensity of credit relationships through its impact on the fluidity of the credit market (firms' opportunities to switch banks) and its effects on the types of banks operating in the provinces. Provinces differ in the importance of local banks relative to banks with a national scope and this mostly reflects the impact of the 1936 regulation (Guiso et al., 2004). Local banks are inclined to establish long-term credit relationships which entail personal ties between loan officers and firm managers (Guiso et al., 2003). Banks with a national scope, instead, tend to resort to transactional lending technologies based on hard (codified) information about firms. Ferri et al. (2014), Fiordelisi and Mare (2014) and Becchetti et al. (2016) find that local banks have a stronger tendency than national banks to engage in personal, long-term credit relationships in the Italian credit market.

Besides exhibiting heterogeneity in the intensity of credit relationships, Italian provinces also feature variation in the dynamics (intensity and modes) of firm entry. As documented by King (2015) and by the Italian National Institute of Statistics (ISTAT, 2017), for example, Italian provinces are highly heterogeneous in terms of firms' entry dynamics, with pronounced differences not only across macro-areas (North, Center and South) but also within macro-areas. This heterogeneity is evident from our data, as shown in Appendix Figure 1 and as discussed below.

3.2 Data and measurement

Data sources Our main data sources are the "Indagine sulle Imprese Manifatturiere", a survey carried out by a major Italian banking group, Capitalia; the Register of Firms of the Italian Chambers of Commerce; the Orbis database of Bureau van Dijk; and the "Startup Survey", the first national survey on startups based in Italy conducted by the Italian Ministry of Economic Development. We also use data of the Italian National Institute of Statistics (ISTAT) on institutional and economic characteristics of the provinces; Bank of Italy data on the structure of provincial banking sectors; and prior studies (detailed below) on industry-level measures of asset

and investment specificity and human capital intensity.

Information on credit relationships is drawn from four waves of the Capitalia survey, each covering three-year periods (1995-1997, 1998-2000, 2001-2003, and 2004-2006). The survey, which targets manufacturers within Italy, includes a representative sample of manufacturing firms with 10–500 employees (94% of the sample) and the universe of manufacturers with more than 500 employees. Between 4,500 and 5,000 firms were interviewed in each wave, for a total of 18,333 observations. The firms represent almost 15% of the population in terms of employees and value added. Collected data include balance sheets, relationships with banks, and types of information accumulated by banks.[8] The fact that the Capitalia survey leaves out micro-enterprises with less than 10 employees, plausibly the youngest ones at early stages, is not a source of concern for the purposes for which we use this survey, that is, measuring the intensity of relationships between banks and incumbents and the nature of the information accumulated by banks on incumbents.

Information on the intensity of firm entry is drawn predominantly from the Register of Firms, which lists the total number of newly registered firms (entrants) and the total number of incumbent firms in a province, sector and year. We also construct alternative indicators of the intensity of entry using Orbis data. In all cases, we focus on manufacturers.

To study firms' mode of entry (de novo or spinoff), we rely on the survey on startups. This was administered in 2016 and investigated a representative sample of startups that were conceived during the previous decade (from the mid-2000s). The questionnaire was filled in by 2,250 firms that obtained the formal registration at the Chambers of Commerce between 2010 and 2015.

Local intensity of relationship banking To measure the intensity of relationship banking in a province, we 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 (see Appendix Table 1 for all definitions). These indicators are based on questions in each Capitalia survey wave that ask every firm the number of years it has been doing business with its main bank; and the number of banks from which the firm borrows. The length of the main credit relationship is often used to measure the information accumulated by the main bank (Ongena and Smith, 2001); multiple credit relationships can instead dilute the main relationship (Degryse et al., 2009).

[8] We double-checked the representativeness of the Capitalia survey by comparing its distributions of manufacturing firms along a number of firm characteristics with the corresponding distributions in Census data. As detailed in Appendix A, the distributions are very similar in the survey and in the Census.

As shown in Appendix Table 2, over the 1995-2006 period spanned by the Capitalia survey waves, the average length of credit relationships in a province is slightly above 17 years and the mean number of banks of a firm in a province is 5. There is variation both across provinces and over time, though the intertemporal variation is significantly less pronounced than the cross-sectional variation: the mean length of credit relationships ranges between 16.8 years and 18.4 years across survey waves; the mean number of banks ranges between 4.8 and 5.9. Looking at the cross-sectional distribution, relationship lending is pervasive in some northern provinces, especially in the regions of Veneto, Emilia Romagna and Trentino, while it is weaker in some southern provinces (Appendix Figure 1). Yet, there is also pronounced heterogeneity within geographical areas. Taking the mean across survey waves, in the northern provinces of Verona, Bologna, and Imperia, for example, the average length is 18.9, 15.9, and 14.7 years, respectively. In the southern ones of Foggia, Caltanissetta, and Bari it is 16.5, 14.2, and 12.5 years. The mean number of banks is 6 and 3.6 in the northern provinces of Genoa and Belluno while it is 6.9 and 4.1 in the southern ones of Caltanissetta and Brindisi. Overall, the cross-sectional, within-survey standard deviation of the credit relationship length is between 12.1 and 12.5 across survey waves, and the coefficient of variation (standard deviation normalized by the survey mean) is between 65% and 75%.

We can perform a comparison with other countries. In surveys on European firms, the average number of banks is as low as 3.6 in Finland and as high as 7.4 in Greece, while the average length of credit relationships is 18.1 years in Norway, 15.5 in Denmark, and 11.7 in Belgium (Ongena and Smith, 2001; de Bodt et al., 1999). In the 2010 EFIGE survey, the average length ranges from 22.7 years in Germany (2.7 banks per firm) to 13.6 in Spain and 8.9 in Hungary (4.4 and 1.8 banks).

Entry intensity and mode To capture the intensity of entry in a province and (two digit ATECO) manufacturing sector, we use the Register of Firms. We compute the ratio of newly registered firms in the province and sector in a year over the incumbent firms in the province and sector.[9] In the 1995-2006 period, on average, the ratio of entrant to incumbent firms equals 4.99% (Appendix Table 2). In an average year, it ranges from 2% in some provinces to 10% in others. In robustness analysis, using Orbis data, we also consider the share of firms in a province and sector with no more than two years of activity. Due to data availability, when using this proxy we consider entrants in 2004-2006, the time frame of the last Capitalia wave.

[9] Appendix A presents estimation results obtained scaling newly registered firms by the provincial population.

We also study whether firms are founded by new entrepreneurs (de novo entrants) or are spinoffs. The Capitalia survey asks each firm if during the years covered by the survey a spinoff was created from the firm. We then construct the probability of a spinoff as an indicator variable that takes the value of one if a firm responds affirmatively to this question, zero otherwise. Using the survey on startups, we also compute the share of entrants in a province and sector that are founded by former employees of firms operating in the same sector. Following Andersson and Klepper (2013), we identify a spinoff as an entrant in which the majority of owners/managers previously worked for a firm of the same sector. This information refers to startups that were conceived from the mid-2000s and were formally registered in the 2010-2015 period. On average, 28.3% of entrants consist of spinoffs.[10]

3.3 Empirical methodology

The baseline empirical model To test the link between the intensity of relationship banking and the dynamics of entry in the Italian local credit markets, we first estimate the following baseline empirical model:

$$FirmEntry_{ijt} = \alpha_1 + \alpha_2 Relation_{it} + \alpha_3^{\intercal}\mathbf{Z}_i + \alpha_4^{\intercal}\mathbf{C}_{it} + \gamma_j + \gamma_t + \varepsilon_{ijt}. \quad (1)$$

In equation (1), $FirmEntry_{ijt}$ is the measure of entry of firms in province i, sector j, period t. Periods are three-year windows based on the survey waves, and we take the average entry over the years of each wave. $Relation_{it}$ is the measure of local intensity of credit relationships in province i and period t;[11] Z_i is a vector of time-invariant province-level controls measured in the year 2001, the sample mid-point, as well as macro-area (North and Center) dummies; and C_{it} is a vector of time-varying province-level controls. We insert a broad range of controls that may explain entry. We include the unemployment rate to capture local economic and labor market conditions, the population growth rate of the province, the average firm age in the province, proxies for material

[10]The survey on startups does not link spinoffs to the firms from which they originated. Thus, we cannot track spinoffs to the relationships between banks and parent companies.

[11]In the baseline regressions, we do not exploit variation of the intensity of credit relationships across sectors. However, in Appendix A we also show robustness to a test that considers $Relation_{ijt}$ in place of $Relation_{it}$ (see Appendix Table A4). In the data most of the variation of the intensity of credit relationships is geographical (across provinces), especially due to the heterogenous tightness of the 1936 banking regulation. And, indeed, the literature tends to focus on geographical variation of credit relationships, while there is less evidence of variation across industries. Finally, in our data computing the intensity of credit relationships in survey wave-province-two digit sector cells would lead some cells to be quite sparse.

infrastructures, the trade openness, detailed proxies for local banking concentration and market power (the Herfindhal index of bank branches, the loan shares of the largest bank and the three largest banks in the province, and the Lerner Index), a measure of local financial development (branches over population), and a measure of judicial efficiency. Material infrastructures, trade openness, and judicial efficiency are slow-moving variables and are measured at the sample mid-point (2001). Unemployment, firm age, population growth, financial development, and banking concentration are computed as the average over the time frame of each Capitalia wave.

We saturate the regressions with a full set of sector fixed effects (γ_j) and time (survey wave) fixed effects (γ_t). In a tighter specification, we drop time-invariant provincial controls and macro-area dummies and insert province fixed effects (γ_i). ε_{ijt} denotes the error term.

Instruments 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 controls and fixed effects. Nevertheless, there remains the possibility that, in a local credit market, the intensity of credit 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 variables (IV) approach, exploiting 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 to enhance bank stability. The Banking Law imposed strict limits on the ability of different types of banks to open new branches. Specifically, while national banks could open branches only in the main cities, local cooperative and savings banks could expand within the boundaries of the province or region where they operated in 1936, and hence were less constrained by the regulation than national banks. Thus, 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 province in 1936.[12] Guiso, Sapienza and Zingales (2003, 2004) demonstrate that the regulation deeply affected local credit markets (creation and location of new branches) in the following decades. From 1936 to 1985, the number of bank branches grew by 87% versus 1228% in the United States. By contrast, from the end of the 1980s to the late 1990s, that is, after the deregulation, it grew by about 80%, almost double that of the United States.

[12] A region comprises multiple provinces.

The variation in the constrictiveness of regulation across provinces can be safely considered exogenous. As discussed by Guiso, Sapienza and Zingales (2003, 2004), in 1936 the distribution of types of banks across provinces, and hence the constrictiveness of regulation in a province, did not reflect market forces but the interaction between previous waves of bank creation and the history of Italian unification.[13] Moreover, the regulation was not designed with the needs of the provinces in mind. In fact, the differences in the restrictions on the various types of banks were related to differences in banks' ties with the Fascist regime. Provincial banking markets were liberalized during the 1990s, following the introduction of directives of the European Union.

In practice, following Guiso et al. (2003, 2004) and Herrera and Minetti (2007), our instruments for the intensity of credit relationships consist of provincial data on the number of savings banks in 1936 (per 100,000 inhabitants) and the number of new branches opened by incumbent banks (per 100,000 inhabitants) during the deregulation period (1991-1998). As noted, savings banks were less constrained by the regulation than national banks and hence are used by Guiso et al. (2003, 2004) to capture the constrictiveness of regulation. As observed by Herrera and Minetti (2007), besides this indicator, another variable that is likely to reflect the constrictiveness of the regulation is the (average annual) number of new branches created in a province by incumbent banks in the years immediately after the deregulation (per 100,000 inhabitants): the higher the constrictiveness of the regulation in a province, the higher the observed flow of new branches in the province during the deregulation. We expect that the 1936 regulation had a long-lasting impact on banks' ability and incentive to engage in long-term credit relationships with firms, due to its twofold effect on the credit market fluidity: its effect on banks' ability to open new branches (and hence on firms' opportunities to switch banks) and its effect on the types of banks able to open new branches in the provinces (and hence on firms' propensity to switch banks). For example, local banks, including savings banks, are traditionally inclined to establish long-term credit relationships which entail personal ties between loan officers and firm managers (Guiso et al., 2003; Ferri et al., 2014). Banks with a national scope, instead, generally resort to transactional lending technologies. Thus, the regulation locked in geographic heterogeneity in the intensity of relationship lending due to different exogenous propensities of different types of banks to establish long-term credit relationships. Studying the effect of credit relationships on incumbent firms in

[13] Appendix Figure 2 shows the presence of savings banks and national banks in Italian provinces in 1936.

Italy, Herrera and Minetti (2007) and Minetti (2011) instrument the length of credit relationships and the number of banks with analogous indicators of the 1936 banking regulation.

Let $\mathbf{Ip}_i$ be the vector of instruments that are correlated with the local intensity of credit relationships in the province but affect firm entry only through the banking channel. The effect of these instruments on $Relation_{it}$ is captured by β_3 in the local banking equation

$$Relation_{it} = \beta_1^{\intercal}\mathbf{Z}_i + \beta_2^{\intercal}\mathbf{C}_{it} + \gamma_t + \beta_3^{\intercal}\mathbf{Ip}_i + u_{it}, \tag{2}$$

where $\mathbf{Z}_i$ and $\mathbf{C}_{it}$ refer to the controls in the second stage equation, and u_{it} is the error term.

The augmented empirical model After testing the effects of the local intensity of credit relationships on firm entry, we study the role of banks' information in the effects. This can further confirm that the results are driven by information-based relationship banking. Let $Information_j$ be a proxy for an information channel in sector j. The augmented empirical model reads

$$FirmEntry_{ijt} = \alpha_1 + Relation_{it} \times (\alpha_2 + \alpha_3 Information_j) + \alpha_4^{\intercal}\mathbf{Z}_i + \alpha_5^{\intercal}\mathbf{C}_{it} + \gamma_j + \gamma_t + \varepsilon_{ijt}. \tag{3}$$

The proxies for banks' information types are discussed in Section 3.5.

3.4 Main estimates

Relationship banking and the intensity of firm entry In Table 1 we regress firms' entry rate in a province and sector on the average length of credit relationships in the province (the results are fully robust to using the number of banks as an inverse indicator of the local intensity of relationship lending, as shown in Table 2).[14] The estimates from a parsimonious OLS specification without controls and fixed effects (column 1) reveal that in provinces where credit relationships are tighter firms' entry rate is lower.[15] This result is robust to the addition of sector and time fixed effects and macro-area dummies (column 2). It is also virtually unaltered when, as in column 3, we further include provincial characteristics and, as in column 4, we insert additional measures of banking concentration and market power in the province (share of the largest bank in the province,

[14] We cluster standard errors by industry to account for possible error correlation within industries. In Appendix A we show that the results are robust to alternative clustering approaches (see Appendix Table A4).

[15] The R-squared in column 1 is low. In unreported regressions similar to that in column 1, we obtained that when regressing entry on other covariates in isolation, the R-squared also takes low values. This suggests that multiple factors are needed to explain variation in firm entry. Later in the analysis, we will see that the explanatory power of the average length of credit relationships in isolation grows significantly when augmenting the empirical model with indicators for banks' information.

Table 1: Credit relationships and firm entry

VARIABLES	(1) Entrants/ Incumbents OLS	(2) Entrants/ Incumbents OLS	(3) Entrants/ Incumbents OLS	(4) Entrants/ Incumbents OLS	(5) Entrants/ Incumbents OLS	(6) Entrants/ Incumbents 2SLS
Relationship length	-0.047***	-0.033***	-0.036***	-0.037***	-0.047***	-0.649***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.137)
+ controls	N	N	Y	Y	Y	Y
+ additional controls for bank concentration	N	N	N	Y	N	N
Area fixed effects	N	Y	Y	Y	N	Y
Provincial fixed effects	N	N	N	N	Y	N
Time and Industry fixed effects	N	Y	Y	Y	Y	Y
Observations	9,384	9,384	9,292	9,292	9,384	9,292
R-squared	0.001	0.142	0.158	0.159	0.264	0.047
F instruments						37.38
Overid p value						0.003

Notes: This table reports the effects of the average length of credit relationships in a province on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. The average relationship length is expressed in years; the dependent variable is expressed in percentage points. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. The main set of controls includes: unemployment rate, population growth, bank branches HHI, Branches/population, average firms' age, trade openess, material infrastructure and judicial efficiency. Column (4) also includes two additional controls for bank concentration: the share of the top bank and the index of bank market power. Regressions (2)-(6) include geographical area, time and industry fixed effects. In columns (2)-(4) and (6), geographical fixed effects are macro-area dummies; in column (5), they are provincial dummies (and time-invariant controls are dropped). In column (6) the provincial average length of credit relationships is instrumented using the number of provincial saving bank branches in 1936 and the number of new branches by incumbent banks in the 1991-1998 period (per 100,000 inhabitants). See Appendix Table 1 and Section 3.3 for details on the control variables. The table also reports F-tests on excluded instruments and p-values for overidentification tests. *Significant at 10%; ** significant at 5%; *** significant at 1%.

and the Lerner Index).[16,17] The result is also confirmed when we drop time-invariant province-level controls and macro-area dummies in favor of province fixed effects (column 5). Finally, the estimates are robust to using an IV approach (column 6). 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 for weak instruments).[18] The second stage confirms the OLS estimates.

Looking at the magnitude of the effects, the estimated coefficient on $Relation_{it}$ in the OLS regressions of columns 4-5, for example, suggests that credit relationships longer by 1 year (about 5% of the average relationship length) imply a ratio of entrants to incumbents 0.037-0.047 percentage points lower (about 1% of the average entry rate in a year). The estimated coefficient in the

[16]The coefficient estimates on the controls are in line with expectations (see Appendix Table 3). Higher unemployment is associated with higher entry, suggesting that self-employment and entrepreneurship substitute for employment. Population growth promotes entry. Somewhat surprisingly, material infrastructures drive down entry.

[17]Including also the share of the three largest banks in the province leaves the results unaltered (Appendix Table 4). The Lerner index is at the regional level (a region comprises one or multiple provinces). Observe that in the regressions of columns 1-4, we do not insert province fixed effects so as not to take out permanent differences in entry. These permanent differences are a focus of our analysis (as noted, the data show that most of the variation is cross-sectional rather than intertemporal).

[18]The signs of the estimated coefficients on the instruments are in line with expectations. For example, provinces with a higher presence of savings banks in 1936 exhibited a larger growth of local bank branches. Local banks are more inclined to establish long-term credit relationships with firms.

2SLS regression of column 6 implies that credit relationships longer by 1 year lead to about a 0.6 percentage points lower ratio of entrants to incumbents.[19] We will further discuss the magnitude of these effects when comparing them with the quantitative predictions of the theoretical model.

Robustness tests Table 2 shows robustness tests (see Panel A for the OLS estimates and Panel B for the 2SLS estimates). In columns 1-2, we measure entry with the share of firms with no more than two years of activity (Orbis data, column 1) and with the probability that a spinoff is created from a firm (column 2). We find again a negative impact of the local intensity of relationship lending on entry. Columns 3-4 show that the results carry through when using alternative measures of the local intensity of relationship lending, namely, as an inverse measure, the average number of banks funding a firm in the province and the share of firms in the province with relationship length above 10 years. Further, column 5 shows that the results are robust to winsorizing observations at the 1% tail of the relationship length distribution (the results obtained by trimming the data are similar). In the Appendix we also verify that the results continue to hold when we scale the number of entrant firms by the provincial population (see Appendix Table 4).

Relationship banking, mode of entry, and size at entry In Table 3, Panel A, we study the link between local intensity of credit relationships and entry mode. The results in column 1 show that the intensity of credit relationships in the province is positively associated with the spinoff rate (ratio of spinoffs to total entrants).[20] This result is robust to defining spinoffs as entrants in which all owners/managers (rather than their majority) previously worked for a firm of the same sector (column 2). The estimated coefficient in column 1 suggests that a 1-year increase in the average credit relationship length (about 5% of the average relationship length) is associated with a 0.7 percentage points increase in the spinoff rate (about 2.5% of the average spinoff rate).

In Table 3, Panel B, we consider the impact of credit relationship intensity on entrants' size, using information in the survey on startups. We estimate firm-level regressions replacing the

[19] Given the complex interplay of possible omitted factors and reverse causality forces, a priori it is not obvious whether one might be concerned about a downward or an upward bias of the OLS estimate. In our context, the IV coefficient estimate is significantly larger than the OLS estimate, similar to what is frequently observed in empirical studies. Jiang (2017), for example, reviews 255 empirical studies on credit and financial markets, and shows that on average IV coefficient estimates are 18 times larger than OLS estimates and more than 9 times larger even if one winsorizes (at 1%) the most extreme studies. As noted by Jiang (2017), the IV coefficient estimates could produce an effect larger than the population average treatment effect for legitimate econometric reasons due to the fact that they are uncovering a "local average treatment effect", even when they fully satisfy the exclusion restriction.

[20] As the data on entry modes refer to startups conceived from the mid-2000s and registered in 2010-2015, in Table 3 the average length of credit relationships is from the last Capitalia survey wave.

Table 2: Credit relationships and firm entry. Robustness checks

	Panel A: OLS estimations				
	(1)	(2)	(3)	(4)	(5)
	Alternative entry measures		Alternative independent variables		Winsorizing relationship length
VARIABLES	Share of firms with ≤ 2yrs (Orbis)	Firm spin-off probability	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents
Relationship length	-0.207***	-0.003*			-0.041***
	(0.067)	(0.002)			(0.008)
Relationship length (over 10 y.)			-1.095***		
			(0.361)		
Number of banks				0.343***	
				(0.052)	
+ controls	Y	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y	Y
Time fixed effects	N	Y	Y	Y	Y
Observations	2,688	11,372	9,292	9,315	9,292
R-squared	0.120	0.043	0.159	0.162	0.569
	Panel B: 2SLS estimations				
VARIABLES	Share of firms with ≤ 2yrs (Orbis)	Firm spin-off probability	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents
Relationship length	-0.408	-0.014			-0.647***
	(0.914)	(0.012)			(0.126)
Relationship length (over 10 y.)			-4.865***		
			(2.413)		
Number of banks				1.965***	
				(0.367)	
+ controls	Y	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y	Y
Time fixed effects	N	Y	Y	Y	Y
Observations	2,688	11,399	9,292	9,315	9,292
F instruments	141.2	1.052	71.53	95.38	49.88
Overid p value	0.043	0.964	0.001	0.111	0.105

Notes: This table reports robustness checks for the effects of credit relationships on firm entry dynamics. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, as well as area and industry fixed effects. Regressions (2)-(5) also include time fixed effects (column 1 is a cross-sectional regression using the Orbis dataset). In Panel B our proxy for credit relationship intensity is instrumented using the number of provincial saving bank branches in 1936 and the number of new branches by incumbent banks in the 1991-1998 period (per 100,000 inhabitants). See Appendix Table 1 and Section 3.3 for details on the control variables. The table also reports F-tests on excluded instruments and p-values for overidentification tests. * Significant at 10%; ** significant at 5%; *** significant at 1%.

dependent variable in (1) with the firm's number of employees at entry.[21] The estimates reveal that entrants are larger in local markets where credit relationships are more intense. Interestingly, although the sign patterns are confirmed, the coefficients are estimated less precisely for the size at entry of de novo entrants than for that of spinoff entrants.

Relationship banking, credit to entrants, and other outcomes In the tests of Tables 1-3, we have focused on the effects of the local intensity of credit relationships on the intensity and modes of firm entry. In Table 4, we extend the analysis and reestimate our baseline specifications

[21]The regressions in Panel B of Table 3 are estimated at the firm level. Observe, instead, that the information on the entry rate and the spinoff rate used in previous regressions is at the province-sector level.

Table 3: Credit relationships, entry modes, and size at entry

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

Notes: This table reports the effects of the average length of credit relationships in the province on the mode of entry (ratio of spin-off on the number of new firms) and the size at entry. The average relationship length is expressed in years; in Panel A, the spin-off ratio is on a scale 0 to 1. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables and area dummies. Regressions in columns (3)-(7) include also industry fixed effects. The data for the dependent variables of the regressions of this table come from the "Rilevazione sul sistema delle Start-up innovative". See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

by considering the impact of the local intensity of credit relationships on related outcomes on which the theoretical model will yield predictions.

Exploiting data from the Orbis database, in Panel A of Table 4 we consider the credit extended to entrant firms.[22] The dependent variable in column 1 consists of the share of entrant firms that receive a positive (non-negligible) amount of credit in a province and sector, while in column 2 the dependent variable is the average credit extended to an individual entrant firm in a province and sector. The estimated coefficient in column 1 is negative, though not statistically significant, suggesting that the average credit relationship length does not boost, and could actually reduce, entrants' credit market participation. When considering instead the intensive margin of credit in column 2, we estimate a positive effect of the average length of credit relationships on the mean amount of credit granted to an entrant. This is in line with the finding of a positive effect of the average credit relationship length on the average size of firms at entry.[23]

In Panel B of Table 4, we reestimate our baseline specifications by considering the impact of the local intensity of credit relationships on firms' exit rate (number of firms that exit from a province and sector in a year over the incumbent firms in the province and sector). The estimates reveal that a stronger local relationship intensity reduces firms' rate of exit in a significant manner.

Finally, in Panel C of Table 4, we consider the impact of the local intensity of credit relationships

[22] As noted, due to data availability, the Orbis data we use are cross-sectional.

[23] In untabulated tests, we also detect a significantly positive effect of the average credit relationship length on the (log of) total credit extended to incumbent firms and on the average credit to an incumbent.

Table 4: Credit relationships, credit to entrants, and other outcomes

VARIABLES	*Panel A: Credit to entrants*		*Panel B: Exit*	*Panel C: Value added*		
	(1) Share of entrants obtaining credit	(2) Average credit to an entrant	(3) Exiters/ Incumbents	(4) Total value added (log) (All)	(5) Total value added (log) (Incumbents)	(6) Total value added (log) (Entrants)
Relationship length	-0.001	0.005*	-0.001**	0.026***	0.026***	0.008***
	(0.003)	(0.003)	(0.000)	(0.008)	(0.008)	(0.003)
+ controls	Y	Y	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y	Y	Y
Time fixed effects	N	N	Y	N	N	N
Observations	1,411	1,410	9,292	1,530	1,530	1,530
R-squared	0.152	0.131	0.569	0.456	0.459	0.280

Notes: This table reports the effects of the average length of credit relationships in the province on the credit extended to entrants and on other outcomes. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables and area and industry fixed effects. Regression (3) also includes time fixed effects. The data for the dependent variables of regressions (1)-(2) and (4)-(6) come from the Orbis database; the data for the dependent variable of column (3) come from the Register of the Italian Chambers of Commerce. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

on measures of entrants' and incumbents' value added. We will comment extensively on these estimates later in the analysis (Section 5.3).

3.5 Unbundling the effect of credit relationships

In Tables 1-3, we have found that the local intensity of credit relationships is negatively associated with entry and positively associated with the share of spinoffs among entrants. Credit relationships are a major repository of information accumulated by banks on incumbents' technology and assets, on their sector and local economy, and on their managers and employees (Degryse et al., 2009). This information can be reused when financing entrants or can crowd out information acquisition on entrants. To examine the role of these channels in our results, we exploit data in the Capitalia survey on the information generally accumulated by banks and on the specificity or reusability of this information in the financing of entrants. We complement these data with sectoral measures of information specificity from prior studies.

Bank information types The last Capitalia survey wave asks each firm precise questions on the type of information generally accumulated by banks in credit relationships and on the reuse of this information in the credit market. We can construct five indicators of bank information types.

The first three indicators capture incumbent-specific information of banks that, as stressed by the survey, is not transferable to entrants and, if anything, can crowd out effort and resources of

loan officers in screening entrants. The first is a dummy equal to one if the main bank heavily relies on specific, soft information on the firm and its clients that is obtained through loan officers' contacts with the firm. The second is a dummy equal to one if the bank relies on information specific to the firm's assets.[24] In 27% of the cases, banks focus on at least one of these information types. The third is a dummy equal to one if the bank collects specific information on the firm's innovation capacity. Banks acquiring this information (17% of the cases) are keen to preserve the incumbent's leadership and discourage entry (Bhattacharya and Chiesa, 1995; Yosha, 1995).[25]

The remaining two indicators capture instead bank information that is reusable in the financing of entrants. In particular, the fourth indicator is a dummy equal to one if the bank intensely collects information on the incumbent's sector and local economy (20% of cases). The fifth indicator is a dummy equal to one if the bank intensely collects information about managers. This information is "embedded" in firms' managers and reusable by banks when managers found spinoffs (Drexler and Schoar, 2014; Uzzi and Lancaster, 2003). The incidence of this type of information is slightly more than 30%. In each case, to measure the importance of a type of information in a sector, we compute the average of the variable across the firms in the sector.

Appendix Table 5 reports the pairwise correlations among the information indicators. In line with expectations, the indicators exhibit some correlation, but the correlation coefficients are not disproportionately high. This suggests that the surveyed firms discriminate among the various information types when responding to the survey questions. For example, the correlation of the first indicator (specific information on the firm and its clients) with the third indicator (specific information on the firm's innovation capacity) equals 0.34, while its correlation with the second indicator (specific information on the firm's assets) equals 0.21.[26]

Tables 5A-5B show the estimates of the augmented model in (3). The estimates reveal that, when banks' information is specific to incumbents and their assets, stronger local credit relationships are more likely to depress entry (first two information indicators; Table 5A, columns 1-2, and

[24]The question from which we construct this second indicator was asked in multiple survey waves, so we will estimate regressions using a larger number of observations. Inspection of the survey responses does not reveal a noticeable change in firms' responses to this question in the survey wave in which the questions referring to other indicators were introduced.

[25]In Bhattacharya and Chiesa (1995) and Yosha (1995), firms engage in R&D projects and innovative technologies. As part of their financing process, banks learn information about firms' R&D results at interim stages. Banks with a tighter relationship with an incumbent innovator can have less incentives to disclose this information to rival firms to which they also provide financing.

[26]Inspection of a matrix of conditional frequencies also confirms the informativeness of the indicators.

Table 5A: Credit relationships, bank information, and entry

VARIABLES	(1) Entrants/ Incumbents	(2) Entrants/ Incumbents	(3) Entrants/ Incumbents	(4) Entrants/ Incumbents	(5) Entrants/ Incumbents
Relationship length	0.021*	0.102**	0.135**	0.015	-0.001
	(0.011)	(0.048)	(0.053)	(0.031)	(0.018)
Information specific to incumbents					
Rel length * Information specific	-0.114*				
to incumbent firm	(0.067)				
Rel length * Information specific		-0.507***			
to incumbent firm assets		(0.174)			
Rel length * Information specific			-0.611*		
to incumbent firm innovation			(0.304)		
Information reusable for de novo or spinoff entrants					
Rel length * Information on				0.010	
sector and local economy				(0.182)	
Rel length * Information on managers					0.188*
(embedded information)					(0.106)
+ controls	Y	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y	Y
Time fixed effects	N	Y	N	N	N
Observations	2,121	8,484	2,121	2,121	2,121
R-squared	0.313	0.158	0.288	0.313	0.288

Notes: This table reports the effects of information channels (bank information types) from credit relationships on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. The regressions in columns (1) and (3)-(5) refer to the years 2004-2006 for which the indicator for information channels are available. See Section 3.5 for the description of all the information channels and Appendix Table 1 for a detailed definition of information channel variables. All the columns report the OLS estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, area and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5B: Credit relationships, bank information, and entry (ctd.)

VARIABLES	(1) Firm spin-off probability	(2) Firm spin-off probability	(3) Ratio Spin-offs/ All entrants	(4) Ratio Spin-offs/ All entrants
Relationship length	0.009	-0.010	0.005*	-0.002
	(0.007)	(0.008)	(0.003)	(0.004)
Information specific to incumbents				
Rel length * Information specific	-0.279**		-0.160***	
to incumbent firm	(0.138)		(0.056)	
Information reusable for de novo or spinoff entrants				
Rel length * Information on managers		0.116*		0.017
(embedded information)		(0.064)		(0.014)
+ controls	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y
Observations	1,693	1,693	252	252
R-squared	0.038	0.039	0.125	0.107

Notes: This table reports the effects of information channels (bank information types) from credit relationships on the firm spin-off probability (columns 1-2) and on the ratio between spin-offs and new firm entries in the province (columns 3-4). In columns (1)-(2), firm spin-off probability is from the Capitalia survey. In columns (3)-(4) the ratio spin-offs (all owners)/all entrants is from the "Rilevazione sul sistema delle Start-up innovative" (like in Table 3). See Section 3.5 for the description of all the information channels and Appendix Table 1 for a detailed definition of information channel variables. All the columns report the OLS estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, area and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5B, column 1).[27] They are also more likely to depress entry when banks have the incentive to conceal specific information on innovative incumbents from entrants (i.e., the third information indicator; see Table 5A, column 3), especially in sectors where trade secrecy matters (Appendix Table 6). The estimates do not point to an effect of reusable information about the sector or local economy (fourth information indicator; Table 5A, column 4). Overall, we thus find that, when information is specific to incumbents, larger information of relationship banks reinforces the negative impact of relationship lending on firm entry. Moreover, information that is reusable but not "embedded" in managers does not help mitigate the negative impact of relationship lending.

By contrast, when banks collect information on managers that is transferable to spinoffs, relationship lending increases the probability that a spinoff is created from a firm (Table 5B, column 2) and the share of spinoffs among entrants (Table 5B, column 4), although the latter effect is estimated imprecisely.

Industry characteristics In Table 5C, we exploit sectoral indicators of specificity put forward by previous studies. We expect banks' reuse of information in the financing of entrants to be easier when assets and investments are less specific. Moreover, we expect it to be easier when human capital is more relevant, as managers and employees who create spinoffs can exploit information acquired by banks on their human capital. The relevance of human capital in the sector is from Ciccone and Papaioannou (2009). To capture asset specificity (lack of redeployability), as in Guiso and Minetti (2010) and following Shleifer and Vishny (1992), we use the co-movement between the value added of the firm and that of its industry peers (see Appendix A1 for details). Finally, we capture investment specificity with the proportion of specific investments in the sector, as measured by Nunn (2007).

The estimates in Table 5C suggest that a stronger local intensity of credit relationships especially reduces entry in sectors with specific assets and investments (columns 2-3) and lower incidence of human capital (column 1).[28]

[27] We also experimented with running the regression in column 1 of Table 5A without controls and fixed effects, obtaining a value of the R-squared (0.076) significantly larger than that obtained in column 1 of Table 1. This hints at the usefulness of the bank information indicators in explaining variation in firm entry.

[28] Appendix Tables 7A-7B contain refinements of the tests of Table 5C. In line with expectations, we obtain that the attenuating effect of human capital intensity is more pronounced in provinces-sectors in which a larger share of entries consist of spinoffs (for which information on managers' human capital can be more relevant). On the other hand, the magnifying effect of investment and asset specificity is also present in provinces-sectors in which a larger share of entries consist of spinoffs (see Appendix Table 7A). We also experimented with including the triple interactions between the sectoral indicators of investment or asset specificity and the proxies for banks' information

Table 5C: Credit relationships, industry characteristics and entry

VARIABLES	(1) Entrants/ Incumbents	(2) Entrants/ Incumbents	(3) Entrants/ Incumbents
Relationship length	-0.397***	0.005	
	(0.134)	(0.014)	(0.119)
Rel length * Human capital intensity	0.031**		
	(0.011)		
Rel length * Assets specificity		-0.078***	
		(0.025)	
Rel length * Investments specificity			-0.353**
			(0.130)
+ controls	Y	Y	Y
Area, Time and Industry fixed effects	Y	Y	Y
Observations	9,292	9,292	9,292
R-squared	0.159	0.157	0.157

Notes: This table reports the effects of information channels on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. In this table information channels are captured by industry characteristics; see Section 3.5 for the description of all the information channels and Appendix Table 1 for a detailed definition of information channels variables. All the columns report the OLS estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, area, time and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

To summarize, Tables 5A-5C suggest that a stronger local intensity of credit relationships between banks and incumbent firms discourages de novo entry especially when banks' information is specific to incumbents and their assets while it promotes spinoff creation when banks accumulate knowledge on managers that is transferable to spinoffs.

4 The Model Economy

Motivated by the empirical patterns, we study a dynamic general equilibrium model with credit relationships and firm entry. The model can be thought as broadly representing the economy of an Italian province. We investigate whether the model can rationalize the evidence and use it to evaluate the implications for aggregate investment and output.

4.1 Model setup

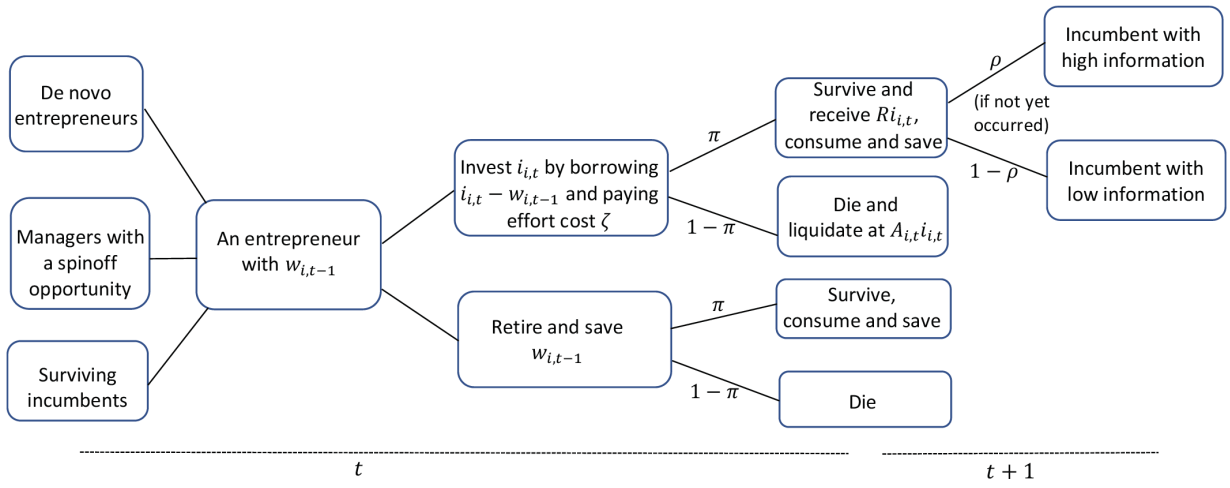
Overview The model belongs to a broad class of studies in which, due to limited pledgeability of investment returns, entrepreneurs face constraints in accessing credit (e.g., Kiyotaki and Moore,

types. The results in Appendix Table 7B suggest that information specificity and investment or asset specificity reinforce each other in amplifying the negative effect of credit relationship intensity on firm entry.

1997; Perri and Quadrini, 2018; Bassetto et al., 2015; Iacoviello, 2015). In line with the evidence, we depart from a setup à la Kiyotaki and Moore (1997) in two main dimensions. The first departure is that we allow for entry of entrepreneurs and, among entrants, distinguish between de novo and spinoff entrants. We focus on endogenous investment differences driven by credit access. Thus, for example, we do not posit exogenous technological differences between de novo and spinoff entrants, such as different productivity or investment costs.

The second departure from a setup à la Kiyotaki and Moore (1997) is that we let the pledgeability (verifiability) of incumbents' and entrants' returns depend on lenders' accumulation and reuse of information in the credit market (see, e.g., Diamond and Rajan, 2001b). In particular, lenders accumulate information in credit relationships and reuse it in financing entrants, affecting their credit access. We formalize this by taking a leaf from a broad macroeconomics literature on knowledge and information spillovers (e.g., Aghion and Jaravel, 2015; Jones, 1995). As we will see, lenders' accumulation of information exerts conflicting effects on the pace and modes of entry.

Figure 1: Timeline



Environment Consider an infinite horizon, discrete time economy ($t = 0, 1, 2...$). There is a final good which can be invested and consumed. The economy is populated by households and entrepreneurs. Households, in turn, comprise workers ("managers") and lenders. Managers can work for entrepreneurs. Lenders can intermediate funds, borrowing final good in a nation-wide or international capital market and lending it to entrepreneurs. We normalize to one the gross interest rate in the capital market.

Entrepreneurs At the beginning of each period t, a unit measure of new entrepreneurs enter the economy. Moreover, each manager who worked for an entrepreneur becomes an entrepreneur (has a spinoff opportunity) with probability σ.[29] Entrepreneurs die at the end of each period with probability $(1-\pi)$.

Figure 1 describes the timing of events. In each period, an entrepreneur (indexed by i) chooses whether to invest or to retire. If she retires, she can save her wealth in the capital market until she dies. If she invests, she needs to sustain a fixed investment effort cost ζ, hire a manager, and choose the investment size $i_{i,t}$. If the entrepreneur survives, her investment yields a gross return $Ri_{i,t}$ $(R > 1)$. If she dies, her investment is liquidated for $A_{i,t}i_{i,t}$, where $A_{i,t}$ captures the liquidation value of the firm's assets and is an *i.i.d.* process across entrepreneurs and time, distributed according to the distribution function G over the support $\left[0, \overline{A}\right]$ (with $\overline{A} < R$).

In case of death, an entrepreneur bequeaths her wealth to entering entrepreneurs, after any repayment obligation. We posit that all bequests are pooled through a mutual fund and that each potential entrant (de novo or spinoff) receives an equal share of all bequests.

Entrepreneurs' lifetime utility function reads

$$U_t = \sum_{j=0}^{\infty} (\beta\pi)^j \left[\pi \log(c_{i,t+j}) - 1_{i,t+j}(invest)\zeta\right], \tag{4}$$

where c denotes consumption. Henceforth, we normalize agents' discount factor β to one.

Lenders and managers There is a large measure of infinitely-lived risk-neutral households, comprising workers ("managers") and lenders.[30] Managers supply services to entrepreneurs in a competitive market. Lenders finance entrepreneurs in the credit market. When entering the economy, a new entrepreneur can establish credit relationships with a set of lenders. Without loss of generality, we consider the case in which an entrepreneur borrows from one of her relationship lenders.

In any period t, an entrepreneur with initial wealth $w_{i,t-1}$ borrows $i_{i,t} - w_{i,t-1}$ to make an investment $i_{i,t}$. The loan contract is stipulated after $A_{i,t}$ is observed and specifies the triple $\left\{i_{i,t} - w_{i,t-1},\ R^L_{i,t},\ d_{i,t}\right\}$, where $R^L_{i,t}$ is the gross interest rate per unit of loan in case of en-

[29] While working for incumbent firms, managers acquire knowledge and experience useful for starting entrepreneurial activities (Klepper and Sleeper, 2005).

[30] We allow the measure of managers to grow over time so that the outflow of managers who become entrepreneurs gets replenished by an inflow of new managers.

trepreneur's survival, and $d_{i,t}$ is the share of total liquidation value accruing to the lender in case of entrepreneur's death. A lender's participation constraint requires that his expected repayment from financing the entrepreneur is no lower than the cost of his funds,

$$\pi R_{i,t}^{L}\left(i_{i,t}-w_{i,t-1}\right)+\left(1-\pi\right)d_{i,t}A_{i,t}i_{i,t}\geq i_{i,t}-w_{i,t-1}. \tag{5}$$

If the investment succeeds, the lender receives $R_{i,t}^{L}\left(i_{i,t}-w_{i,t-1}\right)$. If it is liquidated at $A_{i,t}i_{i,t}$, the lender receives $d_{i,t}A_{i,t}i_{i,t}$. The cost of funds for the lender is $(i_{i,t}-w_{i,t-1})$.

Information and pledgeability In our economy there is limited pledgeability of investment returns. As in prior studies, this can be thought as stemming from limited commitment of entrepreneurs combined with limited capability of lenders to replace them. In particular, as detailed in Appendix C, we can think that the entrepreneur of a firm can threaten to withhold her production or liquidation skills (moral hazard). Lenders, in turn, have limited capability to replace entrepreneurs in case they withhold their production or liquidation skills. As a result, lenders can be forced to renegotiate their repayments downwards.

Due to limited pledgeability, the returns that a lender can appropriate depend on his information about the entrepreneur and manager and about the firm's assets.[31] In the most general formulation, we let the pledgeable return of a firm in case of investment success or entrepreneur's death be given by

$$\underbrace{\lambda}_{\substack{\textit{General pledgeability}\\ (\textit{legal framework etc.})\ (+)}}\qquad \underbrace{\Psi_{\omega,t}^{J}}_{\substack{\textit{Accumulation, reuse}\\ \textit{of information}\ (+\ \textit{or}\ -)}}\qquad \underbrace{Ri_{i,t}\ \ \textit{or}\ \ A_{i,t}i_{i,t}}_{\substack{\textit{Ouput or liquidation}\\ \textit{return}\ (+)}} \tag{6}$$

The return pledgeable to a lender can then be broken down into three components: (i) general factors that influence the average pledgeability of all entrepreneurs (λ), such as the quality of the legal framework; (ii) information accumulated and reused by lenders about returns ($\Psi_{\omega,t}^{J}$). This information depends on the entrepreneur's type (indexed by ω) and can differ between output and liquidation returns ($J=H,A$), as detailed below; (iii) the output ($Ri_{i,t}$) in case of investment

[31] As we elaborate in Appendix C, we can think that the lender's information raises his outside option in case of renegotiation and, hence, his appropriation capability in at least two ways. Information can enable the lender to step in and better manage production and liquidation in the event of borrower strategic default. The lender's information can also reduce delays and costs associated with the recovery of the investment. A broad literature finds evidence of these effects of lenders' information (see, e.g., Hoshi et al., 1990; Höwer, 2016).

success or the liquidation return ($A_{i,t}i_{i,t}$) in case of entrepreneur's death.

Using (6), an entrepreneur's contract with a lender must then satisfy the following pledgeability constraints, in addition to the lender's participation constraint,

$$\lambda\Psi^H_{\omega,t}Ri_{i,t} \geq R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right), \tag{7}$$

$$\lambda\Psi^A_{\omega,t} \geq d_{i,t}. \tag{8}$$

$\lambda\Psi^H_{\omega,t} \in [0,1]$ captures the lender's information on entrepreneur and manager which allows to verify their output in case of success. In case of entrepreneur's survival the repayment to the lender $R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right)$ cannot exceed the pledgeable output $\lambda\Psi^H_{\omega,t}Ri_{i,t}$. $\lambda\Psi^A_{\omega,t} \in [0,1]$ captures the information on the assets which allows the lender to recover value in case of liquidation. This is specific to the firm's assets, that is, not reusable when financing other firms. In case of death and liquidation the lender's share of liquidation value $d_{i,t}$ cannot exceed the pledgeable share $\lambda\Psi^A_{\omega,t}$.

Incumbents, de novo entrants and spinoffs ($\omega \in \{I, N, S\}$) differ in lenders' information on investment returns and, hence, in the pledgeability of returns (see also Table 6, Panel B).

(i) *Incumbents.* Lenders' information on the returns and assets of incumbents is potentially higher than for entrants, due to the information accumulated on incumbents in credit relationships. To capture the fact that incumbents may not immediately benefit from lenders' information, we posit that, after an entrepreneur's entry, the lender has a probability $\rho \in (0,1]$ of upgrading to higher information in each following period, if the upgrade has not yet occurred; with probability $1-\rho$ he retains the same information. Formally, for incumbents whose lenders have upgraded to high information levels $\Psi^J_{I,t} = \overline{\Psi}\psi_I,\ J = A, H$, for any t. ψ_I shapes lenders' informational advantage on incumbents. $\overline{\Psi}$ is a parameter that governs the intensity of relationship lending.

(ii) *Entrants.* Lenders' ability to verify entrants' returns is shaped by their information accumulation in two ways. First, when managers found spinoffs, lenders can reuse information on managers accumulated during their interactions with managers in incumbent firms (embedded information flow). Second, lenders' information on incumbents can be reused, or can crowd out, their information acquisition on entrants (non-embedded information spillover). Formally, for de novo entrants, $\Psi^J_{N,t} = F(L^I_t),\ J = A, H$, where L^I_t is the aggregate stock of loans extended by lenders to incumbents; if the non-embedded information spillover is positive, then $F'(L^I_t) > 0$; if it is negative, then $F'(L^I_t) < 0$. For spinoff entrants, $\Psi^A_{S,t} = F(L^I_t)$ and $\Psi^H_{S,t} = \overline{\Psi}\psi_S$, where $\psi_S \leq \psi_I$.

Table 6. Credit relationships and banks' information

Panel A: Empirical proxies for banks' information and model counterparts

	Empirical proxy	Model
Bank information types:	*Information not reusable for de novo or spinoff entrants*	
	Information specific to incumbent firms	$F(L_t^I)$
	Information specific to incumbents' assets	$F(L_t^I)$
	Information specific to incumbents' innovation	$F(L_t^I)$
	Information reusable for de novo or spinoff entrants	
	Information on sector and local economy	$F(L_t^I)$
	Information on managers (embedded information)	$\overline{\Psi}\psi_S$
Industry characteristics:	Human capital intensity	$\overline{\Psi}\psi_S$
	Assets specificity	$F(L_t^I)$
	Specificity of investments	$F(L_t^I)$

Panel B: Role of banks' information in the model

Firm type	Pledgeability levels	
	Human capital	Assets
Incumbents	$\lambda\overline{\Psi}\psi_I$	$\lambda\overline{\Psi}\psi_I$
De novos	$\lambda \underbrace{F(L_t^I)}_{non-emb.\ spill.}$	$\lambda \underbrace{F(L_t^I)}_{non-emb.\ spill.}$
Spin-offs	$\lambda \underbrace{\overline{\Psi}\psi_S}_{emb.\ flow}$	$\lambda \underbrace{F(L_t^I)}_{non-emb.\ spill.}$

Notes: This table summarizes the proxies for banks' information in the empirical analysis (Panel A) and their counterparts in the model (Panel B).

We let $\overline{\Psi}\psi_S > F(L_t^I)$ so as to reflect the positive information flow embedded in lenders' previous information on spinoff managers (which is absent for de novo entrants).

4.2 Discussion

Mapping between modeling and evidence As noted in the empirical analysis, considering the provinces of a country reduced the risk of omitted variable bias and implicitly controlled for differences in formal institutions (the effect of λ on pledgeability in our decomposition in (6)). In what follows, we discuss the two information channels, as reflected in the pledgeability of entrepreneurs' returns (the effect of $\Psi_{\omega,t}^J$ in the decomposition in (6)) and how they relate to the empirical proxies in Section 3 (refer also to Table 6, Panel A).

As shown in the empirical analysis, in credit relationships banks establish ties with entrepreneurs and managers. Managers who subsequently start businesses can exploit these ties and resort to the banks with which they interacted when working for incumbent firms (embedded information flow). This is a stock of "soft" information and personal ties with banks (Uzzi and Lancaster, 2003; Drexler and Schoar, 2014) that is hard to verify for third parties, so managers can exploit it

to enhance the pledgeability of their returns when starting their own business but cannot commit to using it to the benefit of de novo entrepreneurs. To capture the fact that firms' assets are inherently specific to the firms (e.g., the asset liquidation market is local), in the model managers can exploit their stock of soft information and personal ties to enhance the pledgeability of the output of their spinoffs, but less so to enhance the pledgeability of the asset liquidation values.

As for the non-embedded information spillover, as shown in the empirical tests, on the positive side it can capture information on the sector or local economy accumulated by lenders while financing incumbents and that can be reused when entrants pledge returns (Boot and Thakor, 2000). On the negative side, it can capture limited information capacity: focusing loan officers on acquiring information specific to incumbents crowds out lenders' screening and monitoring of entrants' pledged returns. It may also capture lenders' propensity to keep information on incumbents' technology secret when financing entrants.

Mapping between modeling and prior literature Our formalization follows the macroeconomics literature on knowledge and information spillovers (Aghion and Jaravel, 2015). The function $F(\cdot)$ for non-embedded information spillovers echoes, e.g., the "knowledge production function" in Jones (1995), in which new knowledge produced depends on the current knowledge stock. This impact can be positive ("standing-on-shoulders") or negative ("fishing-out"), just like in our economy $F(\cdot)$ can depend positively ($F' > 0$) or negatively ($F' < 0$) on lenders' stock of loans to incumbents (L_t^I). The formalization of embedded information flows echoes, e.g., the knowledge spillover in Klepper and Sleeper (2005), in which spinoff managers can use market knowledge accumulated in incumbent firms to better access product markets. In our economy, spinoff managers can use the information and personal ties accumulated with banks in incumbent firms to better access the credit market than de novo entrants ($\Psi_{S,t}^H = \overline{\Psi}\psi_S > F(L_t^I) = \Psi_{N,t}^H$).

4.3 Agents' decisions

After characterizing the problem of retired entrepreneurs, we study the decisions of incumbents, de novos and spinoffs along the extensive and intensive margins of investment (the decision whether to invest or to retire and, for those who invest, the size of investments).

Retirees Conditional on retiring (r), an entrepreneur with initial wealth $w_{i,t-1}$ solves

$$V^r(w_{i,t-1}) = \max_{c_{i,t},w_{i,t}} \pi \left[\log(c_{i,t}) + V^r(w_{i,t})\right], \tag{9}$$

$$\text{s.t.} \quad c_{i,t} + w_{i,t} = w_{i,t-1}. \tag{10}$$

V^r is the value function before the death shock realizes. We obtain $c_{i,t} = (1-\pi)w_{i,t-1}$ and

$$V^r(w_{i,t-1}) = \frac{\pi \log(w_{i,t-1})}{1-\pi} + \frac{\pi \log(1-\pi)}{1-\pi} + \frac{\pi^2 \log(\pi)}{(1-\pi)^2}. \tag{11}$$

Incumbents Recall that with probability ρ a lender's information about an entrepreneur upgrades to $\lambda\Psi^J_{I,t} = \lambda\overline{\Psi}\psi_I$ $(J = A, H)$ in the following period. If this has not yet occurred, an incumbent's problem boils down to that of an entrant (see below). If the upgrade has occurred, conditional on investing an incumbent with initial wealth $w_{i,t-1}$ solves

$$V^I(w_{i,t-1}, A_{i,t}) = \max_{c_{i,t},w_{i,t},i_{i,t},d_{i,t}} \pi \left[\log(c_{i,t}) - \frac{\zeta}{\pi} + \int_0^{\overline{A}} \max\{V^r(w_{i,t}), V^I(w_{i,t}, A_{i,t+1})\} dG(A_{i,t+1})\right]$$

$$\text{s.t.} \quad c_{i,t} + w_{i,t} = Ri_{i,t} - R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right), \tag{12}$$

$$\pi R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right) + (1-\pi)\, d_{i,t} A_{i,t} i_{i,t} \geq i_{i,t} - w_{i,t-1}, \tag{13}$$

$$\lambda\overline{\Psi}\psi_I R i_{i,t} \geq R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right), \tag{14}$$

$$\lambda\overline{\Psi}\psi_I \geq d_{i,t}, \tag{15}$$

where (12) is the incumbents' budget constraint, (13) is the lender's participation constraint, and (14) and (15) are the pledgeability constraints.[32] Observe that, since the managerial market is competitive and managers' outside option is normalized to zero, an incumbent retains $Ri_{i,t} - R^L_{i,t}\left(i_{i,t} - w_{i,t-1}\right)$ in case of investment success.[33]

Letting the lender extract no surplus at the loan contract stage, the lender's participation constraint (13) binds.[34] We obtain that investment is bounded (i.e., incumbents need a downpayment

[32] In case of death, the entrepreneur receives 0, and $A_{i,t}(i_{i,t} - \lambda\overline{\Psi}\psi_I d_{i,t})$ is wasted, which reflects costs that lenders sustain when repossessing collateral assets during borrowers' bankruptcies.

[33] While working for an incumbent, a manager does not extract surplus from his ties with the lender. The entrepreneur has the same relationship with the lender, so the manager's ties are dispensable. The manager can however exploit his ties in any spinoff he subsequently starts.

[34] In Appendix C we show robustness to considering a scenario in which the lender extracts a share of the surplus. In particular, we consider a case in which, in the event of negotiation breakdown, the entrepreneur has to forego the investment and a case in which the entrepreneur can resort to another lender.

to borrow) for any $A_{i,t}$ as long as

$$\text{Assumption 1: } \lambda\overline{\Psi}\psi_I\left[\pi R + (1-\pi)\,\overline{A}\right] < 1. \tag{16}$$

We also posit

$$\text{Assumption 2: } \pi R > 1. \tag{17}$$

Under Assumption 2, an entrepreneur strictly prefers investing a positive amount and stipulating a contract in which the pledgeability constraints (14) and (15) bind. Solving for $R^L_{i,t}$, $d_{i,t}$ and $i_{i,t}$,

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \left[\pi\lambda\overline{\Psi}\psi_I R + (1-\pi)\,\lambda\overline{\Psi}\psi_I A_{i,t}\right]}. \tag{18}$$

The incumbent's investment payoff (the right hand side of (12)) can then be expressed as

$$\left(1 - \lambda\overline{\Psi}\psi_I\right) R i_{i,t} = R^I(A_{i,t}) w_{i,t-1}, \tag{19}$$

where the return $R^I(A_{i,t})$ to the incumbent's wealth satisfies

$$R^I(A_{i,t}) \equiv \frac{\left(1 - \lambda\overline{\Psi}\psi_I\right) R}{1 - \left[\pi\lambda\overline{\Psi}\psi_I R + (1-\pi)\,\lambda\overline{\Psi}\psi_I A_{i,t}\right]}. \tag{20}$$

$R^I(A_{i,t})$ is increasing in $\lambda\overline{\Psi}\psi_I$ for any $A_{i,t}$. We can state the following lemma.

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

$$c_{i,t} = (1-\pi) R^I(A_{i,t}) w_{i,t-1}, \tag{21}$$

$$V^I(w_{i,t-1}, A_{i,t}) = \frac{\pi \log(w_{i,t-1})}{1-\pi} + \frac{\pi \log(1-\pi)}{1-\pi} + \frac{\pi^2 \log(\pi)}{(1-\pi)^2} + \Gamma^I_t(A_{i,t}) = V^r(w_{i,t-1}) + \Gamma^I_t(A_{i,t}), \tag{22}$$

where $\Gamma^I_t(A_{i,t})$, the difference between incumbent value and retiree value, satisfies

$$\Gamma^I_t(A_{i,t}) = \pi\left[\frac{\log R^I(A_{i,t})}{1-\pi} - \frac{\zeta}{\pi} + \int_{\hat{A}^I_{t+1}}^{\overline{A}} \Gamma^I_{t+1}(A_{i,t+1}) dG(A_{i,t+1})\right]. \tag{23}$$

In (23), $\pi\left(\frac{\log R^I(A_{i,t})}{1-\pi} - \frac{\zeta}{\pi}\right)$ is the direct utility gain from investing: an incumbent pays utility cost ζ but earns a higher return $R^I(A_{i,t})$ than saving her wealth in the capital market. The $\int_{\hat{A}^I_{t+1}}^{\overline{A}} \Gamma^I_{t+1}(A_{i,t+1}) dG(A_{i,t+1})$ term is the option value of being an incumbent. An incumbent invests if and only if $V^I(w_{i,t-1}, A_{i,t}) > V^r(w_{i,t-1})$, that is, if $\Gamma^I(A_{i,t}) > 0$. We can prove the following:

Lemma 2 *Incumbents invest if and only if their asset liquidation value $A_{i,t}$ exceeds $\hat{A}^I_t$. The*

investment threshold $\hat{A}_t^I$ *is determined by the following recursive equation*

$$\frac{\log R^I(\hat{A}_t^I)}{1-\pi} - \frac{\zeta}{\pi} + \int_{\hat{A}_{t+1}^I}^{\overline{A}} \Gamma_{t+1}^I(A_{i,t+1}) dG(A_{i,t+1}) = 0. \tag{24}$$

Because $\int_{\hat{A}_{t+1}^I}^{\overline{A}} \Gamma_{t+1}^I(A_{i,t+1}) dG(A_{i,t+1}) \geq 0$, it must be that $\frac{\log R^I(\hat{A}_t^I)}{1-\pi} - \frac{\zeta}{\pi} \leq 0$.

Entrants We now turn to the entrants' decision problem. Consider first a manager with a spinoff opportunity. If the manager invests in a spinoff, she faces pledgeability constraints determined by the information levels of the lenders with whom she interacted in an incumbent firm. In the following period, her lender upgrades to higher information with probability ρ, in which case her continuation value is $V^I(\cdot)$. The problem of a spinoff manager with initial wealth $w_{i,t-1}$ then reads

$$V^S(w_{i,t-1}, A_{i,t}) = \max_{\substack{c_{i,t}, w_{i,t}, \\ i_{i,t}, d_{i,t}}} \pi \left[\begin{array}{c} \log(c_{i,t}) - \frac{\zeta}{\pi} + \rho \int_0^{\overline{A}} \max\{V^r(w_{i,t}), V^I(w_{i,t}, A_{i,t+1})\} dG(A_{i,t+1}) + \\ + (1-\rho) \int_0^{\overline{A}} \max\{V^r(w_{i,t}), V^S(w_{i,t}, A_{i,t+1})\} dG(A_{i,t+1}) \end{array} \right]$$

$$\text{s.t.} \quad c_{i,t} + w_{i,t} = R i_{i,t} - R_{i,t}^L (i_{i,t} - w_{i,t-1}), \tag{25}$$

$$\pi R_{i,t}^L (i_{i,t} - w_{i,t-1}) + (1-\pi)\, d_{i,t} A_{i,t} i_{i,t} \geq i_{i,t} - w_{i,t-1}, \tag{26}$$

$$\lambda \overline{\Psi} \psi_S R i_{i,t} \geq R_{i,t}^L (i_{i,t} - w_{i,t-1}), \tag{27}$$

$$\lambda F(L_t^I) \geq d_{i,t}. \tag{28}$$

The pledgeability constraints are affected both by the embedded information flow ($\overline{\Psi}\psi_S$) and by the non-embedded information spillover ($F\left(L_t^I\right)$, and, through it, by incumbents' aggregate stock of loans L_t^I). Since the lender's participation constraint and the pledgeability constraint bind,

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \left[\pi \lambda \overline{\Psi} \psi_S R + (1-\pi)\, \lambda F\left(L_t^I\right) A_{i,t}\right]}. \tag{29}$$

Consider next a new entrepreneur. Conditional on investing, a de novo entrant with wealth $w_{i,t-1}$ solves a problem isomorphic to that of a spinoff manager subject to the information levels of the lenders with whom he establishes credit relationships upon entry. If she invests, in the following period her lender upgrades to higher information with probability ρ, in which case the continuation value is $V^I(\cdot)$. As the lender's participation constraint and the pledgeability constraints bind,

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \left[\pi \lambda F\left(L_t^I\right) R + (1-\pi)\, \lambda F\left(L_t^I\right) A_{i,t}\right]}. \tag{30}$$

Note that a de novo's pledgeability constraints, and hence her investment scale, are affected by the non-embedded information spillover ($F\left(L_t^I\right)$). We can now state the following:

Lemma 3 *De novo (spinoff) entrants invest if and only if their asset liquidation value $A_{i,t}$ exceeds $\hat{A}_t^N$ ($\hat{A}_t^S$). The investment thresholds for de novo and spinoff entrants, $\hat{A}_t^\omega$ for $\omega = N, S$, are determined by the following recursive equation:*

$$\frac{\log R_t^\omega(\hat{A}_t^\omega)}{1-\pi} - \frac{\zeta}{\pi} + \rho \int_{\hat{A}_{t+1}^I}^{\overline{A}} \Gamma_{t+1}^I(A_{i,t+1}) dG(A_{i,t+1}) + (1-\rho) \int_{\hat{A}_{t+1}^\omega}^{\overline{A}} \Gamma_{t+1}^\omega(A_{i,t+1}) dG(A_{i,t+1}) = 0, \quad (31)$$

where

$$\Gamma_t^\omega(A_{i,t}) = \pi \left[\frac{\log R^\omega(A_{i,t})}{1-\pi} - \frac{\zeta}{\pi} + \rho \int_{\hat{A}_{t+1}^I}^{\overline{A}} \Gamma_{t+1}^I(A_{i,t+1}) dG(A_{i,t+1}) + (1-\rho) \int_{\hat{A}_{t+1}^\omega}^{\overline{A}} \Gamma_{t+1}^\omega(A_{i,t+1}) dG(A_{i,t+1}) \right],$$

and where

$$\begin{aligned} R^N(A_{i,t}) &\equiv \frac{\left[1-\lambda F(L_t^I)\right] R}{1-\left[\pi\lambda F(L_t^I) R + (1-\pi)\,\lambda F(L_t^I) A_{i,t}\right]}, \\ R^S(A_{i,t}) &\equiv \frac{\left[1-\lambda \bar{\Psi}\psi_S\right] R}{1-\left[\pi\lambda \bar{\Psi}\psi_S R + (1-\pi)\,\lambda F(L_t^I) A_{i,t}\right]}. \end{aligned}$$

4.4 Aggregation and steady state

For illustration purposes, we pose $\rho = 1$; robustness for the $\rho < 1$ case will be shown in Section 5.4. From (18), (30) and (29), the aggregate loan stock, $L_t \equiv L_t^I + L_t^N + L_t^S$, reads

$$L_t\left(W_{t-1}^\omega, \lambda\Psi_{\omega,t}^H, \lambda\Psi_{\omega,t}^A\right) = \sum_{\omega\in\{I,N,S\}} W_{t-1}^\omega \int_{\hat{A}_t^\omega}^{\overline{A}} \frac{\left[\pi\lambda\Psi_{\omega,t}^H R + (1-\pi)\lambda\Psi_{\omega,t}^A A_{i,t}\right]}{1-\left[\pi\lambda\Psi_{\omega,t}^H R + (1-\pi)\lambda\Psi_{\omega,t}^A A_{i,t}\right]} dG(A_{i,t}), \quad (32)$$

where W_{t-1}^ω is the aggregate wealth of type ω entrepreneurs. Expression (32) can be interpreted as an aggregate loan production function. In Goodfriend and McCallum (2007), for example, the aggregate amount of loans is an increasing function of lenders' stock of information (here corresponding to $\lambda\Psi_{\omega,t}^H$, $\lambda\Psi_{\omega,t}^A$) and of borrowers' wealth (W_{t-1}^ω) and collateral ($A_{i,t}$). Key differences from Goodfriend and McCallum (2007) are the distinction between incumbents and entrants and lenders' reuse of information accumulated with incumbents in the financing of entrants.

We can now study the aggregate behavior of the economy. For any given $A_{i,t}$, it can be shown that $R_t^N(A_{i,t}) < R_t^S(A_{i,t}) < R^I(A_{i,t})$. Proposition 1 follows.

Proposition 1 *The investment thresholds of incumbents, de novos and spinoffs satisfy $\hat{A}_t^N > \hat{A}_t^S > \hat{A}_t^I$ for all t.*

Proposition 1 reflects the fact that incumbents have easier access to credit than spinoffs, who in turn have easier access to credit than de novos.

Due to the linear policy functions implied by logarithm utilities, we can characterize economic aggregates without keeping track of the distribution of wealth. The law of motion of the aggregate wealth of incumbents (W_t^I) satisfies

$$W_t^I = \pi^2 \int_{\hat{A}_t^I}^{\overline{A}} R_t^I(A_{i,t}) dG(A_{i,t}) W_{t-1}^I + \pi^2 \int_{\hat{A}_t^N}^{\overline{A}} R_t^N(A_{i,t}) dG(A_{i,t}) W_{t-1}^N + \pi^2 \int_{\hat{A}_t^S}^{\overline{A}} R_t^S(A_{i,t}) dG(A_{i,t}) W_{t-1}^S.$$

Each type-ω entrepreneur will invest if $A_{i,t} > \hat{A}_t^\omega$, survive with probability π, and save a fraction π of her net worth in the event of survival. The aggregate wealth of potential de novos and spinoffs at the beginning of period $t+1$ is respectively given by

$$W_t^N = B_t \frac{1}{1 + \sigma\left(M_t^I + M_t^N + M_t^S\right)},$$
$$W_t^S = B_t \frac{\sigma\left(M_t^I + M_t^N + M_t^S\right)}{1 + \sigma\left(M_t^I + M_t^N + M_t^S\right)},$$

where B_t denotes the aggregate amount of bequests made in period t. In Appendix B, we also report the law of motion of the bequests, B_t, and of the retirees' aggregate wealth, W_t^r.

We can next characterize the measures of de novo entrants (M_t^N), spinoff entrants (M_t^S) and incumbents (M_t^I). These are defined before the realization of entrepreneurs' death shock. In every period t there is a unit measure of new entrepreneurs. Thus, de novos' measure is

$$M_t^N = 1 - G(\hat{A}_t^N). \tag{33}$$

Since each firm employs one manager, in period $t-1$ the measure of managers equals the measure of firms, $M_{t-1}^I + M_{t-1}^N + M_{t-1}^S$. Thus, the measure of spinoffs created by managers in period t is

$$M_t^S = \left[1 - G(\hat{A}_t^S)\right] \sigma\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right). \tag{34}$$

In period $t-1$, the measure of surviving entrepreneurs is $\pi\left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right)$. Thus, the

measure of incumbents in period t is

$$M_t^I = \left[1 - G(\hat{A}_t^I)\right] \pi \left(M_{t-1}^I + M_{t-1}^N + M_{t-1}^S\right). \tag{35}$$

In steady state the measures of incumbents, de novos and spinoffs are constant. We obtain

$$M^N = 1 - G(\hat{A}^N), \tag{36}$$

$$M^S = \frac{\sigma \left[1 - G(\hat{A}^S)\right] \left[1 - G(\hat{A}^N)\right]}{1 - \pi \left[1 - G(\hat{A}^I)\right] - \sigma \left[1 - G(\hat{A}^S)\right]}, \tag{37}$$

$$M^I = \frac{\pi \left[1 - G(\hat{A}^I)\right] \left[1 - G(\hat{A}^N)\right]}{1 - \pi \left[1 - G(\hat{A}^I)\right] - \sigma \left[1 - G(\hat{A}^S)\right]}. \tag{38}$$

The steady state measures of de novos and spinoffs are decreasing in the investment thresholds $\hat{A}^N$ and $\hat{A}^S$, which reflect their credit market participation (extensive margin). The $\hat{A}^I$ threshold affects the $\hat{A}^N$ and $\hat{A}^S$ thresholds through its impact on L_t^I and, hence, on $F\left(L_t^I\right)$. In the case of spinoffs the $\hat{A}^I$ threshold has also a direct effect: as spinoffs originate from incumbents, a lower measure of incumbents - $\hat{A}^I \uparrow$ - reduces spinoffs. We will return to these mechanisms below.

Guided by the evidence, we focus on three entry indicators: entrants' measure $M^N + M^S$; the ratio of entrants to incumbents $\left(M^N + M^S\right)/M^I$; and the ratio of spinoffs to total entrants $M^S/\left(M^N + M^S\right)$. In Appendix B, we present the steady state expressions for these variables.

5 Model Analysis

We calibrate the model to the Italian data of Section 3 (Section 5.1). Then, we perform simulations for the short- and long-run effects of the intensity of relationship lending on entry (Section 5.2). In Section 5.3 we study aggregate output implications. Section 5.4 contains robustness and extensions.

It is useful to summarize up front the mechanisms at work in the model economy. Credit relationships influence entry through lenders' accumulation and reuse of information and the resulting pledgeability of returns (Lemma 3). First, the embedded information flow from credit relationships promotes spinoff entry, while the non-embedded spillover affects both de novo and spinoff entry (see the impact of ψ_S and $F(L_t^I)$ on the entry thresholds in Lemma 3). Second, as captured by the term $\rho \int_{\hat{A}_{t+1}^I}^{\overline{A}} \Gamma_{t+1}^I(A_{i,t+1}) dG(A_{i,t+1})$ in equation (31), information accumulated by lenders eases

Table 7: Calibration

Parameter	Symbol	Value
Fixed parameters		
Distribution of asset liquidation value		Truncated $N(\frac{1}{2}, \frac{1}{16})$
Upper bound on idiosyncratic liquidation value	$\overline{A}$	1.000
Investment return if success	R	1.021
Relationship lending information advantage	$\overline{\Psi}$	1.000
Fitted parameters		
Probability of entrepreneur survival	π	0.982
Utility cost of investing	ζ	3.207
Probability of spinoff opportunity	σ	0.021
Aggregate pledgeability value	λ	0.480
Information advantage on incumbents	ψ_I	1.574
Embedded information flow on spinoffs	ψ_S	1.278
Elasticity non-embedded spillover $F(.)$	γ	-1.057

lending, increases incumbents' profitability and the future value of entry, encouraging de novo and spinoff entry. These information channels interact with entrepreneurs' compositional dynamics. Entries affect incumbents' measure over time (equation (35)), which feeds back to lenders' information accumulation. Further, incumbents' measure directly influences spinoff entry, as spinoffs originate from incumbents (equation (34)). The predictions on key empirical targets (e.g., the entry indicators) depend on the strength and interaction of these mechanisms.

5.1 Calibration

The model is calibrated to annual frequency and parameterized in two steps. First, we fix a set of parameters to values directly calculated from data or standard business sector targets. Second, given those fixed parameters, we choose the remaining parameters to match targets in the data.

Parameters are in Table 7, the top panel of which reports the parameters that we fix. We assume that the liquidation value $A_{i,t}$ of firms' assets follows a truncated normal distribution on $[0, \overline{A}]$, with a mean of 1/2 and a standard deviation of 1/4. Then $\overline{A}$ is two standard deviations away from the mean and equal to one, which implies that the liquidation value cannot be greater than the initial investment. The chosen mean and standard deviation of $A_{i,t}$ are in the ballpark of the estimates on asset recovery values in Almeida et al. (2011). We set R such that the net return of firms in case of success $(R-1)$ equals 2.14%, which is calculated from the Orbis database. In the baseline steady state, we normalize the aggregate intensity of relationship lending, $\overline{\Psi}$, to one.

Table 8: Empirical moments and model fits

Variable	Data	Baseline Model
Panel A: Targeted moments		
Ratio of measure: entrants/incumbents	4.99%	4.94%
Ratio of measure: spinoffs/entrants	28.30%	28.22%
Ratio of aggregate turnover: entrants/incumbents	0.64%	0.65%
Average leverage:		
Incumbents	4.70	4.25
De novo entrants	1.80	1.98
Spinoffs	2.01	2.64
Effect of a 1-yr increase of relationship on L^I	5.10%	5.10%
Panel B: Untargeted moments		
Average relationship length	17.35	20.23
Ratio of aggregate wealth: entrants/incumbents	0.74%	0.66%

We use the data from Italy to calibrate seven parameters (see the bottom panel of Table 7 for the fitted parameters). Three parameters, namely the probability of investment success (π), the fixed investment effort cost (ζ), and the probability of spinoff opportunities (σ), refer to the investment technology. Three parameters refer to the pledgeability of investment returns to lenders (reflecting lenders' information on investment returns): λ, the degree of pledgeability common to all entrepreneurs' output and assets; ψ_I, the relative pledgeability of incumbents' output and assets; and ψ_S, the relative pledgeability of spinoffs' output. The last parameter, γ, governs the non-embedded information spillover function, which is set as a power function $F(L_t^I) = (L_t^I)^\gamma$. We calibrate these seven parameters to match seven empirical targets. Six of those targets regard the model steady states: the ratio of entrants to incumbents, the ratio of spinoffs to total entrants, the leverage of incumbents, de novos and spinoffs, and the ratio of the aggregate turnover of entrants over that of incumbents. The last target is the effect of a one-year increase in the relationship length from the steady-state value on the stock of relationship loans.[35]

Table 8, Panel A, reports the empirical targets and model fits. The model matches the data moments fairly well. In accounting for the model's performance to match data, the exogenous component of the probability of firm termination ("death", $1-\pi$), is most responsible for matching the ratio of entrants to incumbents, shown in equation (50) in Appendix B. Since this ratio is less

[35]The literature calibrates information spillovers in different ways, depending on contexts (Aghion and Jaravel, 2015). Our approach is close to studies in entrepreneurship which calibrate information spillovers by looking at proxies for entrepreneurs' market access. In our setting, we focus on entrepreneurs' access to the credit market (pledgeability of returns).

than 5% in the data, both $(1-\pi)$ and $G(\hat{A}^I)$ (the endogenous component of the probability of firm termination, "retirement") have to be sufficiently low. The calibration implies an exogenous component of the probability of firm termination $(1-\pi)$ of 1.8%.[36] The most important parameter accounting for the ratio of spinoffs to total entrants is σ, as in (51). The parameters governing the degrees of pledgeability of the three types of entrepreneurs, λ, ψ_I and ψ_S, are most responsible for matching the leverages of de novos, incumbents and spinoffs (see (30), (18) and (29), respectively). The model captures the feature that in the data incumbents have a higher leverage than entrants. The calibrated λ, ψ_I and ψ_S imply that the share of returns pledgeable by an incumbent is 75%, while the pledgeable shares of a spinoff's output and of a de novo's returns are roughly 15 and 25 percentage points lower, respectively. Lastly, γ is calibrated to replicate the effect of a one-year increase in the relationship length on the stock of relationship loans, which is 5.10%.[37] The negative non-embedded information spillover γ implied by the calibration is also consistent with the estimates for the empirical proxies of $F(L_t^I)$: in Tables 5A-5C we estimated a negative effect of information specific to incumbents in the link between relationship lending and entry (while we found no evidence of a positive effect of banks' information on the sector and local economy).

We verified whether the model can capture other features of the data not targeted in the calibration. As shown in Table 8, Panel B, the predictions of the model about the ratio of the aggregate wealth of entrants over the aggregate wealth of incumbents and about the average credit relationship length are in the ballpark of the data (we slightly underpredict the aggregate wealth ratio and slightly overpredict the average relationship length). The model also predicts that interest rates should be higher for incumbents than for entrants. Using Orbis data to construct a proxy for interest rates (total repayment expenses over total liabilities) we obtained that indeed in our data the interest rate for incumbents exceeds somewhat that for entrants.

5.2 Qualitative and quantitative effects

We consider an experiment that permanently increases $\overline{\Psi}$, raising lenders' information advantage on incumbents. This is interpreted as a stronger intensity of relationship lending. In fact, in

[36] In the Capitalia survey, the probability of firms' bankruptcy due to exogenous risk factors (a proxy for $1-\pi$), as captured by Moody's RisKCalc, equals 1.4%.

[37] In Section 3.4 we discussed the effects of the average credit relationship length on the stock of loans to incumbents. As discussed in Appendix A, we also verified that in the data there is some evidence of a negative association between, e.g., asset liquidation values and the aggregate stock of loans to incumbents.

equilibrium a higher $\overline{\Psi}$ implies longer credit relationships, as it lowers incumbents' investment threshold $\hat{A}^I$, reducing the probability of relationship termination due to retirement. We set the higher $\overline{\Psi}$ such that the average duration of credit relationships is about one year longer in steady state (5% of the average credit relationship length). Table 9, Panel A, shows the effects on the steady state. Figure 2 displays the responses along the transition.

The higher $\overline{\Psi}$ reduces the measure of entrants ($M^N + M^S$) and the ratio of entrants to incumbents ($\left(M^N + M^S\right)/M^I$). After 5 years the measure of entrants is about 0.9% lower and the ratio of entrants to incumbents is 4.83% rather than 4.94%. In the long run, the ratio of entrants to incumbents drops by 0.23 percentage points to 4.71%. This decrease is in between the impact in the OLS regressions of Table 1, columns 2-4, and the impact in the 2SLS regression of column 6. The OLS regression of column 4 suggests that credit relationships longer by one year imply a ratio of entrants to incumbents about 0.04 percentage points lower. The 2SLS regression of column 6 implies a 0.6 percentage points lower ratio of entrants to incumbents. The coefficients of those regressions provide a natural counterpart of cross-sectional long-run effects, as the regressions are saturated with time fixed effects (but not with province fixed effects).

The steady-state ratio of spinoffs to total entrants ($M^S/(M^N + M^S)$) after the increase in $\overline{\Psi}$ is 0.56 percentage points higher, rising from 28.22% to 28.78%. This is consistent with the empirical findings: in Table 3, column 1, we estimated that credit relationships longer by 1 year imply a 0.7 percentage points higher ratio of spinoffs to total entrants.

Table 9, Panel A, and Figure 2 also display the impact of the higher $\overline{\Psi}$ on entrants' average size (investment). In line with the estimates, this is larger, by 6.17% in the long run. Interestingly, the size of spinoffs at entry rises significantly more than that of de novos (9.29% versus 4.22%).[38]

Interpretation To interpret the effects, let us first look at the measure of entrants. The higher $\overline{\Psi}$ progressively raises the stock of relationship loans to incumbents, L^I, crowding out lenders' information acquisition on managers and assets of de novos ($F(\cdot) \downarrow$) and, hence, slowing down de novo entry. This negative spillover also affects lenders' information acquisition on the assets of spinoffs (spinoff managers are already known to lenders). For spinoffs, there are two more mechanisms. The higher $\overline{\Psi}$ implies a larger amount of information on managers transferable to

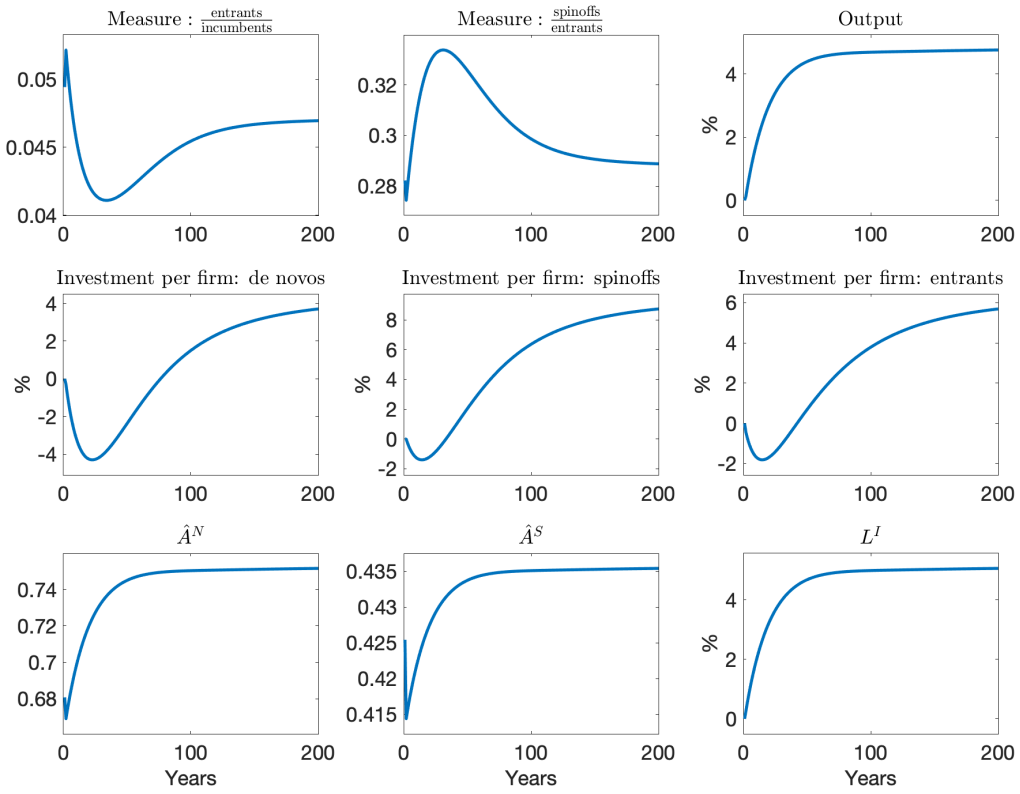
[38] In the empirical analysis, we indeed estimated a more clear-cut positive impact of the intensity of credit relationships on the size at entry of spinoffs than on that of de novos. Consistent with the empirical estimates, the model also predicts a drop in firms' exit rate, both in the short and in the long run.

Table 9: Effect of a higher $\overline{\Psi}$

Variable	Baseline	Higher $\overline{\Psi}$
Panel A: Firm entry		
Ratio of measure: entrants/incumbents	4.94%	4.71%
Ratio of measure: spinoffs/entrants	28.22%	28.78%
Firm size at entry (% change from baseline)	-	6.17%
Panel B: Macroeconomic variables		
Aggregate output (% change from baseline)	-	4.79%
Ratio of aggregate output: entrants/incumbents	0.45%	0.30%
Panel C: Other business sector variables		
Ratio of aggregate credit: entrants/incumbents	0.24%	0.15%
Ratio of aggregate wealth: entrants/incumbent	0.66%	0.44%

Note: $\overline{\Psi}$ in the higher-$\overline{\Psi}$ economy is set such that the average relationship length in this economy is one year longer than in the baseline model.

Figure 2: Responses to an Increase in Relationship Lending Intensity



Notes: The figure shows the impulse response functions of selected variables of the model to an increase in $\overline{\Psi}$. The increase in $\overline{\Psi}$ is set to raise the average credit relationship length by 5%.

spinoffs (embedded information flow, $\overline{\Psi}\psi_S \uparrow$). This tends to boost spinoff entry. By reducing de novo entries, however, the higher $\overline{\Psi}$ progressively lowers incumbents' measure. Since spinoffs originate from incumbents, this depresses spinoff creation in the longer run. In our simulation, the negative effects on de novo and spinoff entry are predominant, lowering the measure of entrants.

When looking at the ratio of entrants to incumbents, one has also to consider the denominator of the ratio. The higher $\overline{\Psi}$ directly boosts incumbents' measure by raising the pledgeability of their returns, but, as noted, the reduced entry progressively gains relevance, depressing incumbents' measure. As Table 9, Panel A, and Figure 2 show, the net effect on the ratio of entrants to incumbents is negative both in the short and in the long run.[39]

Let us now turn to the composition of entrants between spinoffs and de novos. The higher $\overline{\Psi}$ has a direct depressing effect on the measure of de novos. As noted, the effect on spinoffs is articulated, reflecting the interplay between the information channels and the progressive reduction in the measure of incumbents from which spinoffs originate. In line with the empirical findings, under our calibration the ratio of spinoffs to total entrants rises.

The responses along the transition (Figure 2) show that, in the short run, the share of spinoffs overshoots its long-run increase. Information flows from credit relationships to spinoffs play a large role in the short run. Subsequently, the progressive drop in spinoff creation due to the smaller flow of spinoffs from incumbents gains relevance. The short-run undershooting of the entry rate is again attributable to the predominance of information channels in the short run. In particular, the significant drop in de novo entries plays a relevant role in the first portion of the transition.[40]

5.3 Aggregate output

We investigate the effects on total output, net of investment.[41] Total output, Y_t, is the sum of incumbents' output, Y_t^I, and entrants' output, Y_t^{N+S}. Let $\overline{w}_t^I$ denote incumbents' average wealth and $\bar{b}_t$ denote the bequest received by each entrant. In steady state,

$$Y^I = \underbrace{M^I}_{Ext.\downarrow} \underbrace{\int_{\hat{A}^I}^{\bar{A}} \frac{\overline{w}^I \left[\pi R + (1-\pi)A - 1\right]}{1 - \lambda\overline{\Psi}\psi_I[\pi R + (1-\pi)A]} dG}_{Int.\uparrow},$$

[39] On impact there is a slight increase in the entry rate due to the increase in the future value of being an incumbent (see equation (31)).

[40] In the Appendix, we elaborate on the length of the transition and on the parameters that affect it.

[41] We treat the asset liquidation value not appropriated by entrepreneurs or lenders as a transfer to "liquidators". The results are very similar if we treat it as a deadweight loss (see Appendix Figure 5).

$$Y^{N+S} = \underbrace{M^N}_{Ext.\downarrow} \left[\underbrace{\int_{\hat{A}^N}^{\bar{A}} \frac{\bar{b}\left[\pi R + (1-\pi)A - 1\right]}{1 - \lambda F[\pi R + (1-\pi)A]} dG}_{Int.\uparrow} + \underbrace{\frac{M^S}{M^N}}_{Ext.\uparrow} \underbrace{\int_{\hat{A}^S}^{\bar{A}} \frac{\bar{b}\left[\pi R + (1-\pi)A - 1\right]}{1 - \lambda[\pi R \overline{\Psi} \psi_S + (1-\pi)AF]} dG}_{Int.\uparrow} \right].$$

Figure 2 and Table 9, Panel B, show the short- and long-run effects of the higher $\overline{\Psi}$ on total output. The higher $\overline{\Psi}$ leads to a larger output (in the long run, by 4.79%). To understand this, it is useful to separate extensive ($Ext.$) and intensive margin ($Int.$) effects. On the extensive margin, the higher $\overline{\Psi}$ leads to a lower measure of entrants ($M^N + M^S \downarrow$) and, hence, to a lower measure of incumbents ($M^I \downarrow$) in the long run. This shrinks output. A second extensive margin effect is through the higher ratio of spinoffs to de novos ($\frac{M^S}{M^N} \uparrow$). Spinoffs can use higher leverage to invest more than de novos, due to the information that lenders transfer from incumbents to spinoffs (as shown in Table 8, in the original steady state spinoffs' leverage is more than 20% higher than that of de novos). Thus, the credit reallocation from de novo entrants to spinoffs boosts output.

On the intensive margin, the higher $\overline{\Psi}$ implies a higher investment scale of entrants and, to a larger extent, of incumbents. Consider entrants' investment scale. There is an increase in the bequests received by entrants ($\bar{b} \uparrow$). However, de novos can leverage their wealth less, as the pledgeability of their returns drops ($F \downarrow$). As for spinoffs, their pledgeability and, hence, their leverage is subject to opposite forces ($\overline{\Psi}\psi_S \uparrow$ but $F \downarrow$). Overall, entrants' investment scale expands. Incumbents experience a larger boost to their investment scale. They are larger to begin with, as firms' scale at entry is larger. This increases their wealth ($\overline{w}^I \uparrow$). They also experience an increase in pledgeability ($\overline{\Psi} \uparrow$).[42] All the intensive margin effects tend therefore to boost total output.

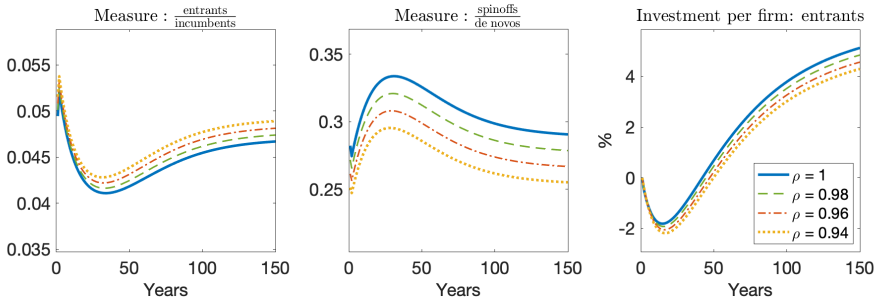
The simulation reveals that the larger investment of entrants and incumbents and the reallocation of credit from de novos to spinoffs outweigh the output effect of the overall lower entry and of the resulting long-run contraction in the number of active firms.

A further look at the data: output effects To test the consistency of the output predictions with the data, we return to investigate our Italian database. In Table 4, Panel C, using a specification analogous to (1), we estimate the impact of the average credit relationship length in the province on the total output (firms' value added) produced in a province and sector (Orbis data). We uncover a positive effect of the local intensity of credit relationships on the (log) total output (column 4). This is in line with the predictions of the model that the positive forces associated with

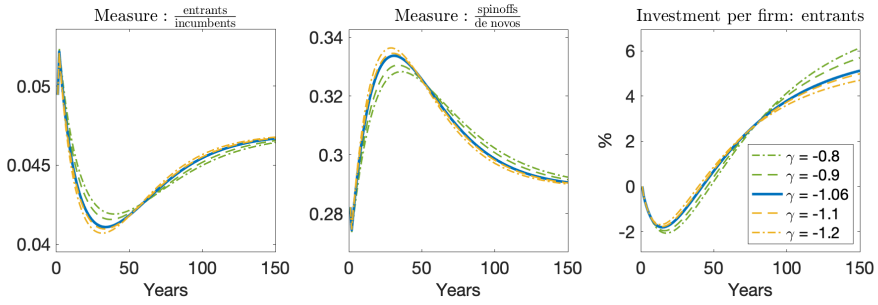
[42] The ratio of entrants' total wealth over that of incumbents is 33% lower in the long run (Table 9, Panel C).

stronger credit relationships outweigh the negative ones. To further pin down the contribution of the mechanisms of the model, we next replace the (log) total output in a province and sector with the (log) total output of incumbents and the (log) total output of entrants. Consistent with the model predictions (Table 9, Panel B), the estimates in columns 5 and 6 suggest a stronger positive impact of the intensity of credit relationships on incumbents' output than on entrants' output.

Figure 3: Robustness of Impulse Responses



a. Sensitivity of responses to ρ



b. Sensitivity of responses to γ

Notes: Robustness to alternative calibrations of the parameter ρ and the parameter γ.

A relevant observation is worth making at this point. Our estimates suggest that the 1936 Italian banking regulation could have induced firms to engage in more intense credit relationships (Table 1). In turn, the higher intensity of credit relationships is predicted to boost output (Table 4, Panel C). A reader could then be tempted to infer that our analysis suggests an overall positive impact of the banking regulation on output. This conclusion would however be unwarranted. The regulation can in fact have influenced, and possibly depressed, output through mechanisms alternative to those uncovered in our analysis.[43] Our analysis thus helps pin down a channel of influence of the regulation on output which is however neither the unique force at work nor necessarily the most significant one from a quantitative viewpoint.

[43]One such mechanism could consist of the impact of the banking regulation on households' access to consumer credit, and hence, e.g., its influence on education, migration and urbanization.

5.4 Robustness and extensions

Sensitivity In the baseline calibration, with probability $\rho = 1$, after an entrepreneur's entry, relationship lenders upgrade to higher information on the entrepreneur and her investments in the following period. In Figure 3, Panel a, we let $\rho < 1$, so that the accumulation of information in credit relationships is slower (see Appendix Table 8 and Appendix Figure 3 for more details). We thus use the exogenous transition probability ρ between entrants and incumbents as a reduced-form way to capture lenders' gradual grasp of information. All the results carry through. Expectedly, the effects of a higher $\overline{\Psi}$ (e.g., the decline in the ratio of entrants to incumbents) are slightly attenuated, as the impact of $\overline{\Psi}$ on information accumulation is slightly less pronounced.

Figure 3, Panel b, shows that the results are also robust to altering the parameter γ in the function $F(L_t^I)$ for non-embedded information spillovers in a [-20%,+20%] range around the baseline value. Details for a more complete set of impulse responses are in Appendix Figure 4.

Policies While our focus is positive rather than normative, it is useful to investigate the efficiency properties of the equilibrium and the scope for policy intervention. Besides being affected by credit constraints due to limited pledgeability, our economy features externalities driven by spillovers from incumbents to entrants. This raises the possibility that credit be misallocated across the different categories of entrepreneurs. First, the amount of loans granted to incumbents negatively affects the pledgeability of entrants (recall the negative non-embedded spillover $F'(\cdot) < 0$). Secondly, the mass of spinoffs depends on that of incumbents, as spinoffs originate from existing firms. Finally, credit allocated to incumbents has an impact on the size of the bequests received by entrants.

These externalities lead us to ask whether a policy maker who is subject to the same pledgeability constraints as private agents but can influence the allocation of funds would pursue a reallocation of credit. In Appendix C, we consider a policy maker who can use one regulatory instrument, a loan-to-value ratio, and impose a limit (ψ_P) on the amount that an entrepreneur can borrow, for each unit of pledged returns (output and asset liquidation value). For example, the policy maker can restrict incumbents' borrowing below what would be implied by the pledgeability of their returns ($\psi_P < \psi_I$).[44] We posit that the policy maker targets total output. To the extent that the policy maker can implement a scheme of taxes and transfers ex post (after output is

[44]The policy maker can also set $\psi_P \geq \psi_I$, but in this case the regulatory limit would not be binding.

produced), a higher output would allow to attain a Pareto improvement, increasing total welfare.

We show that a binding loan-to-value ratio constraint on incumbents ($\psi_P < \psi_I$) can raise total output ($Y^I + Y^{N+S}$). Limiting the loans to incumbents lowers their investment and output ($\partial Y^I/\partial \psi_P < 0$) but raises the pledgeability of entrants, by mitigating the negative non-embedded spillover ($F'(L_t^I) < 0$). An interpretation is that lenders' monitoring/screening capacity is a scarce resource and, by lowering ψ_P and thus L_t^I, the policy maker can reallocate this scarce capacity to entrants. In turn, the increase in entrants' pledgeability favors entry (extensive margin) and expands the investment of each entrant (intensive margin). When these effects are strong enough, a binding $\psi_P < \psi_I$ on incumbents raises entrants' output Y^{N+S} by more than it reduces incumbents' output Y^I. Put differently, in spite of reducing incumbents' output, the policy maker can boost total output by raising the suboptimally low entry rate towards the constrained optimal level.

A numerical experiment performed in Appendix C reveals that in our calibrated economy a binding loan-to-value ratio on incumbents ($\psi_P < \psi_I$) raises total steady state output only when entrants' leverage reaches implausibly large values. When the policy intervention implies a smaller, more plausible entrants' leverage, it instead reduces output.

6 Conclusion

Relationship lending is pervasive in credit markets. Little is known, however, on its effects on firm entry and the resulting implications for the macroeconomy. Using data from the Italian local credit markets, we have found that a stronger intensity of relationships between banks and incumbent firms slows down entry, while increasing entrants' size. It also tilts entry towards spinoffs from incumbents rather than de novo entries. The evidence suggests that banks' accumulation and reuse of information contributes to these effects. To rationalize these patterns, we have developed a dynamic general equilibrium model in which information accumulated by lenders in credit relationships flows to spinoffs that originate from incumbents. On the other hand, information accumulation in relationships can crowd out lenders' screening and monitoring of entrants, especially de novo entrants. The calibrated model matches the impact of credit relationships on the entry rate and on the relative importance of spinoffs and de novos. The model predicts that, while slowing down entry, relationship lending can raise output by expanding firms' investment scale and

reallocating credit towards spinoffs, which benefit from the information accumulated by lenders.

The analysis leaves open relevant questions. In the model we have abstracted from technological differences between entrants and incumbents. A strand of literature maintains that new firms are sometimes quicker in introducing new technologies, while other studies highlight that older firms can count on a more experienced labor force. If entrants are more (less) productive, by depressing entry relationship lending could negatively (positively) influence firms' average productivity. A second interesting question regards the formation of and exit from credit relationships. In the model we have taken a parsimonious approach to modeling this process. Further research is needed to incorporate a richer, endogenous dynamics of the creation and destruction of credit relationships and of its possible interplay with banking regulations. Finally, an interesting question regards the effect that, through entry, credit relationships could have on the concentration and competitiveness of product markets. We leave these and other issues to future research.

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Online Appendices

(not for publication)

These online Appendices contain additional data information and further estimates (Appendix A), technical proofs and additional details of the model (Appendix B), as well as further model extensions and possible microfoundations (Appendix C). Specifically, Appendix A provides more information on data sources, measurement of trade secrecy (with related additional tests), measurement of co-movement, and more evidence on information spillovers. Appendix B contains technical proofs, laws of motion of agents' wealth and bequests, and robustness for alternative values of ρ and γ. Appendix C contains a possible microfoundation for the limited pledgeability of firms' investment returns, extensions with alternative assumptions on inter-bank competition, and details on the policy analysis.

Appendix A. Additional Data Information and Further Estimates

Details on data sources (complements Section 3.2) We draw data from four main sources: 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 "Startup Survey", a survey of startups carried out by the Italian Ministry of Economic Development. Moreover, for control variables and instruments, we use other databases, including data of the Italian National Institute of Statistics (ISTAT) on characteristics of the provinces; Bank of Italy data on the structure of Italian provincial banking sectors; and prior studies on human capital intensity, asset specificity, and investment specificity.

In the main text we discussed essential features of the Capitalia Survey. Data in this survey include detailed information about firms' ownership and governance, workforce, bank-firm relationships, internationalization activities, investments in innovation and R&D. Industry codes (ATECO) at different digits are also reported. As noted in the main text, we double-checked the representativeness of the Capitalia survey by comparing the distributions of manufacturing firms along a number of firm characteristics in the survey with the corresponding distributions in the 2001 Census data. These distributions are very similar in the survey and in the Census. Consider

first the distribution of firms by size. In the survey this is 39.9% for firms with 11-20 employees, 37.1% for 21-50 employees, 16.2% for 51-250 employees, 3.9% for 251-500 employees, 2.9% for more than 500 employees. In the census the distribution is: 46.2% for 11-20 employees, 37.8% for 21-50 employees, 13.9% for 51-250 employees, 1.3% for 251-500 employees, 0.8% for more than 500 employees. Regarding the distribution by geographical areas, in the census this is 37.75% for the North west, 31.06% for the North east, 18.26% for the Center, 12.92% for the South. In the survey it is 37.6% for the North west, 27.4% for the North east, 20.6% for the Center, 14.4% for the South.

Data on firm entry and on firm exit come predominantly from the Register of the Italian Chambers of Commerce. The Italian Business Register contains information (incorporation, amendments, cessation of trading) for all firms with any legal status and within any sector of economic activity, with headquarters or local branches within Italy, as well as any other subjects as required by law. The Business Register contains all the main information on companies (name, statute, management, headquarters, etc.) and all the subsequent events occurred after registration (for example changes to the statute and to company officers, changes in registered address, liquidation, insolvency proceedings, etc.). We also construct an alternative indicator of firm entry using the Orbis database of Bureau Van Dick (the share of firms with no more than two years of activity). Orbis provides information on more than 365 million companies across the globe. Orbis obtains and treats data from more than 160 separate providers. As noted in the main text, the data used to construct the alternative measure of firm entry are available for the years 2004-2006.

To study firms' mode of entry we rely on the "Startup Survey", a survey of start-ups carried out by the Italian Ministry of Economic Development (MISE). In March 2016, ISTAT and MISE launched the "Startup Survey", the first national statistical survey of startups. The survey targeted a representative sample of startups. On the survey end date (May 2016), 2,250 startups had completed the questionnaire. About 58% of the companies interviewed were located in the North of Italy: 31.2% in the North West and 26.8% in the North East. The other areas of the country were also well represented: 22% were based in the South and 20% in the Centre. Both the territorial distribution and the sector distribution of the respondents reflected the population of startups as a whole. 60.2% of companies recorded a value of production of up to €100,000 in the 2015, 30.1% between 100,000 and 500,000, and 9.6% generated more than €500,000.

As noted in the main text, we use the Orbis database to measure the share of entrants obtaining credit and the average credit extended to an entrant in a province and sector, as well as the total value added of all firms, incumbent firms and entrant firms in a province and sector.

We use the book "Struttura funzionale e territoriale del sistema bancario italiano 1936–1974" and the Statistical Bulletin of the Bank of Italy for our instrumental variables and for the control variables about the structure of local banking sectors. The book contains historical data on the regional structure of the Italian banking system, such as the number of financial institutions by type (e.g., savings bank) and province for the 1936–1974 period. The Statistical Bulletin is a quarterly publication that contains a wide range of data on financial intermediaries, interest rates, monetary aggregates, and other information collected by the Bank of Italy. In particular, this data set contains demographic information on banks' branches sorted by province.

Finally, the Lerner index was obtained from Coccorese and Pellecchia (2013).

Measurement of trade secrecy use (complements Section 3.5) In Appendix Table 6, we reestimate the regression in column 3 of Table 5A differentiating firms according to the importance of trade secrecy in the sector. In line with expectations, we find evidence that the incentive of relationship banks to conceal information from entrants is especially strong in sectors in which trade secrecy is more relevant.

To measure the reliance of incumbent firms on trade secrecy in different industries we refer to the Community Innovation Survey (CIS). The CIS is a survey of innovation activity in European firms. The survey is designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation. Using this survey, we compute the share of firms using trade secrets by economic sector. This measure is based on the following survey question: "How effective were the following methods for maintaining or increasing the competitiveness of product and process innovations introduced during the last two years? Patents; Design registration; Copyright; Trademarks; Lead time advantages; Complexity of goods or services; Secrecy (include non-disclosure agreements)."

Measurement of co-movement (complements Section 3.5) For the sectoral measure of asset specificity used in Table 5B, we use the degree of co-movement between the value added of the firm and that of other firms in the same industry (Guiso and Minetti, 2010). 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 co-movement of sales from Guiso and Minetti (2010), who compute it using data from Compustat firms over the period 1950-2000 for a total of 251,782 firm-year observations. Guiso and Minetti (2010) 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 impute this measure to the firms in our sample using the industry code.

More evidence on negative spillovers ($F'(.) < 0$) (complements Section 5.1) As noted in the main text, we verified whether in the data there is some evidence of a negative association between, e.g., asset liquidation values and the aggregate stock of loans to incumbents. To this end, we considered provincial data from the Italian National Institute of Statistics (ISTAT) database on firms' assets recovery values in court proceedings. We estimated a simple regression in which the dependent variable is the average share of recoverable asset value and the independent variable is the aggregate value of loans to incumbents in the province (Orbis data). The estimated coefficient suggests that an increase by 1 million in the value of loans to incumbents reduces the average share of recoverable asset value by 1.28 percentage points (statistically significant at the 5% level).

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Appendix B. Technical Proofs and Further Model Details

Proof of Lemma 1 We guess, and later verify, that the investment decision follows the threshold strategy

$$V^I(w_{i,t-1}, A_{i,t}) > V^r(w_{i,t-1}) \quad \text{if} \quad A_{i,t} > \hat{A}_t^I.$$

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

$$V^I(w_{i,t-1}, A_{i,t}) = \max_{c_{i,t}, w_{i,t}} \pi \left[\log(c_{i,t}) - \frac{\zeta}{\pi} + \int_0^{\hat{A}_{t+1}^I} V^r(w_{i,t}) dG(A_{i,t+1}) + \int_{\hat{A}_{t+1}^I}^{\overline{A}} V^I(w_{i,t}, A_{i,t+1}) dG(A_{i,t+1}) \right],$$

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

Combining the first order conditions of $c_{i,t}$ and $w_{i,t}$, we obtain

$$\frac{1}{c_{i,t}} = \int_0^{\hat{A}_{t+1}^I} \frac{\partial V^r(w_{i,t})}{\partial w_{i,t}} dG(A_{i,t+1}) + \int_{\hat{A}_{t+1}^I}^{\overline{A}} \frac{\partial V^I(w_{i,t}, A_{i,t+1})}{\partial w_{i,t}} dG(A_{i,t+1}).$$

Using the equation above, the envelope condition

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

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

$$\frac{1}{c_{i,t}} = \int_0^{\hat{A}_{t+1}^I} \frac{\pi}{(1-\pi) w_{i,t}} dG(A_{i,t+1}) + \int_{\hat{A}_{t+1}^I}^{\overline{A}} \frac{\pi R^I(A_{i,t+1})}{c_{i,t+1}} dG(A_{i,t+1}). \tag{39}$$

We now use equation (39) to verify that $c_{i,t} = (1-\pi) R^I(A_{i,t}) w_{i,t-1}$ and $w_{i,t} = \pi R^I(A_{i,t}) w_{i,t-1}$ for incumbents. Under this guess, the right-hand-side of equation (39) becomes

$$\begin{aligned} &\int_0^{\hat{A}_{t+1}^I} \frac{\pi}{(1-\pi) w_{i,t}} dG(A_{i,t+1}) + \int_{\hat{A}_{t+1}^I}^{\overline{A}} \frac{\pi R^I(A_{i,t+1})}{(1-\pi) R^I(A_{i,t+1}) w_{i,t}} dG(A_{i,t+1}) \\ =& \frac{\pi}{(1-\pi) w_{i,t}} = \frac{1}{(1-\pi) R^I(A_{i,t}) w_{i,t-1}} = \frac{1}{c_{i,t}}, \end{aligned}$$

so the guess is verified.

We then prove the solution to the value function $V^I(w_{i,t-1}, A_{i,t})$ in Lemma 1. The Bellman

equation for incumbents can be written as

$$V^I(w_{i,t-1}, A_{i,t}) = \max_{c_{i,t}, w_{i,t}} \pi \left[\log(c_{i,t}) - \frac{\zeta}{\pi} + V^r(w_{i,t}) + \int_{\hat{A}^I_{t+1}}^{\overline{A}} V^I(w_{i,t}, A_{i,t+1}) - V^r(w_{i,t}) dG(A_{i,t+1}) \right].$$

Using the verified policy functions $c_{i,t} = (1-\pi) R^I(A_{i,t}) w_{i,t-1}$ and $w_{i,t} = \pi R^I(A_{i,t}) w_{i,t-1}$, 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

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

which completes the proof of Lemma 1.

Proof of Lemma 3 Let us consider de novo entrants. Exploiting (30), de novos' investment payoff, $\left[1 - \lambda F(L^I_t)\right] R i_{i,t}$, can be expressed as $R^N(A_{i,t}) w_{i,t-1}$, where

$$R^N(A_{i,t}) \equiv \frac{\left[1 - \lambda F(L^I_t)\right] R}{1 - \lambda F(L^I_t) \left[\pi R + (1-\pi) A_{i,t}\right]}. \tag{40}$$

De novos with wealth $w_{i,t-1}$ solve

$$\begin{aligned} V^N(w_{i,t-1}, A_{i,t}) = \max_{c_{i,t}, w_{i,t}, i_{i,t}, d_{i,t}} \pi \Bigg[& \log(c_{i,t}) - \frac{\zeta}{\pi} \\ & + \rho \left(\int_0^{\hat{A}^I_{t+1}} V^r(w_{i,t}) dG(A_{i,t+1}) + \int_{\hat{A}^I_{t+1}}^{\overline{A}} V^I(w_{i,t}, A_{i,t+1}) dG(A_{i,t+1}) \right) \\ & + (1-\rho) \left(\int_0^{\hat{A}^N_{t+1}} V^r(w_{i,t}) dG(A_{i,t+1}) + \int_{\hat{A}^N_{t+1}}^{\overline{A}} V^N(w_{i,t}, A_{i,t+1}) dG(A_{i,t+1}) \right) \Bigg]. \end{aligned} \tag{41}$$

Assumption 1 ensures that de novo entrants need a downpayment to borrow. Following the same steps as those in the Proof of Lemma 1, we know that, conditional on investing, a de novo entrant's consumption function and value function respectively satisfy

$$c_{i,t} = (1-\pi) R^N(A_{i,t}) w_{i,t-1}, \tag{42}$$

$$V^N(w_{i,t-1}, A_{i,t}) = V^r(w_{i,t-1}) + \Gamma^N_t(A_{i,t}), \tag{43}$$

where $\Gamma_t^N(A_{i,t})$, the gap between de novo entrant value and retiree value, now equals

$$\begin{aligned}\Gamma_t^N(A_{i,t}) &= \pi\left[\frac{\log R_t^N(A_{i,t})}{1-\pi}-\frac{\zeta}{\pi}\right]+ \\ &\pi\rho\int_{\hat{A}_{t+1}^I}^{\overline{A}}\Gamma_{t+1}^I(A_{i,t+1})dG(A_{i,t+1})+\pi(1-\rho)\int_{\hat{A}_{t+1}^N}^{\overline{A}}\Gamma_{t+1}^N(A_{i,t+1})dG(A_{i,t+1}). \quad (44)\end{aligned}$$

A de novo entrant invests if and only if $V^N(w_{i,t-1},A_{i,t})>V^r(w_{i,t-1})$. Therefore, the threshold $\hat{A}_t^N$ above which de novos invest solves the recursive equation $\Gamma_t^N(\hat{A}_t^N)=0$, where the expression for $R^N(\hat{A}_t^N)$ is obtained from (40).

A totally analogous reasoning can be carried out, *mutatis mutandis*, for spin-offs.

Proof of Proposition 1 The proof follows from direct comparison of Lemmas 2 and 3.

Laws of Motion of Wealth and Bequests and Steady State (complements Section 4.4) We here specify the law governing the evolution of wealth over time for incumbents (W_t^I), spinoffs (W_t^S), de novos (W_t^N) and retirees (W_t^r). Incumbents' wealth evolves according to

$$W_t^I=\pi^2\int_{\hat{A}_t^I}^{\overline{A}}R_t^I(A_{i,t})dG(A_{i,t})W_{t-1}^I+\pi^2\int_{\hat{A}_t^N}^{\overline{A}}R_t^N(A_{i,t})dG(A_{i,t})W_{t-1}^N+\pi^2\int_{\hat{A}_t^S}^{\overline{A}}R_t^S(A_{i,t})dG(A_{i,t})W_{t-1}^S.$$

Let the total amount of bequests made in period t be

$$B_t=(1-\pi)W_{t-1}^r+(1-\pi)G(\hat{A}_t^I)W_{t-1}^I+(1-\pi)G(\hat{A}_t^N)W_{t-1}^N+(1-\pi)G(\hat{A}_t^S)W_{t-1}^S. \quad (45)$$

Then we have

$$\begin{aligned}W_t^N &= B_t\frac{1}{1+\sigma\left(M_t^I+M_t^N+M_t^S\right)}, \\ W_t^S &= B_t\frac{\sigma\left(M_t^I+M_t^N+M_t^S\right)}{1+\sigma\left(M_t^I+M_t^N+M_t^S\right)}, \\ W_t^r &= \pi^2W_{t-1}^r+\pi^2G(\hat{A}_t^I)W_{t-1}^I+\pi^2G(\hat{A}_t^N)W_{t-1}^N+\pi^2G(\hat{A}_t^S)W_{t-1}^S.\end{aligned}$$

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

In steady state the measures of incumbents, de novos and spinoffs are

$$M^N = 1 - G(\hat{A}^N), \tag{46}$$

$$M^I = \frac{\pi \left[1 - G(\hat{A}^I)\right] \left[1 - G(\hat{A}^N)\right]}{1 - \pi \left[1 - G(\hat{A}^I)\right] - \sigma \left[1 - G(\hat{A}^S)\right]}, \tag{47}$$

$$M^S = \frac{\sigma \left[1 - G(\hat{A}^S)\right] \left[1 - G(\hat{A}^N)\right]}{1 - \pi \left[1 - G(\hat{A}^I)\right] - \sigma \left[1 - G(\hat{A}^S)\right]}. \tag{48}$$

Therefore, the steady state measure of entrants is

$$M^N + M^S = \frac{\left[1 - G(\hat{A}^N)\right] \left\{1 - \pi \left[1 - G(\hat{A}^I)\right]\right\}}{1 - \pi \left[1 - G(\hat{A}^I)\right] - \sigma \left[1 - G(\hat{A}^S)\right]}, \tag{49}$$

while the steady state ratio of entrants to incumbents is

$$\frac{M^N + M^S}{M^I} = \frac{1 - \pi \left[1 - G(\hat{A}^I)\right]}{\pi \left[1 - G(\hat{A}^I)\right]}, \tag{50}$$

and the steady state ratio of spinoffs to total entrants equals

$$\frac{M^S}{M^N + M^S} = \frac{\sigma \left[1 - G(\hat{A}^S)\right]}{1 - \pi \left[1 - G(\hat{A}^I)\right]}. \tag{51}$$

Robustness for Information Accumulation ($\rho < 1$) (complements Section 5.4) In Appendix Table 8 and in Appendix Figure 3, we show the robustness of the results to letting ρ take values lower than one, so that the accumulation of relationship lenders' information on incumbents is more gradual. All the results of the analysis carry through. Below, we also show agents' measures and law of wealth accumulation for the case $\rho < 1$.

Recall that with probability ρ the lender upgrades to higher information in the following period. We then need to distinguish those incumbents who benefit from relationship banking ("relational" incumbents) from those who do not ("non-relational" incumbents). The measures of de novos (M_t^N), spinoffs (M_t^S), "relational" incumbents (M_t^I) and "non-relational" incumbents (M_t^{IN}, M_t^{IS}) can then be, respectively, expressed as

$$M_t^N = 1 - G(\hat{A}_t^N),$$

$$M_t^S = \left[1 - G(\hat{A}_t^S)\right] \sigma \left(M_{t-1}^I + M_{t-1}^{IN} + M_{t-1}^{IS} + M_{t-1}^N + M_{t-1}^S\right),$$

$$M_t^I = \left[1 - G(\hat{A}_t^I)\right] \left[\pi\rho \left(M_{t-1}^{IN} + M_{t-1}^{IS} + M_{t-1}^N + M_{t-1}^S\right) + \pi M_{t-1}^I\right],$$

$$M_t^{IN} = \left[1 - G(\hat{A}_t^N)\right] (1-\rho)\, \pi \left(M_{t-1}^{IN} + M_{t-1}^N\right),$$

$$M_t^{IS} = \left[1 - G(\hat{A}_t^S)\right] (1-\rho)\, \pi \left(M_{t-1}^{IS} + M_{t-1}^S\right).$$

We can now state the law governing the evolution of wealth over time for all types of entrepreneurs and for retirees. Relational incumbents' (W_t^I) and non-relational incumbents' (W_t^{IN}, W_t^{IS}) wealth, respectively, evolves according to

$$\begin{aligned} W_t^I &= \pi^2 \int_{\hat{A}_t^I}^{\overline{A}} R_t^I(A_{i,t}) dG(A_{i,t}) W_{t-1}^I + \pi^2\rho \int_{\hat{A}_t^N}^{\overline{A}} R_t^N(A_{i,t}) dG(A_{i,t}) \left(W_{t-1}^N + W_{t-1}^{IN}\right) + \\ &\quad + \pi^2\rho \int_{\hat{A}_t^S}^{\overline{A}} R_t^S(A_{i,t}) dG(A_{i,t}) \left(W_{t-1}^S + W_{t-1}^{IS}\right), \end{aligned}$$

$$W_t^{IN} = \pi^2 (1-\rho) \int_{\hat{A}_t^N}^{\overline{A}} R_t^N(A_{i,t}) dG(A_{i,t}) \left(W_{t-1}^N + W_{t-1}^{IN}\right),$$

$$W_t^{IS} = \pi^2 (1-\rho) \int_{\hat{A}_t^S}^{\overline{A}} R_t^S(A_{i,t}) dG(A_{i,t}) \left(W_{t-1}^S + W_{t-1}^{IS}\right),$$

Let the total amount of bequests made in period t be

$$B_t = (1-\pi)W_{t-1}^r + (1-\pi)G(\hat{A}_t^I)W_{t-1}^I + (1-\pi)G(\hat{A}_t^N)\left(W_{t-1}^N + W_{t-1}^{IN}\right) + (1-\pi)G(\hat{A}_t^S)\left(W_{t-1}^S + W_{t-1}^{IS}\right).$$

We can then finally express the wealth for de novos (W_t^N), spinoffs (W_t^S) and retirees (W_t^r) as

$$\begin{aligned} W_t^N &= B_t \frac{1}{1 + \sigma\left(M_t^I + M_t^N + M_t^S + M_t^{IN} + M_t^{IS}\right)}, \\ W_t^S &= B_{t-1} \frac{\sigma\left(M_t^I + M_t^N + M_t^S + M_t^{IN} + M_t^{IS}\right)}{1 + \sigma\left(M_t^I + M_t^N + M_t^S + M_t^{IN} + M_t^{IS}\right)}, \\ W_t^r &= \pi^2 W_{t-1}^r + \pi^2 G(\hat{A}_t^I) W_{t-1}^I + \pi^2 G(\hat{A}_t^N)\left(W_{t-1}^N + W_{t-1}^{IN}\right) + \pi^2 G(\hat{A}_t^S)\left(W_{t-1}^S + W_{t-1}^{IS}\right). \end{aligned}$$

Appendix C. Microfoundations and Further Model Extensions

Justification for Lenders' Verification Problem (complements Section 4.1) In the baseline analysis, a lender can appropriate a fraction $\lambda\Psi^J_{\omega,t}$ of the returns (output or asset liquidation proceeds) of the entrepreneur, for $J = A, H$ and $\omega \in \{I, N, S\}$. In what follows, we lay out a way to endogenize the problem that underlies the limited appropriation ability of the lender. As in Kiyotaki and Moore (1997), Jermann and Quadrini (2012), Perri and Quadrini (2018) and Diamond and Rajan (2001), in order to induce a renegotiation of the initial loan contract, the entrepreneur can threaten to withhold her skills necessary for carrying out production or liquidation of the firm's investment. Moreover, the lender is unable to perfectly substitute the entrepreneur in case the latter withholds her production or liquidation skills. In particular, the outside value the lender would be able to obtain is lower than what the entrepreneur can obtain (the inside value). There is therefore a combination of limited commitment of the entrepreneur to using her production and liquidation skills (moral hazard) together with limited capability of lenders to replace entrepreneurs if they withhold their skills.

When the entrepreneur threatens to withhold her skills, entrepreneur and lender bargain over the surplus associated with the entrepreneur's skills, relative to the lender's. In the renegotiation, we let the lender have zero bargaining power vis-à-vis the entrepreneur (as, e.g., in Diamond and Rajan, 2001, and Jermann and Quadrini, 2012), so the lender will be pushed down to obtaining what he could produce or liquidate by himself.

As noted above, in line with prior studies, we can think that a lender has limited capability to replace the entrepreneur in production or liquidation. For example, as argued by Diamond and Rajan (2001), the lender can have a limited understanding of how the business was built, where personnel was hired from and where assets were purchased.[45] And, as discussed by Jermann and Quadrini (2012), the limited skills of the lender relative to the entrepreneur can materialize in limited knowledge on the markets for the firm's products or assets. In case of asset liquidation, for example, this will hinder the lender's ability to identify the best alternative users of the assets. In our setting, similarly to Diamond and Rajan (2001), the capability of a lender to replace the entrepreneur depends on the knowledge the lender has about production and liquidation. Indeed,

[45] Mahone (2021) documents the presence of significant frictions in the secondary markets for private businesses in the United States.

we could also think that in every period some of this information must be relearned by the lender, as there could be shocks to the market for assets, for example.

This theoretical background justifies the different pledgeability parameters assumed for our three types of entrepreneurs. The established relationship between the incumbent and the lender implies that the latter has a deeper knowledge of the project and assets and, hence, can recover a higher fraction of the firm's value, both in case of success and in case of asset liquidation. The absence of such relationship for de novo entrepreneurs, on the other hand, explains the lower pledgeability of their project returns and assets. Finally, spinoffs are founded by managers who are already known by the lender. As a result, if the manager withholds her skills, the lender may be able to exploit the knowledge of the project and recover a fraction of the project returns higher than in the case of de-novo entrepreneurs ($\bar{\Psi}\psi_S > F(L)$). This fraction is, however, (weakly) lower than that of incumbents, because the business characteristics (e.g., the sector, the local market) of the entrepreneurial venture founded by the manager may be different from those of the original incumbent firm ($\psi_S \leq \psi_I$). Such differences also contribute to explain why, in the model, the pledgeable value of the spinoffs' assets is assumed to be the same as that of de novos. If, for instance, the manager moves to a different local market, it may be hard for the lender to recover the value of the assets in case of liquidation. Moreover, firms' assets can be inherently specific to the firm, so that the lender's knowledge of the manager does not help him to recover the asset value of the liquidated firm any better than that of de novos.

Alternative Assumptions on Inter-bank Competition (complements Section 4.3) In the baseline analysis, a lender's participation constraint is always binding, as the lender does not extract surplus from the entrepreneur's project. In this Appendix section, we relax this assumption and show that the insights of the baseline analysis carry through when we let a lender extract some surplus from the entrepreneur's project. We posit that the lender from which the entrepreneur borrows funds for his project can, after granting credit, threaten to withhold her financing. We consider two possible scenarios for the outside option of the entrepreneur in case a lender reneges on her credit. In a first scenario, the firm has just to give up the investment in the project. In the second scenario, the firm can still resort to another lender, who however is less efficient in verifying the entrepreneur's returns and, hence, can finance a smaller investment. We let α denote

the bargaining power of the lender in the renegotiation with the entrepreneur.

In the first scenario, we have

$$V^I(w_{i,t-1}, A_{i,t}) = \max_{c_{i,t}, w_{i,t}, i_{i,t}, d_{i,t}} \pi \left[\log(c_{i,t}) - \frac{\zeta}{\pi} + \int_0^{\overline{A}} \max\{V^r(w_{i,t}), V^I(w_{i,t}, A_{i,t+1})\} dG(A_{i,t+1}) \right]$$

$$\text{s.t.} \quad c_{i,t} + w_{i,t} = R i_{i,t} - R^L_{i,t} \left(i_{i,t} - w_{i,t-1} \right), \tag{52}$$

$$\pi \lambda \overline{\Psi} \psi_I R i_{i,t} + (1-\pi) \lambda \overline{\Psi} \psi_I A_{i,t} i_{i,t} \geq \alpha \left[(\pi R i_{i,t} + (1-\pi) A_{i,t} i_{i,t}) - i_{i,t} \right] + i_{i,t} - w_{i,t-1}, \tag{53}$$

$$\lambda \overline{\Psi} \psi_I R i_{i,t} \geq R^L_{i,t} \left(i_{i,t} - w_{i,t-1} \right), \tag{54}$$

$$\lambda \overline{\Psi} \psi_I \geq d_{i,t}, \tag{55}$$

In words, as (53) shows, the lender appropriates her outside option, $i_{i,t} - w_{i,t-1}$, plus a fraction α of the surplus generated by the investment project, $\pi R i_{i,t} + (1-\pi) A_{i,t} i_{i,t} - i_{i,t}$. After simple algebra, we obtain

$$\pi R i_{i,t} (\lambda \overline{\Psi} \psi_I - \alpha) + (1-\pi) A_{i,t} i_{i,t} \left(\lambda \overline{\Psi} \psi_I - \alpha \right) \geq i_{i,t} (1-\alpha) - w_{i,t-1}, \tag{56}$$

or

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \alpha - \left(\lambda \overline{\Psi} \psi_I - \alpha \right) \left[\pi R + (1-\pi) A_{i,t} \right]} \tag{57}$$

When $\alpha = 0$, this boils down to the expression of the baseline setting $i_{i,t} = \frac{w_{i,t-1}}{1 - \lambda \overline{\Psi} \psi_I [\pi R + (1-\pi) A_{i,t}]}$.

The second scenario occurs when, in case credit is reneged, the entrepreneur can turn to an alternative lender who however is less efficient in verifying the entrepreneur's returns ($\widehat{\psi}_I < \psi_I$). Let $\widehat{i}_{i,t}$ denote the investment that could be realized if the entrepreneur turned to this alternative lender. We have that the optimization problem of the entrepreneur is isomorphic to that under the first scenario except that (53) is replaced by

$$\pi \lambda \overline{\Psi} \psi_I R i_{i,t} + (1-\pi) \lambda \overline{\Psi} \psi_I A_{i,t} i_{i,t} \geq \alpha \left\{ i_{i,t} \left[\pi R + (1-\pi) A_{i,t} - 1 \right] - \widehat{i}_{i,t} \left[\pi R + (1-\pi) A_{i,t} - 1 \right] \right\} + i_{i,t} - w_{i,t-1}, \tag{58}$$

or

$$i_{i,t} = \frac{w_{i,t-1} + \alpha \widehat{i}_{i,t} \left[\pi R + (1-\pi) A_{i,t} - 1 \right]}{1 - \alpha - \left(\lambda \overline{\Psi} \psi_I - \alpha \right) \left[\pi R + (1-\pi) A_{i,t} \right]}$$

where

$$\widehat{i}_{i,t} = \frac{w_{i,t-1}}{1 - \lambda \overline{\Psi} \widehat{\psi}_I \left[\pi R + (1-\pi) A_{i,t} \right]}.$$

Replacing $\widehat{i}_{i,t}$ into the above expression for $i_{i,t}$,

$$i_{i,t} = \frac{w_{i,t-1}}{1 - \lambda\overline{\Psi}\widehat{\psi}_I \left[\pi R + (1-\pi) A_{i,t}\right]} \frac{1 - \alpha - (\lambda\overline{\Psi}\widehat{\psi}_I - \alpha)\left[\pi R + (1-\pi) A_{i,t}\right]}{1 - \alpha - \left(\lambda\overline{\Psi}\psi_I - \alpha\right)\left[\pi R + (1-\pi) A_{i,t}\right]}.$$

It is immediate that in both the above scenarios the level of investment is related to the pledgeability parameters in a manner similar to the baseline analysis.

The Problem of a Policy Maker (complements Section 5.4) As noted in the main text, the presence of knowledge spillovers flowing from incumbents to entrants raises the possibility that credit be misallocated across the different categories of entrepreneurs. In this section, we study the problem of a policy maker who is subject to the same pledgeability constraints as private agents and can control credit allocation through one regulatory instrument, a loan to value ratio on incumbent and/or entrant entrepreneurs.[46] In particular, we posit that the policy maker can impose a regulatory limit (ψ_P) on the amount of loan that an entrepreneur can obtain from a private lender, for each unit of pledged returns (output and asset liquidation value). The policy maker cares about the total output of the economy. To the extent that the policy maker is able to implement a scheme of taxes and transfers ex post (after output is produced), it can be shown that this is equivalent to treating total welfare as the policy objective (in fact, by reallocating the total output among agents through ex post taxes and transfers, the policy maker could neglect concavities in utility functions).

It is immediate that the policy maker would never set $\psi_P \geq \psi_I$, as in this case the regulatory limit would be (weakly) looser than the private pledgeability constraint and, hence, would not be binding. It is also immediate that the policy maker would not set $\psi_P < F(L)$. This would restrict the access to credit of entrants, reducing their investment and output, with no benefit for incumbents' investment and output. In what follows, we show that instead the policy maker can choose $\psi_P < \psi_I$, restricting an incumbent's borrowing below what would be implied by the pledgeability of the incumbent's returns.

Using simple algebra, we obtain that in this augmented setting the investment of an incumbent equals

$$i_{i,t}^P = \frac{w_{i,t-1}}{1 - \lambda\overline{\Psi}\min\left\{\psi_P, \psi_I\right\}\left[\pi R + (1-\pi) A_{i,t}\right]} \tag{59}$$

[46] In our model, all projects are profitable as $\pi R > 1$. This model feature renders the problem of optimal credit allocation relatively uninteresting, because an unconstrained social planner would finance all projects indistinctively.

and the investment payoff to an incumbent then satisfies

$$\left(1-\lambda\overline{\Psi}\min\left\{\psi_P,\psi_I\right\}\right)Ri_{i,t}^{P} = R^{I,P}(A_{i,t})w_{i,t-1}, \tag{60}$$

$$\text{where } R^{I,P}(A_{i,t}) = \frac{\left(1-\lambda\overline{\Psi}\max\left\{\psi_P,\psi_I\right\}\right)R}{1-\lambda\overline{\Psi}\min\left\{\psi_P,\psi_I\right\}\left[\pi R+(1-\pi)A_{i,t}\right]}. \tag{61}$$

It is easy to verify that, for given wealth, under a binding regulation ($\psi_P<\psi_I$), $i_{i,t}^{P}<i_{i,t}$ and $R^{I,P}(A_{i,t})<R^{I}(A_{i,t})$, that is, for given wealth, an incumbent will receive a smaller loan than in the private equilibrium and expect a lower return from his investment project. This also implies that the threshold asset value $\hat{A}_t^{I,P}$ below which an incumbent will not invest tends be higher than in the private equilibrium and satisfies

$$\frac{\log R^{I,P}(\hat{A}_t^{I,P})}{1-\pi}-\frac{\zeta}{\pi}+\int_{\hat{A}_{t+1}^{I,P}}^{\overline{A}}\Gamma_{t+1}^{I}(A_{i,t+1})dG(A_{i,t+1})=0.$$

A lower loan amount received by each active incumbent, and a lower measure of active incumbents ($M^{I,P}<M^{I}$), will imply a lower stock of relationship loans to incumbents (let this be denoted by $L_t^{I,P}$). Steady state output can be expressed as

$$\begin{aligned} Y^{I}+Y^{N+S} = {} & M^{I,P}\int_{\hat{A}^{I,P}}^{\bar{A}}\frac{\overline{w}^{I,P}\left[\pi R+(1-\pi)A-1\right]}{1-\lambda\overline{\Psi}\psi_P[\pi R+(1-\pi)A]}dG+ \\ & +M^{N,P}\int_{\hat{A}^{N,P}}^{\bar{A}}\frac{\overline{b}^{P}\left[\pi R+(1-\pi)A-1\right]}{1-\lambda F(L_t^{I,P})[\pi R+(1-\pi)A]}dG+ \\ & +M^{S,P}\int_{\hat{A}^{S,P}}^{\bar{A}}\frac{\overline{b}^{P}\left[\pi R+(1-\pi)A-1\right]}{1-\lambda[\pi R\overline{\Psi}\min\left\{\psi_P,\psi_S\right\}+(1-\pi)AF(L_t^{I,P})]}dG. \end{aligned}$$

The effects of a binding regulation ($\psi_P<\psi_I$) on the previous expression can be ordered as follows.

Incumbents. As noted above, for given wealth, each active incumbent will receive a lower loan amount. This will also tend to push down the measure of active incumbents. Both forces tend to depress incumbents' output and reduce the first addend. Observe, however, that in the general equilibrium the wealth of incumbents ($\overline{w}^{I,P}$) is affected too, as it comes from the wealth accumulation of entrants (whose investment and returns will be affected by the policy). This wealth effect can contrast the first two forces, possibly attenuating their impact on incumbents' output.

Entrants. The impact on entrants (the second and third addend) is twofold. (a) On the one hand, the lower stock of loans to incumbents boosts the value of $F(\cdot)$, that is $F(L^{I,P})>$

$F(L^I)$. Intuitively, the limited monitoring capacity is now reallocated from incumbents to entrants, increasing the pledgeability of their returns. Through this channel, the loan amount received by all entrants tends to increase, and the thresholds of entrants tend to drop. (b) On the other hand, the lower returns of incumbents may depress the bequests received by entrants ($\bar{b}^P < \bar{b}$). Through this channel, the loan amount received by all entrants tends to drop, and the threshold of entrants tends to increase.

Depending on whether the spillover effect (increase of $F(\cdot)$), or the bequest effect (reduction of $\bar{b}^P$), dominates, i) the loan amount of entrants can increase or decrease; ii) the thresholds of entrants, and thus their measures, can increase or decrease. Note also that the measure of spinoffs tends also to mechanically drop because there can be less incumbents from which they originate.

If the spillover effect is sufficiently strong, then the output of entrants can increase, and if

$$-\frac{\partial Y^I}{\partial \psi_P}\bigg|_{\psi_P=\psi_I} < \frac{\partial Y^{N+S}}{\partial \psi_P}\bigg|_{\psi_P=\psi_I}$$

that is, if entrants' output increases by more than incumbents' output decreases, the policy maker will indeed set $\psi_P < \psi_I$. Put differently, in spite of reducing incumbents' output, the policy can boost total output by raising the suboptimally low entry rate towards the constrained optimal level.

We consider a numerical policy experiment under which the policy maker sets $\psi_P < \psi_I$. The results of the policy experiment can be summarized as follows. We obtain that moderately reducing the loan to value ratio of incumbents ψ_P depresses the total steady state output of the economy. In particular, the contraction of incumbents' output Y^I, due to their reduced loan amount (leverage) and their more limited participation, outweighs the increase in entrants' output induced by the lower negative spillovers. On the other hand, when the policy maker reduces incumbents' loan to value ratio ψ_P more significantly, the total steady state output of the economy starts recovering and, eventually, for significantly low values of the LTV, it ends up exceeding the total output in our baseline steady state. Intuitively, when entrants' leverage and participation rise substantially, there is a significant wealth accumulation by entrants and this turns into a significant increase in incumbents' wealth ($\overline{w}^{I,P}$). This wealth effect tends to offset the reduced leverage of incumbents, so that incumbents' output remains stable relative to our baseline steady state. Since entrants' output increases, the overall effect of the policy on total steady state output becomes positive.

Our experiment, however, reveals that the LTV policy starts exerting a positive net effect on total output only when ψ_P is sufficiently small that entrants' leverage reaches implausibly large values. For example, even when entrants' leverage rises to 3 as a result of the policy, total output drops by more than 20% and only for significantly larger leverage values of entrants, total output starts rising. This suggests that a policy maker able only to control the LTV policy tool is unable to enhance total output unless the policy takes quite extreme values.

Appendix Table 1: 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 infrastructures (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 and sector (entrants) over the number of incumbent firms in the same province and sector. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Register)
Entrants/Population	The ratio of newly registered firms in a province and sector (entrants) over the population in the province. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Register and ISTAT)
Share of firms with $\leq$ 2yrs	The share of manufacturing firms with no more than 2 years of activity in a province and sector. (Orbis)
Ratio Spin-offs (majority owners)/All entrants	Ratio in the province between spin-offs (having the majority of the owners with experience in the same industry) and all entrants. (MED)
Ratio Spin-offs (all owners)/All entrants	Ratio in the province between spin-offs (having all the owners with experience in the same industry) and all entrants. (MED)
Size at entry	Number of employees of entrant firms. (MED)
Firm spin-off probability	A dummy equal to one if a spin-off from the firm has occurred in the three years of the survey; zero otherwise. (SIMF)
Share of entrants obtaining credit	Share of entrant firms with a positive (non-negligible) amount of credit. Entrants defined based on numbers of years of activity, as for Share of firms with $\leq$ 2yrs. (Orbis)
Average credit entrants	The average amount of bank credit (million euro) to entrant firms in a province and sector. Entrants defined based on numbers of years of activity, as for Share of firms with $\leq$ 2yrs. (Orbis)
Exiters/Incumbents	The ratio of exiter firms in a province and sector over the number of incumbent firms in the same province and sector. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Register)
Total value added (log)	Logarithm of the total amount of value added (million euro) of firms in a province and sector. We compute this value for all the firms in a province/sector (All); for the incumbents firms (Incumbents) and for the entrant firms (Entrants). Entrants defined based on numbers of years of activity, as for Share of firms with $\leq$ 2yrs. (Orbis)
Main Independent Variables	
Relationship length	The average length of credit relationships in the province, in the survey wave. (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 wave. (SIMF)
Number of banks	The average number of banks of a firm in the province, in the survey wave. (SIMF)
Human capital intensity	Average years of schooling at the industry level in 1980. (Ciccone and Papaioannou, 2009)
Assets specificity	A dummy equal to one if the comovement between the sales of the firm and those of other firms in the same industry is above the median; zero otherwise. (Guiso and Minetti, 2010)
Investments specificity	Index that measures the proportion of relationship-specific investments in the sector (Nunn, 2007).
Information specific to firm	The last survey wave asks each firm: "Which of these characteristics are key in selecting your main bank?". We use responses that refer to the bank's information about the firm and its own market as well as frequent contacts with the credit officer at the bank. For each firm we construct a dummy variable equal to one if the firms indicate these characteristics. Then we construct an average index for each industry. (SIMF)
Information specific to firm assets	The last survey wave asks each firm: "In your view, which criteria does your bank follow in granting loans to you?". We use the response that refers to the bank's emphasis and information on firms' collateral assets. For each firm we construct a dummy variable equal to one if the firms indicate this characteristic. Then we construct an average index for each industry. (SIMF)
Information specific to firm innovation	The last survey wave asks each firm: "In your view, which criteria does your bank follow in granting loans to you?". We use the response that refers to the bank's information about firms' innovation capacity. For each firm we construct a dummy variable equal to one if the firms indicate this characteristic. Then we construct an average index for each industry. (SIMF)
Information on sector and local economy	The last survey wave asks each firm: "In your view, which criteria does your bank follow in granting loans to you?". We use the response that refers to the bank's information about firms' sector and local economy. For each firm we construct a dummy variable equal to one if the firms indicate these characteristics. Then we construct an average index for each industry. (SIMF)
Information on managers (embedded information)	The last survey wave asks 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 responses that refer to the bank's information about managers. For each firm we construct a dummy variable equal to one if the firms indicate these characteristics. Then we construct an average index for each industry. (SIMF)
Control Variables	
Unemployment rate (log)	Logarithm of provincial unemployment rate. For each survey wave, we take the average over the years of the wave (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 infrastructures in the province. This index includes information about: Road Network, Railways, Ports, Airports, Environmental Energy Networks, Broadband Services, Business Structure. (GEOWEB)
Population growth	Growth rate of the population in the province. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (ISTAT)
Judicial efficiency	As an inverse measure, 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)
Bank branches HHI	Herfindahl-Hirschman index of bank branches in the province. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Bank of Italy)
Bank branches/population	Number of bank branches in the province, per 1,000 inhabitants. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Bank of Italy)
Average firm age in province	The average age of the firms in the province, in the survey wave. (SIMF)
Share of top bank	Share of branches of the main bank in the province. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006). (Bank of Italy)
Bank market power index	Measure of the estimated market power of banks in the region from Coccorese and Pellecchia (2013). It ranges from 0 to 1: when is equal to 0, each bank acts as is in perfectly competitive market; when is equal to 1, banks act as in monopoly or perfect collusion. For each survey wave, we take the average over the years of the wave (1995-1997, 1998-2000, 2001-2003 and 2004-2006).
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 saving 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)

Appendix Table 2: Summary statistics

Variable	Mean	Std dev
Intensity and modes of firm entry		
Entrants/Incumbents (%)	4.990	6.705
Entrants/Population (1000 inhab.)	0.032	0.114
Share of firms with $\leq$ 2yrs (%)	17.085	16.792
Spin-offs/Entrants (majority)	0.264	0.441
Spin-offs/Entrants (all)	0.162	0.368
Size (employees) at entry	1.764	3.971
Firm spin-off probability	0.035	0.184
Share of entrants obtaining credit	0.585	0.301
Average credit (Entrants)	0.231	0.591
Exiters/Incumbents (%)	1.882	1.991
Total value added (All) (log)	3.204	1.596
Total value added (Incumbents) (log)	3.149	1.610
Total value added (Entrants) (log)	0.743	0.882
Local (provincial) intensity of relationship lending		
Credit relationship length (yrs)	17.356	4.555
Credit relationship length (over 10 y.)	0.566	0.174
Number of banks	5.325	1.427
Provincial economic, structural, and banking conditions		
Unemployment rate (log)	2.047	0.623
Trade openess (log)	-1.158	0.878
Material infrastracture (log)	4.516	0.409
Population growth	0.003	0.005
Judicial efficiency	3.792	1.400
Average firm age in province (yrs)	23.298	6.239
Bank branches HHI	0.088	0.039
Share of top bank	0.269	0.101
Bank market power index	0.139	0.013
Bank branches/Population (1000 inhab.)	0.522	0.181

Notes: This table reports summary statistics for the main variables used in the analysis. See Appendix Table 1 and Section 3.3 for further details on the variables.

Appendix Table 3: Credit relationships and firm entry (with controls)

VARIABLES	(1) Entrants/ Incumbents OLS	(2) Entrants/ Incumbents OLS	(3) Entrants/ Incumbents OLS	(4) Entrants/ Incumbents OLS	(5) Entrants/ Incumbents OLS	(6) Entrants/ Incumbents 2SLS
Relationship length	-0.047***	-0.033***	-0.036***	-0.037***	-0.047***	-0.649***
	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.137)
Provincial economic and banking conditions						
Unemployment rate (log)			2.032***	1.779***	0.819**	0.972***
			(0.224)	(0.228)	(0.313)	(0.287)
Population growth			23.182***	36.631***	131.095***	28.093***
			(8.175)	(9.317)	(14.056)	(7.808)
Branches/population			-0.505	-0.797	5.544***	-0.770*
			(0.495)	(0.538)	(1.621)	(0.453)
Herfindhal-Hirschmann Index			-8.535***	-12.079***	-61.608***	-1.919
			(1.267)	(1.463)	(3.870)	(2.203)
Structural provincial characteristics						
Average firms' age in the province			-0.009	-0.009		0.238***
			(0.012)	(0.012)		(0.057)
Trade openess (log)			-0.029	-0.039		-0.361***
			(0.092)	(0.091)		(0.105)
Material infrastracture (log)			-1.984***	-2.017***		-2.692***
			(0.162)	(0.167)		(0.228)
Judicial inefficiency			0.037	-0.022		0.116**
			(0.042)	(0.036)		(0.051)
Share of top bank				1.718***		
				(0.555)		
Bank market power index				23.360***		
				(6.539)		
Instrumental variables						
Saving banks 1936						0.132***
						(0.000)
New branches incumbent						0.020***
						(0.000)
Area fixed effects	N	Y	Y	Y	N	Y
Provincial fixed effects	N	N	N	N	Y	N
Time and Industry fixed effects	N	Y	Y	Y	Y	Y
Observations	9,384	9,384	9,292	9,292	9,384	9,292
R-squared	0.001	0.142	0.158	0.159	0.264	0.047
F instruments						37.38
Overid p value						0.003

Notes: This table reports the effects of the average length of credit relationships in a province on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. The main set of controls includes: unemployment rate, population growth, bank branches HHI, Branches/population, average firms' age, trade openess, material infrastructure and judicial efficiency. Column (4) also includes two additional controls for bank concentration: the share of the top bank and the index of bank market power. Regressions (2)-(6) include geographical area, time and industry fixed effects. In columns (2)-(4) and (6), geographical fixed effects are macro-area dummies; in column (5), they are provincial dummies (and time-invariant controls are dropped). In column (6) the provincial average length of credit relationships is instrumented using the number of provincial saving bank branches in 1936 and the number of new branches by incumbent banks in the 1991-1998 period (per 100,000 inhabitants). See Appendix Table 1 and Section 3.3 for details on the control variables. The table also reports F-tests on excluded instruments and p-values for overidentification tests. *Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 4: Further robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Additional control variables	Alternative dependent variable		Alternative clustering		Relationship length at provincial & industrial level	
VARIABLES	OLS Entrants/ Incumbents	OLS Entrants/ Population	2SLS Entrants/ Population	2SLS Entrants/ Incumbents	2SLS Entrants/ Incumbents	OLS Entrants/ Incumbents	2SLS Entrants/ Incumbents
Relationship length	-0.038***	-0.051***	-0.288*	-0.649*	-0.649*	-0.020*	1.346
	(0.008)	(0.016)	(0.174)	(0.366)	(0.372)	(0.010)	(2.640)
Share of top 3 banks	6.663***						
	(0.670)						
Bank market power index	18.546***						
	(6.346)						
Instrumental variables							
Saving banks 1936			-0.855***	0.132	0.132		0.366
			(0.000)	(0.288)	(0.282)		(0.576)
New branches incumbent			0.027***	0.020	0.020*		-0.001
			(0.000)	(0.012)	(0.012)		(0.007)
+ controls	Y	Y	Y	Y	Y	Y	Y
Area and Industry fixed effects	Y	Y	Y	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y	Y	Y	Y
Cluster level	Industry	Industry	Industry	Survey	Survey + Industry	Industry	Industry
Observations	9,292	9,292	9,292	9,292	9,292	1,032	1,032

Notes: This table reports further robustness checks for the effects of credit relationships on firm entry dynamics. In column (1) we add, as additional control variables, the share of branches of the three main banks in the province and the bank market power index. In columns (2)-(3) we consider entrants over population as the dependent variable. In columns (4)-(5) we use alternative clusterings. In columns (6)-(7) relationship length varies by province and industry. All the columns report the estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, as well as area, time and industry fixed effects. In columns (3)-(5) and (7) our proxy of credit relationship is instrumented using the number of provincial saving bank branches in 1936 and the number of new branches by incumbent banks in the 1991-1998 period (per 100,000 inhabitants). See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 5: Pairwise correlations across information indicators

	1	2	3	4	5
1. Information specific to incumbent firm	1.000				
2. Information specific to incumbent firm assets	0.210	1.000			
3. Information specific to incumbent firm innovation	0.342	0.477	0.100		
4. Information on sector and local economy	0.341	0.206	0.334	1.000	
5. Information on managers (embedded information)	0.240	0.254	0.431	0.326	1.000

Appendix Table 6: Information channels and trade secrecy

	(1)	(2)
	Trade secrecy use $>$ 41.4	*Trade secrecy use* $\leq$ 41.4
VARIABLES	Entrants/Incumbents	Entrants/Incumbents
Relationship Length	0.149***	-0.007
	(0.048)	(0.087)
Information specific to firm innovation	-0.743**	0.271
	(0.288)	(0.419)
+ controls	Y	Y
Area and Industry fixed effects	Y	Y
Observations	1,717	404
R-squared	0.282	0.178

Notes: This table reports the effects of information spillovers from credit relationships on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. In column (1), the sample includes firms in sectors in which more than 41.1% (first quartile) of the firms rely on trade secrecy. In column (2), the sample includes firms in sectors in which less than 41.1% of the firms rely on trade secrecy. See Section 3.5 for the description of all the information spillovers and Appendix Table 1 for a detailed definition of information spillover variables. All the columns report the OLS estimated coefficients and robust standard errors (clustered at industry level) in parentheses. All the regressions include control variables, area and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 7A: Credit relationships, bank information, and entry

	(1)	(2)	(3)	(4)	(5)	(6)
	Spin-off prob	Spin-off prob	Spin-off prob	Spin-off prob	Spin-off prob	Spin-off prob
	$<$ mean	$\geq$ mean	$<$ mean	$\geq$ mean	$<$ mean	$\geq$ mean
VARIABLES	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents
Relationship length	-0.306	-5.257**	-0.001	-0.121**	0.349***	0.461***
	(0.259)	(2.302)	(0.019)	(0.057)	(0.072)	(0.155)
Rel length * Human capital intensity	0.023	0.428**				
	(0.022)	(0.194)				
Rel length * Assets specificity			-0.077***	-0.242***		
			(0.023)	(0.072)		
Rel length * Investments specificity					-0.415***	-0.731***
					(0.077)	(0.151)
+ controls	Y	Y	Y	Y	Y	Y
Area, Time and Industry fixed effects	Y	Y	Y	Y	Y	Y
Observations	4,704	1,256	4,704	1,256	4,704	1,256
R-squared	0.146	0.121	0.145	0.113	0.145	0.109

Notes: This table reports the effects of information channels on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. The entrants are splitted between sector and province with less (more) propensity to spin-off. See Section 3.5 for the description of all the information channels and Appendix Table 1 for a detailed definition of information channel variables. All the columns report the OLS estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, area and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 7B: Credit relationships, bank information, and entry

VARIABLES	(1) Information specific to incumbent	(2) Information specific to incumbent	(3) Information specific to incumbent assets	(4) Information specific to incumbent assets	(5) Information specific to incumbent firm innovation	(6) Information specific to incumbent firm innovation	(7) Information on sector and local economy	(8) Information on sector and local economy	(9) Information on managers	(10) Information on managers
	Assets specificity	Investments specificity	Assets specificity	Investments specificity	Assets specificity	Investments specificity	Assets specificity	Investments specificity	Assets specificity	Investments specificity
	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents	Entrants/ Incumbents
Relationship length	0.021*	0.022*	-0.024*	0.056	0.055***	0.170***	0.027*	0.011	0.039**	0.017
	(0.012)	(0.011)	(0.013)	(0.038)	(0.016)	(0.044)	(0.014)	(0.035)	(0.014)	(0.013)
Triple interaction term	-0.162*	-0.141	-0.082	-0.369**	-0.356**	-0.847***	-0.094	0.034	-0.390	-0.001
	(0.093)	(0.093)	(0.058)	(0.150)	(0.142)	(0.259)	(0.092)	(0.219)	(0.350)	(0.131)
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area and Industry fixed eff.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time fixed effects	N	N	Y	Y	N	N	N	N	N	N
Observations	2,121	2,121	8,484	8,484	2,121	2,121	2,121	2,121	2,121	2,121
R-squared	0.313	0.313	0.158	0.158	0.292	0.299	0.313	0.313	0.294	0.287

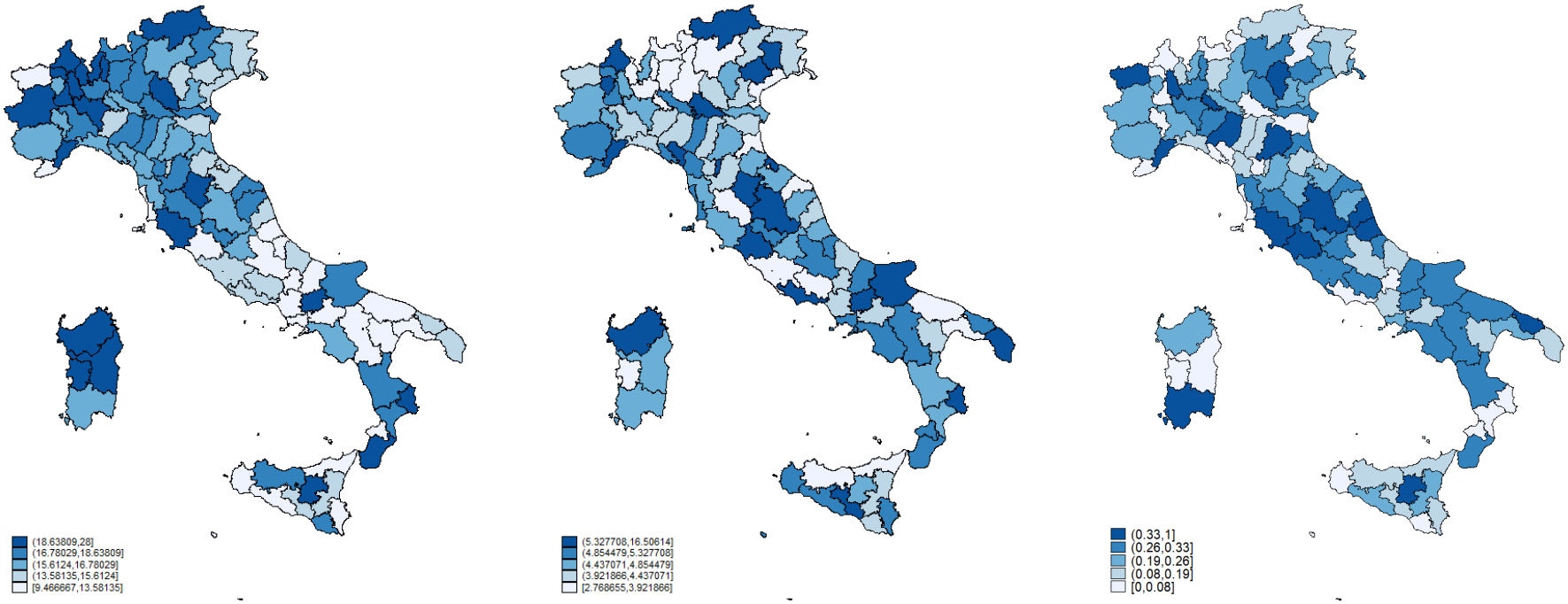
Notes: This table reports the effects of information channels on the number of newly registered firms in a province and sector (entrants) scaled by the number of incumbent firms in the same province and sector. The triple interaction term is among relationship length, the information type and the assets/investments specificity. See Section 3.5 for the description of all the information channels and Appendix Table 1 for a detailed definition of information channel variables. All the columns report the OLS estimated coefficients and robust (clustered at industry level) standard errors in parentheses. All the regressions include control variables, area and industry fixed effects. See Appendix Table 1 and Section 3.3 for details on the control variables. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix Table 8: Effect of a higher $\overline{\Psi}$ ($\rho = 0.94$)

Variable	Baseline	Higher $\overline{\Psi}$
Panel A: Firm entry		
Ratio of measure: entrants/incumbents	5.15%	4.93%
Ratio of measure: spinoffs/entrants	25.12%	25.27%
Firm size at entry (% change from baseline)	-	5.31%
Panel B: Macroeconomic variables		
Gross aggregate output (% change from baseline)	-	4.49%
Ratio of gross aggregate output: entrants/incumbents	0.48%	0.32%
Panel C: Other business sector variables		
Ratio of aggregate credit: entrants/incumbents	0.26%	0.16%
Ratio of aggregate wealth: entrants/incumbent	0.69%	0.46%

Note: $\overline{\Psi}$ in the higher-$\overline{\Psi}$ economy is set such that the average relationship length in this economy is one year longer than the baseline model.

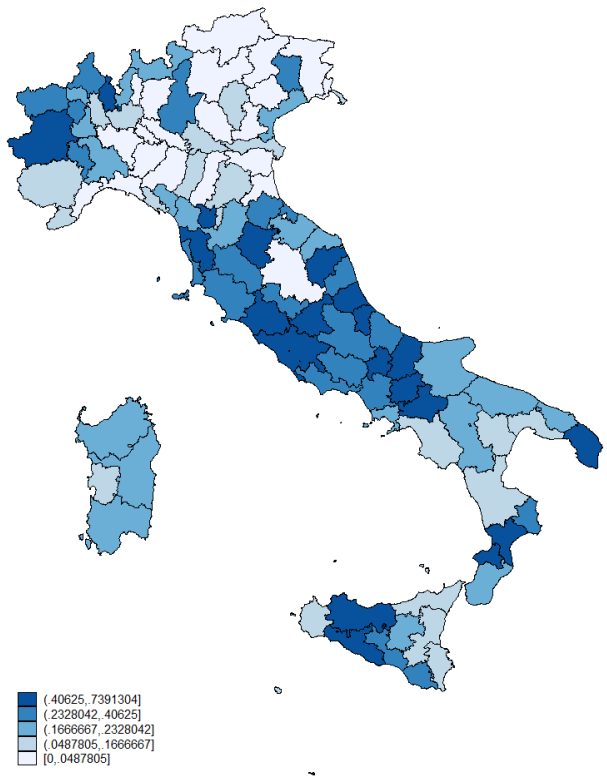
Appendix Figure 1: Credit relationship intensity, entry intensity, and entry mode by province



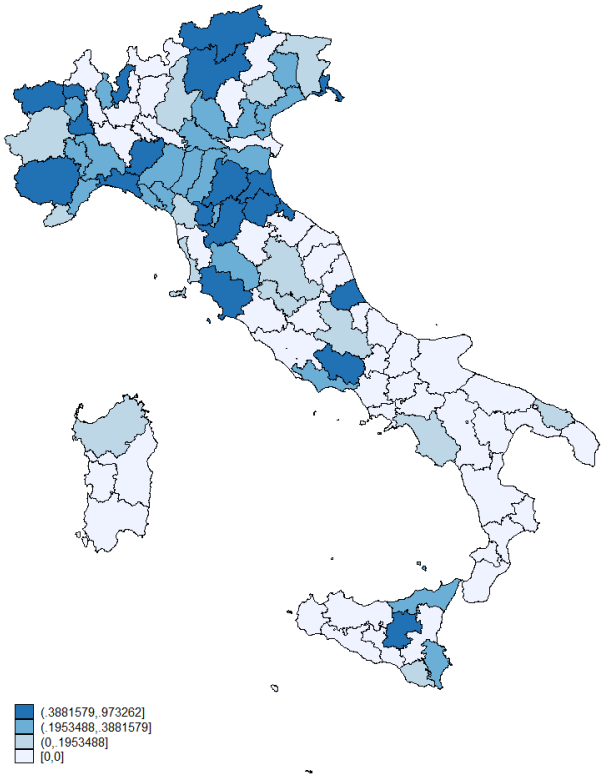
a. Credit relationship length b. Entrants/Incumbents c. Spin-offs/Entrants

Notes: This figure plots the average credit relationship length (a), the ratio of entrants over incumbents (b), and the ratio of spin-offs over entrants (c) in the Italian provinces. See Section 3.2 and, for details on sources and definitions, the Appendix Table 1.

Appendix Figure 2: Saving and national banks in Italy in 1936 by province



a. Share of national banks

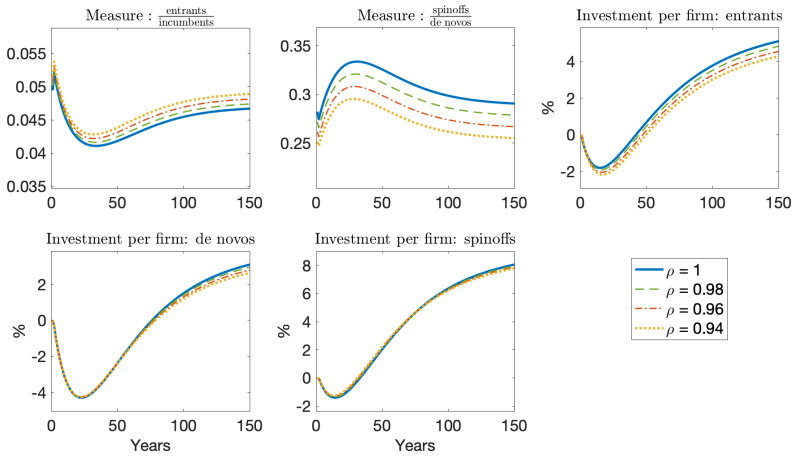


b. Share of saving banks

Notes: This figure plots the share of national (a) and savings (b) banks branches in the Italian provinces in 1936 (authors' calculations on Bank of Italy data). See Section 3.2 and, for details on sources and definitions, the Appendix Table 1.

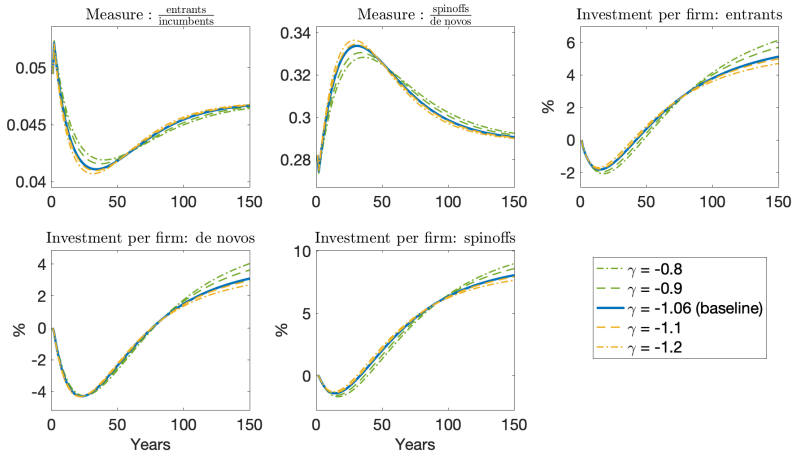
Robustness for alternative parameter values

Appendix Figure 3: Responses for Different Values of ρ



Notes: The figure shows the responses to an increase in $\overline{\Psi}$ for different values of ρ. The increase in $\overline{\Psi}$ is set to raise the average credit relationship length by one year in the baseline economy.

Appendix Figure 4: Responses for Different Values of γ



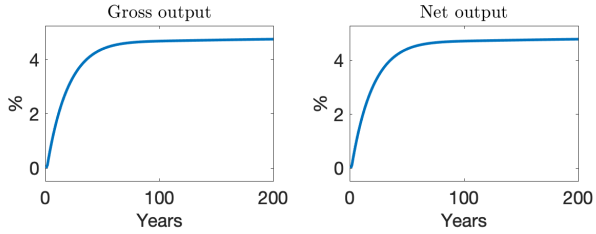
Notes: The figure shows the responses to an increase in $\overline{\Psi}$ for different values of γ. The increase in $\overline{\Psi}$ is set to raise the average credit relationship length by one year in the baseline economy.

Robustness for alternative output measure

We consider robustness to using the output measure that excludes the asset liquidation value not appropriated by entrepreneurs or lenders ("Net output"). Below we show the response of this net

output and, for comparison, of the output measure used in the main text ("Gross output").

Appendix Figure 5: Response of alternative output measure



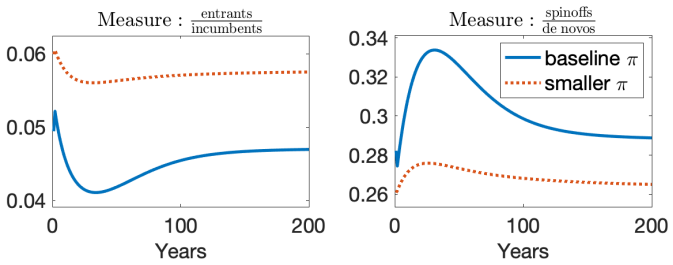
Speed of convergence

In this Appendix subsection we examine the speed of transition of the model more in detail. In particular, we show how the survival probability π affects the speed of convergence. In our experiment, we reduce π in a way such that the steady-state ratio of entrants to incumbents increases from 4.94% in the baseline to 6%. The figure below plots the transition dynamics after an increase in $\bar{\Psi}$. It shows that with a smaller π, both the ratio of entrants to incumbents and the ratio of spinoffs to total entrants converge faster to the new steady state. For example, in year 100, the ratio of entrants to incumbents is 3.4% away from the new steady state when π takes the baseline value, but only 1.0% with a smaller π. The corresponding numbers for the ratios of spinoffs to total entrants are 3.7% and 1.7%, respectively.

Intuitively, when π is lower, in every period a larger fraction of incumbents die or retire and therefore the measure of incumbents converges faster.[1] Therefore, the ratio of entrants to incumbents exhibits a faster speed of convergence. In turn, the measure of spinoffs converges faster, too, as spinoffs are created by former managers of incumbents. As a result, the ratio of spinoffs to total entrants also converges faster.

[1]Note that a smaller π increases the threshold $\hat{A}^I$ and the fraction of incumbents choosing to retire.

Appendix Figure 6: Effect of π on convergence speed



Notes: The figure shows the responses to an increase in $\bar{\Psi}$ for different values of π. The increase in $\bar{\Psi}$ is set to raise the average credit relationship length by one year in the baseline economy.