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Abstract

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Keywords: Lending technologies, Soft information, Credit rationing, Financial crisis

JEL codes: G21, D82, G30, O16

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Abstract

Using a unique sample of European manufacturing firms, we empirically investigate how bank lending technologies and soft information production affected firms' credit availability during the 2007-2009 financial crisis. Estimation results indicate that transactional lending technologies increased firms' credit rationing, whereas soft information production mitigated asymmetric information problems and improved firms' access to credit. By looking at the combined effect of lending technologies and soft information, we also provide evidence of the hardening of soft information phenomenon. When soft information was incorporated in transactional lending techniques firms' credit rationing significantly reduced. This result is especially strong for small borrowing firms and for companies matching with large financial institutions.

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1 Introduction

Firms' access to credit is a topic of significant research interest among academics and a crucial issue for policy makers (Berger and Udell, 2006). During the last years, the global financial crisis has significantly affected firms' credit availability and consistently depressed economic growth. This phenomenon was particularly relevant in Continental Europe, where immature capital markets and negligible corporate bond finance have made banks the main providers of external funds for European firms (Campello et al., 2010). The uniqueness of the recent financial collapse has led many economists to analyze different features of the crisis: the international transmission of the financial shock (De Haas and Van Horen, 2012; De Haas et al., 2015), the effects on the real economy (Amiti and Weinstein, 2011; Aiyar, 2012; Cingano et al., 2016), the behavior of financing constrained firms (Campello et al., 2010; Campello et al., 2011), and bank lending decisions (Sette and Gobbi, 2015; Bolton et al., 2016; Beck et al., 2018; Li et al., 2018).

The aim of this paper is to contribute to this last strand of literature by investigating whether the probability of firms experiencing credit restrictions during the crisis was affected by bank lending technologies and the production of soft information.

Several studies indicate that information asymmetries magnify during deep recessions, such as that of 2007-2009 (De Haas and Van Horen, 2013). However, the extent to which banks are able to overcome this problem may depend on their lending technologies. The current literature has thus far focused on two main classes of lending techniques: transactions-based lending and relationship lending. According to the prevailing paradigm, transactional lending is typically based on the use of hard quantitative data, such as information derived from the borrowers' balance sheet or the collateral guarantees they offer; conversely, relationship lending assigns a key role to the production of soft qualitative information obtained via personal interactions with the borrowing firms (Stein, 2002). This differentiation makes large banks more apt to lend through transactional lending technologies, and local financial institutions to rely more on relationship lending techniques (Berger and Black, 2011). Moreover, while transactions-based lending is argued to be more appropriate to screen and monitor transparent firms, relationship lending and soft information production are particularly useful in dealing with opaque borrowers suffering from more intense information asymmetries (Bartoli et al., 2013). In fact, hard information is less reliable in predicting firm risk profile under uncertainty, whereas continuously updated soft information is better targeted to borrowers' characteristics (Berger and Udell, 2006).

Some recent papers have also suggested the possibility that technological innovation may improve the ability of large banks to lend to opaque borrowers by hardening soft information. Through the inclusion of soft qualitative data into transactional lending technologies, such

as credit scoring models, the problems associated with transmitting this information through the hierarchical layers of large banking organizations diminish with beneficial effect on small businesses' credit availability (Frame et al., 2001; Berger and Frame, 2007).

In order to provide additional evidence about this topic, in this paper we first estimate the impact of transactional and relationship lending technologies on the probability of firms experiencing credit restrictions during the crisis. Then, to shed light on the hardening of soft information phenomenon, we study the combined effect of bank lending technologies and soft information production on firms' credit availability. Finally, as the current paradigm emphasizes the advantages of large banks and firms in transactional lending and the edge of local financial institutions and small businesses in relationship lending, we analyze whether bank type and firm size shape the lending technologies-credit rationing link, by also splitting our aggregate indicators of lending techniques in all their individual components.

To perform our empirical investigation, we draw information on firms' access to credit, bank lending technologies and soft information production from the EU-EFIGE Bruegel-UniCredit survey, which covers 14,759 manufacturing firms from seven European countries: Austria, France, Germany, Hungary, Italy, Spain and UK. To all the surveyed companies we also attach balance sheet data provided by Bvd-Amadeus, the most comprehensive and widely used source of financial information for public and private enterprises in Europe.

By way of preview, estimation results indicate that during the crisis firms matching with banks employing transactional lending technologies had a larger probability of experiencing credit restrictions, while relationship lending techniques did not significantly affect firms' credit availability. Consistently with previous studies (Bartoli et al., 2013; D'Aurizio et al., 2015), we also find that soft information production mitigated asymmetric information problems and improved firms' access to credit. With regard to the hardening of soft information process, estimation results indicate that the probability of firms experiencing credit rationing was somewhat reduced when soft information was used in combination with transactions-based lending technologies. While firms coupling with transactional banks not relying on soft information were more likely to be credit restricted during the crisis, the probability of rationing marginally reduced when firms matched with a transactional bank employing soft qualitative data.

By investigating whether these findings change with firm size and bank type, we provide some other interesting insights. First, estimation results indicate that the adoption of transactional lending technologies was positively associated with the probability of firms experiencing credit restrictions, both for firms matching with local banks and for firms coupling with national financial intermediaries. Conversely, relationship lending technologies did not significantly affect the probability of firms experiencing credit restrictions during the crisis, neither for the subsample of companies matching with local banks, nor for the firms coupling

with large, national financial institutions. From a theoretical point of view it is interesting to find no differences in the effect of transactional and relationship lending technologies across bank types. Whereas the current literature has strongly emphasized the advantages of large banks in transactional lending, and the edge of local financial institutions in relationship lending, our results suggest that it is not the nature of banks, but the technology used that matters for credit availability. Second, regarding the combined effect of bank lending technologies and soft information production, we show that the production of soft information improved firms' access to credit when the firm dealt with a national banks employing transactional lending technologies. As larger banks are the most concerned with the problems associated to the production and transmission of soft information and the most able to manage complex credit scoring models, during a financial crisis they have the greatest incentive to efficiently combine transactional lending techniques and soft qualitative data in order to assess borrowers' creditworthiness. On the contrary, small local banks, usually relying on relational lending technologies, are not able to efficiently exploit the benefits associated with the combined adoption of transactional lending techniques and soft information. Moving on to the role of firm size, estimation results indicate that transactional lending technologies did not affect the probability of large firms to experience credit restrictions in 2009, whereas significantly impacted on the credit rationing status of small and medium-sized businesses. Contrary to the current paradigm (Berger and Udell, 2006; Berger and Black, 2011), we also find that relationship lending technologies did not mitigate the financing problems of small and medium firms. Finally, when we try to unbundle the multidimensional nature of lending technologies, we find that banks' emphasis on collateral guarantees and historical records are negative for firms' credit availability. Conversely, when the main bank has access to interviews with the firm's management, the borrowing firm is less likely to be credit restricted.

In providing these findings, this study contributes to different fields of the banking literature. First, by analyzing whether transactional and relationship lending technologies affected the probability of firms experiencing credit restrictions in 2009, we contribute to the literature on lending technologies during the crisis (Sette and Gobbi, 2015; Bolton et al., 2016; Beck et al., 2018). However, while previous studies mainly focus on relationship lending technologies, in this paper we provide new findings with respect to transactional lending techniques. In particular, to the best of our knowledge, this is the first study showing a negative effect of transactions-based lending techniques on firms' access to credit for both firms dealing with local banks and national financial institutions. Second, we contribute to the literature on soft information. By analyzing the impact of soft information production on European firms' credit availability during the crisis, we corroborate the results of D'Aurizio et al. (2015) for the Italian context and the ones of Bartoli et al. (2013) related to the pre-crisis period. Finally, through the study of the combined effect of soft information production and bank

lending technologies on credit rationing, we add to the current literature on the hardening of soft information (Berger, 2015; Filomeni et al., 2016). By analyzing the 2007-2009 period, we are the first in providing evidence about the hardening of soft information process during the crisis for local and national financial institutions.

The remainder of the paper is organized as follows. Section 2 reviews the current literature on bank lending technologies, soft information production, and their impact on credit dynamics. In Section 3, we describe the dataset, the variables employed in the regression analysis and the econometric model used to perform our investigation. In Section 4 we discuss the empirical results. Section 5 provides some concluding remarks.

2 Related Literature

2.1 Lending technologies and information production

Although banks lend through a variety of lending technologies, the current literature has thus far focused on two main classes of lending techniques: transactions-based lending and relationship lending (see, e.g., Berger and Udell, 1995; 2002; 2006).

Often, the transactions lending label has been used for any type of loan based on easily verifiable information. However, as argued by Berger and Udell (2002; 2006), transactions-based lending cannot be considered a single homogeneous technique but a set of distinct transactions technologies used by financial institutions. The literature has identified three main types of transactions-based lending technologies: financial statement lending, asset-based lending, and credit scoring.¹ Under financial statement lending, firms' creditworthiness is evaluated from firms' financial statements, and both the decision to lend and the loan contract terms are based on the strength of the borrowers' balance sheets and income statements. Asset-based lending is a transactions technology in which financial institutions' decisions are primarily based on the quality of the available collateral, such as accounts receivable and inventory. Credit scoring is an adaptation to business lending of discriminant analysis and other statistical techniques used in consumer lending. This technology combines information derived from the financial statement of the business with data about the financial condition and history of the principal owner.

Relationship lending is at the opposite of transactions-based lending. Under this lending technology, the assessment of borrowers' creditworthiness is based on proprietary information about the firms gathered through a variety of contacts over time. This information is obtained through the provision of loans, deposits, other financial products, and through the analysis of the future prospects of the business. Additional information may also be gathered through

¹Berger and Udell (2006) include among transactions lending technologies also fixed-asset lending, factoring and leasing.

contact with other members of the local community, such as suppliers and customers, who may give specific information about the firm or general information about the business environment in which it operates. Of course, the information gathered over time has significant value beyond the firm's financial statements, collateral, and credit score, helping the relationship lender to mitigate firm opacity better than transactions lenders (Berger and Udell, 2002; 2006).²

The finance literature has recognized several differences between relationship and transactions - based lending, the crucial one being the type of information used by banks in granting and monitoring the loan. While transactions lending technologies are generally associated with the use of hard information produced at the time of loan origination, relationship lending techniques assign a key role to the collection of soft qualitative information over time. This soft information is often communicated in words and may not be easily observed, verified, and transmitted to others (Berger and Udell, 2002; Petersen, 2004). Conversely, hard information is easy to store and transmit, and its content is based on relatively objective criteria, such as financial ratios in the case of financial statement lending, collateral ratios in the case of asset-based lending, or credit scores in the case of credit scoring lending (Berger and Udell, 2002).

The distinction between relationship and transactions-based lending technologies has also been analyzed in connection with banks' organizational structure. According to the prevailing view, large banks hold a comparative advantage in transactions lending and hard information processing, while small-sized and local banks have an edge in relationship lending and soft-information production (Stein, 2002; Berger and Udell, 2006; Berger and Black, 2011). Large banks are argued to have comparative advantages in transactions lending because of economies of scale in the processing and transmission of hard information. Conversely, large financial institutions may be disadvantaged in processing and transmitting soft information through the communication channels of large organizations (Stein, 2002). Relationship lending and soft information production may also be associated with agency problems within the banks as the loan officer is the main repository of the information, giving a comparative advantage to small institutions with fewer layers of management (Berger and Udell, 2002) or less hierarchical distance between the loan officer and the manager that approves the loans (Liberti and Mian, 2009). Moreover, large institutions may be disadvantaged in relationship lending because of Williamson-type organizational diseconomies associated with the provision of transactions loans and other wholesale services (Williamson, 1988; Berger and Udell, 2006). Consistently

²Although the current paradigm has emphasized the dichotomy between transactional and relationship lending, some recent papers have not neglected the hypothesis of complementarity among the two lending technologies. As all lending techniques require screening and monitoring processes that are similar in nature and intensity, it can be reasonably argued that they may be used simultaneously instead of being strictly distinct from each other (Berger and Udell, 2006; Bartoli et al., 2013).

with these theories, Scott (2004) shows that soft information production is significantly higher for firms borrowing from small community financial institutions and when loan officers do not rotate over time. Similarly, Agarwal and Hauswald (2010) suggest that more independent branches produce more soft information. Finally, Ogura and Uchida (2014) find that small regional banks are perceived to put greater emphasis on soft information than large national financial intermediaries.

Recently, the academic literature has also suggested the possibility that technological innovation may improve the ability of large banks to lend to opaque borrowers at a greater distance by hardening soft information (Petersen, 2004; Berger, 2015). By incorporating soft qualitative data into transactional lending technologies, such as credit scoring models, the problems associated with transmitting this information through the hierarchical layers of large banking organizations diminish with beneficial effect on credit availability. Coherently with this view, Frame et al. (2001) find that credit scoring models reduce information costs between borrowers and lenders and increase the portfolio share of US small-business loans. Similarly, Berger et al. (2005a) show that the use of credit scoring models increases SMEs' credit availability, especially for relatively risky borrowers. Finally, Albareto et al. (2008) indicate that the adoption of credit scoring models in medium and large Italian banks has led to an increasing decentralization in lending decisions.

2.2 Measures and benefits of lending technologies

Traditionally, empirical studies on lending technologies have adopted indirect measures of relationship lending: the length of the bank-borrower relationship (Petersen and Rajan, 1994; 1995; Berger and Udell, 1995; Angelini et al., 1998; Ongena and Smith, 2000), the exclusivity of the relationship in terms of the bank being the sole provider of loans to the firm (Harhoff and Korting, 1998; Ongena and Smith, 2000), the share of credit granted by the firm's main bank (Sette and Gobbi, 2015), and the geographical distance between the firm's headquarter and the bank branch (Bofondi and Gobbi, 2006; Hauswald and Marquez, 2006; Alessandrini et al., 2009; Sette and Gobbi, 2015). All these measures proxy for the ability of lenders to accumulate soft information about borrowers. Longer lending relationships allow banks to accumulate information over time. Banks holding a larger share of credit have better access to proprietary information about the borrower. Finally, firms located closer to a bank branch may be easier and cheaper to monitor (Sette and Gobbi, 2015).

Instead of using measures of relationship strength to separate relationship lending from transactions technologies, the literature has recently started to identify one or more specific lending techniques. Frame et al. (2001) and DeYoung et al. (2008) rely on survey data about US banks in order to identify small business credit scoring. Berger and Black (2011) employ

the Survey of Small Business Finance (SSBF) to identify different classes of fixed-asset lending techniques (leasing contracts, real estate lending, motor vehicle loans, and equipment lending). Uchida (2011) relies on a survey on Japanese SMEs to distinguish financial statement lending, fixed-asset lending and relationship lending. Bartoli et al. (2013), by drawing information from the Survey on Italian Manufacturing Firms (SIMF), define transactions-based lending technologies as composed by financial-statement lending, real estate lending, and other fixed-assets lending techniques³

Several studies have analyzed the effect of relationship lending measures on credit availability and cost. Degryse and Ongena (2005) and Agarwal and Hauswald (2010) in models of spatial pricing find that borrowers' transportation costs induce a negative relationship between distance and the level of interest rates. Petersen and Rajan (1994) and Angelini et al. (1998) show that longer lending relationships improve firms' access to credit, while other studies provide mixed findings about the effect on the cost of credit. Berger and Udell (1995) and Brick and Palia (2007) find that borrowers with longer relationships pay lower interest rates or face lower collateral requirements. Conversely, Degryse and Van Cayseele (2000) and Degryse and Ongena (2005) show that interest rates increase with the length of the lending relationship. Additional findings have been provided in relation to multiple banking relationships: banks holding the largest share of credit granted to the firm provide more credit (Elsas and Krahnen, 1998), while the number of banking relationships the firm maintains is positively linked to the probability of experiencing credit restrictions (Cenni et al., 2015).⁴

A number of studies have also analyzed whether the production of soft information about borrowers improves firms' access to credit and investments. For Italy, Bartoli et al. (2013) provide evidence that the use of soft information decreases the probability of firms experiencing credit restrictions. Similarly, D'Aurizio et al. (2015) indicate that during the last financial crisis those banks increasing the adoption of soft information in the screening process cut credit supply less than other financial institutions. For Europe, Cosci et al. (2016) and Cucculelli et al. (2018) find that firms providing soft information in their lending relationships are less likely to be credit rationed and more likely to innovate. Finally, Jiangli et al. (2008) and De Mitri et al. (2010) show that soft information production mitigates the repercussions of aggregate credit contractions. While hard information is less reliable in predicting firm risk profile during a crisis, soft information, which is continuously updated and better targeted to the characteristics of the borrower, can reduce such uncertainty.

³As further discussed in Section 3.2 and similarly to our paper, Uchida (2011) and Bartoli et al. (2013) distinguish relationship and transactions lending technologies on the basis of unique survey data about the loan screening process as perceived by the respondent firms.

⁴See Kysucky and Norden (2016) for an extensive review of the benefits of relationship lending.

2.3 Relationship and transactions-based lending during the crisis

While a large literature has shown the effects of lending technologies during “normal” times, there is less evidence about the effects of relationship and transactions lending during a crisis.

From a theoretical point of view, there are three main reasons why relationship lenders may support borrowers more than transactional lenders during a financial crisis. First, relationship lenders may decide to keep financing their borrowers in order to maintain the informational capital acquired through the years. Second, relationship lenders may want to provide liquidity insurance to borrowers to honor the long-term implicit contract on which the relationship is based. Third, relationship lenders may be forced to keep lending to borrowers because of the higher potential losses associated with holding a large share of the overall credit granted to these borrowers (Sette and Gobbi, 2015). However, when liquidity and capital constraints make banks unable to provide any extra support to borrowers, relationship lenders may behave the same as transactional lenders.

Empirically, only few papers have tested these predictions with a main focus on relationship lending technologies. Sette and Gobbi (2015), for a sample of Italian firms, find that relationship lenders offer more support than transactional lenders during a crisis. Banks located closer to their borrowers, involved in longer relationships, and holding a larger share of credit, granted more loans than other banks. Bolton et al. (2016) confirm the beneficial role of relationship lenders during the last financial crisis: firms operating with relationship banks were less likely to default on their loans and were better able to withstand the crisis thanks to the more favorable continuation lending terms in comparison with firms dealing with transactional lenders. Similar findings are shown by Beck et al. (2018), who conduct face-to-face interviews with bank chief executive officers to classify banks as relationship or transaction lenders. By analyzing how the lending techniques of banks near firms are related to credit constraints, the authors find that while relationship lending is not associated with credit constraints during a credit boom, it alleviates such constraints during a downturn. This positive role of relationship lending results to be stronger for small and opaque firms and in regions with a more severe economic downturn. Opposite results are reported by Carvalho et al. (2015). By studying the transmission of bank distress to non-financial firms from 34 countries during the 2007-2009 financial crisis, the authors find that borrower firms with the strongest lending relationships cut more their investments than other firms. Similar findings are provided by Li et al. (2018), which show that borrowers in distress do not derive benefits from relationship banks.

3 Data and method

3.1 Datasets

In order to perform our empirical investigation, we draw information from two main sources: the EU-EFIGE Bruegel-UniCredit survey on “European Firms in a Global Economy” and the BvD-Amadeus database.

The EFIGE survey, coordinated by the Bruegel Institute and supported by the Directorate General Research of the European Commission, collects information for a representative sample of 14,759 firms (with a lower threshold of 10 employees) across seven European countries: Austria, France, Germany, Hungary, Italy, Spain and UK. The survey has been run in early 2010 and information is mostly collected as a cross-section for the year 2008. Moreover, some questions cover the period 2007-2009 and/or the behavior of firms during the crisis (Altomonte and Aquilante, 2012). In order to ensure statistical representativeness, the dataset has been built to fulfill two main criteria. First, the availability of an adequately large target sample of firms: 3,000 firms for each large country (France, Germany, Italy, Spain and UK) and some 500 firms for each small country (Austria and Hungary). Second, the sample was stratified to ensure representativeness of the collected data for each country, especially focusing on its composition by sectors, regions and size classes. The questionnaire submitted to the surveyed firms covers different broad areas: firm ownership structure and governance systems; workforce characteristics; exports, imports, and internationalization activities; investments, technological innovation and R&D expenditures; financial conditions and bank-firm relationships; market structure and competition.⁵ To all the surveyed firms, we attach balance-sheet information for the years 2007-2009 provided by BvD-Amadeus, the most comprehensive and widely used source of financial information for public and private firms in Europe.

Table 1 reports the summary statistics for all the variables employed in the econometric specifications.⁶ At the average, the surveyed firms have been in business for 26 years; beyond 60 percent of them have fewer than 50 employees (below 5 percent of the firms have more than 500 workers); 10 percent of them are foreign owned, and 22 percent belong to a group. The majority of firms are located in Germany, Italy and Spain (80 percent of the total), while 14 percent of firms operate in UK, 3.3 percent in Hungary and 3 percent in Austria. Alternatively, 82.7 percent of firms belong to the Eurozone.

⁵The data collection has been performed through a survey carried out by a professional Contractor (GFK, the fourth largest market research company in the world).

⁶All of the variables are defined in Table A1

3.2 Variable definitions

3.2.1 Lending technologies

The banking literature has thus far focused on two main classes of lending techniques: transactions - based lending and relationship lending (see Section 2.1). Under transactions-based lending, firms' creditworthiness is evaluated from firms' financial statements, historical records of payments, accounts receivables and collateral guarantees; under relationship lending, the assessment of borrowers' creditworthiness is based on proprietary information about the firms gathered through a variety of contact over time and through the analysis of the future prospects of the business (see, e.g., Berger and Udell, 2002; 2006). Starting from this categorization, we distinguish transactions and relationship lending technologies by relying on question F16 of the EFIGE survey. In this question, firms are required to indicate the type of information they normally provide to their main bank in the screening and monitoring processes.

In particular, the questionnaire reads out as follows:

F16. *Which type of information does the bank normally use/ask to assess your firm's creditworthiness? (a) collateral (0/1); (b) balance sheet information (0/1); (c) interviews with management on firm's policy and prospects (0/1); (d) business plan and firms' targets (0/1); (e) historical records of payments and debt service (0/1); (f) brand recognition (0/1); (g) other (0/1). (Multiple answers are allowed).*⁷

By looking at firms' answers, we build two indicators of lending technologies: (i) Transactions - based lending (Transactional Lending), computed as the average of collateral, balance-sheet information and historical records dummies (alternatives a, b, and e); and (ii) Relationship - based lending (Relationship Lending), computed as the average of interviews with management, business plan, and brand recognition dummies (alternatives c, d, and f). A drawback of these variables is that they are based on the perceptions of borrowers about what their bankers evaluate in the lending decisions. To have better proxies of lending technologies we would use evaluations of banks with respect to each borrower. However, although firms' perceptions of bank screening standards may be imperfect, they should reflect well the lending standards, processes, and procedures effectively used by their main bank.

⁷The survey does not refer to a specific year when posing this question. However, lending technologies are highly persistent over time, as they depend on structural aspects such as the bank-firm distance (Minetti et al., 2018). Nonetheless, since one cannot entirely rule out that the financial crisis have induced some modification in the perception of the lending technologies, some caution should be used when interpreting the empirical results.

To test the robustness of our results, we then exclude collateral guarantees from the definition of transactions-based lending (Transactional Lending 2) and study the stand-alone impact of this variable (Collateral) on the credit rationing phenomenon. In addition, we remove brand recognition from the definition of relationship lending (Relationship Lending 2).⁸

As shown in Table 1, transactional lending is the most employed lending technology: while the average value of the relationship lending indicator is 0.40, the average of the transactional lending index is 0.60. Regarding the specific factors included in the definition of lending technologies, 55.2 percent of firms state to pledge collateral guarantees, 84.4 percent use to provide balance-sheet information, 56 percent are subject to managers' interviews, 47.6 percent are requested for business plans, 40.3 percent are screened through historical records of payments and debt services, and 15.4 percent are evaluated through brand recognition (see Table A2).⁹

3.2.2 Soft information

As described in Section 2.1, soft information is subjective knowledge acquired by lenders in the course of frequent face-to-face interactions with borrowers (Petersen, 2004); it is qualitative, often communicated in words, and not easy to store and transmit (Bartoli et al., 2013). The empirical literature has traditionally employed survey questions to measure soft information. Scott (2004) relies on survey data provided by the membership of the National Federation of Independent Business to create a proxy for soft information production. The survey included a set of characteristics that were central to the owners' relationship with their primary financial institution. Among them, four characteristics were employed to define soft information: “(the bank) Knows you and your business”; “(the bank) Knows your industry”; “(the bank) Knows the local market and/or community”; “(the firm has) Social contact with loan officer”. A similar classification has been employed by Uchida et al. (2012), who exploit a question of the RIETI survey (Management Survey of Corporate Finance Issues) that asks the respondent firms to rate their main bank on different characteristics of the bank's knowledge of the firm. The authors focused on five specific items: “How well the bank knows the firm and its

⁸As a further robustness check, we create two dummy variables for transactional and relationship lending equal to one if at least one of the alternatives included in the definition of the related lending technology was used, and zero otherwise. The estimation results obtained by employing these variables are consistent with our baseline findings and are available upon request.

⁹These values indicate that financial-statement lending, i.e. the transactional lending technology based on balance-sheet analysis, is the most widespread lending technique. However, the presence of a ranking in the use of lending technologies does not rule out the possibility for banks to use together transactional and relationship lending. As all lending techniques require screening and monitoring processes that are similar in nature and intensity, it can be reasonably argued that they may be used simultaneously instead of being strictly distinct from each other. The existence of complementarity between transactions and relationship-based lending is somewhat confirmed by the positive correlation coefficient reported in Table 2 (0.320).

business”; “How well the bank knows the firm’s managers and owners”; “How well the bank knows the firm’s industry”; “How well the bank knows the local community where the firm is located”; “How well the bank knows the firm’s market”. Bartoli et al. (2013) built a similar indicator of soft information production by employing the Survey on Italian Manufacturing Firms (SIMF). The authors chose two characteristics describing the bank-firm relationship: “The bank knows you and your business”; “Frequent contacts with the credit officer at the bank”¹⁰

Based on the current literature, we identify soft information production by employing the following question of the EFIGE survey:

F12. *Which factors are key in the choice of a main bank? (a) the bank offers competitive services and funding (0/1); (b) the bank offers efficient internet services (0/1); (c) the bank’s lending criteria is clear and transparent (0/1); (d) the bank is conveniently located (0/1); (e) the bank has an extensive international network (0/1); (f) the bank offers also a consultancy on strategic financial decisions (0/1); (g) the bank has a long-lasting relationship with the firm (0/1); (h) the bank has flexible procedures/not constrained by red tape (0/1); (i) it was the Group’s main bank (0/1).*

By looking at firms’ answers, we measure soft information production as the average of the following items: “The bank offers a consultancy on strategic financial decision” (alternative f); “The bank has a long-lasting relationship with the firm” (alternative g). Although partially different from the alternatives employed in previous studies, these items should reflect a deep knowledge of the bank about the firm and its business. Summary statistics indicate that 43 percent of the surveyed firms claim to have a long-lasting relationship with their lenders, while 15 percent state to take advantage from the consultancy services offered by their banks. As a result, the average value of our soft information indicator is 0.29 (Table I).

Following Petersen and Rajan (1994), we then consider an additional set of variables measuring soft information production. As the exclusivity and the length of the credit relationships may measure the experience garnered by the main bank about the borrowing firm, we employ the following alternative proxies of soft information: (i) the inverse of the number of banking relationships enjoyed by the surveyed firms (Inverse of Num. Banks, computed as one over the number of banks with which the firm does business); (ii) a dummy variable equal to one if the firm has one banking relationship, and zero otherwise (One Bank); (iii) the financing share of the firm’s main bank (Financing Share); (iv) the length of the firm’s main

¹⁰The question asked to the respondent firms was: “Which characteristics are key in selecting your main bank?”

credit relationship (Duration)¹¹

Table 1 reports the summary statistics for these variables. The average number of banking relationships enjoyed by the sample firms is 3.10, the length of their main lending relationship is 15.85 years, the average financing share of the firms' main bank is 58.95 percent, and 22 percent of the companies in the sample operate with only one bank.

3.2.3 Credit rationing

Firms are defined as credit constrained if, at the prevailing market interest rate, they would like to obtain a larger amount of loans but cannot (Angelini et al., 1998; Guiso, 1998). This theoretical definition has made it difficult to practically identify rationed firms, and has led some authors to resort to indirect indicators of financing constraints. Petersen and Rajan (1994) rely on the fact that credit constrained firms are willing to pay a higher rate to raise additional funds, and define as credit rationed those firms that borrow from non-institutional lenders at abnormally high rates. Gertler and Gilchrist (1994) argue that larger firms have easier access to credit and use firm size as identification criterion to separate rationed and non-rationed companies. Fazzari et al. (1988) claim that firms that retain more of their earnings are more likely to be liquidity constrained and classify them as credit rationed. While these indirect proxies have been particularly useful in the seminal literature on financing constraints, in recent years the usage of survey data is becoming more established due to concerns about the correctness of identification using other methods (Casey and O'Toole, 2014). Although liquidity constraint indicators might be correlated with the firm's access to credit, they could also pick-up other effects that have little or nothing to do with credit constraints (Guiso, 1998).

In this study, the information provided by the EFIGE survey allows us to directly measure the credit rationing status of the surveyed firms. In particular, to create our main dependent variables, we rely on the following questions of the EFIGE survey:

F13. During the last year (2009), was the firm willing to increase its borrowing at the same interest rate of its current credit line? (i) yes; (ii) no.

F14. During the last year (2009), did the firm apply for more credit? (i) yes, applied for it and it was successful; (ii) yes, applied for it and was not successful; (iii) no, did not apply for it.

F15. To increase its borrowing, would the firm have been prepared to pay a higher rate of interest? (i) yes; (ii) no.

¹¹It is important to note that while the Relationship Lending variable measures if lending banks make credit decisions based on soft information, our proxies for soft information measure whether banks actually accumulate them.

Following Minetti and Zhu (2011) and Ferri and Murro (2015), we classify firms as being credit rationed (Rationing=1) if they respond (ii) to question F14, and non-rationed (Rationing=0) if they respond (i) or (ii) to question F14, or (ii) to question F13. We also use a broader definition of credit restrictions, which includes potentially discouraged borrowers from among the rationed ones. More precisely, we build the dummy variable Rationing - Wide that takes the value one if the firm responds (ii) or (iii) to question F14, and zero if it responds (ii) to question F13 or (i) to question F14. Finally, by relying on question F15 of the EFIGE survey, which provides information about borrowers' willingness to pay a higher interest rate, we alternatively classify as rationed (Rationing - Willingness to Pay More) those firms answering (ii) to question F14 and (i) to question (F15). All these measures, although reflecting a different intensity of credit rationing, should capture the existence of credit constraints.

Similar definitions of financially constrained firms have been also adopted by Angelini and Generale (2008), who employed the Survey on Italian Manufacturing Firms (SIMF), by Minetti et al. (2018), who relied on the Unicredit Survey on small and medium-sized enterprises, by Guiso (1998), who used the Bank of Italy Survey on Investment in Industry (SIM), and by Jappelli (1990) and Duca and Rosenthal (1993), who employed the Survey on Consumer Finances in the context of studies of credit constraints among US consumers.

Summary statistics reported in Table 1 indicate that 9 percent of firms were rationed in the bank lending market during the crisis (Rationing), 19 percent were wide rationed (Rationing - Wide), and 5 percent were rationed although they were willing to pay a higher interest rate (Rationing - WtPM). The majority of rationed firms results to be located in Spain and Italy (respectively, 41 and 39 percent), while 8 percent operate in Germany, 7 percent in France, 2 percent in Hungary and UK, and 1 percent in Austria. The univariate tests presented in Table 3 indicate that rationed firms are on average younger, more indebted, less profitable and productive. From a financial point of view, the transactional lending indicator is significantly higher for the subsamples of rationed borrowers, while the production of soft information is larger for non-rationed firms. Moreover, rationed companies borrow from a larger number of banks and enjoy shorter relationships with their main banks.

3.2.4 Control variables

In order to correctly identify the impact of bank lending technologies and soft information production on firms' access to credit and to mitigate the omitted variable concern associated with the cross sectional structure of our dataset, we control for a large set of possible confounding effects. First of all, we consider the following standard firm-specific characteristics and balance-sheet indicators: (i) firm's age, measured by the number of years from the firm's inception (Age); (ii) the number of employees as proxy for firm's size (Size, expressed in logarithm); (iii) the firm's level of indebtedness, proxied by the debt ratio, computed as total debt

over total assets (Debt Ratio); (iv) the firm’s liquidity indicator, measured as current assets over current liabilities (Liquidity Ratio); (v) the differential profitability of the firm (Differential ROS), measured by the difference between the firm’s return on sales and the median return on sales of its industry (Villalonga, 2004); (vi) the firm’s capital intensity (Capital Intensity), computed as the ratio between the firm’s fixed assets and number of employees; (vii) the firm’s level of labour productivity (Labour Productivity), measured by value added per worker; (viii) a dummy variable indicating whether the firm belongs to a business group (Group); (ix) the foreign ownership of the firm (Foreign).¹² Then, in order to fully account for industry- and country-specific effects, we include country and industry dummies (at the NACE 2-digit level of aggregation).

3.3 Econometric specification

To study the impact of lending technologies and soft information production on firms’ access to credit during the crisis, we start building an empirical model that estimates the firm’s probability of being rationed in the bank lending market. Denote y_i^d as firm i ’s desired amount of credit and y_i^a as the actual amount of credit given to firm i , the firm is rationed any time $y_i^* = (y_i^d - y_i^a) > 0$.

Thus, we can model the probability of rationing as:

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

$$y_i^* = \alpha X_i + \beta Z_i + u_i \quad (2)$$

where y_i denotes, alternatively, one of the credit rationing variables described in section 3.2.3 (Rationing, Rationing - Wide or Rationing - WtPM); X_i is the set of lending technologies presented in section 3.2.1; Z_i is a vector of exogenous covariates; u_i is the residual. As the credit rationing variables are dummy variables taking values zero and one, we estimate Equation (2) by maximum likelihood probit regressions. In all the regressions, standard errors are heteroskedasticity robust, clustered at the regional level (NUTS-2).

One might be concerned that the credit crunch during the crisis can trigger changes in banks’ lending technologies, that is, the causality may be reversed. However, we have mild concerns about reverse causality in our setting. In fact, the financial crisis hit in a sudden way at the end of 2008, while bank lending technologies are a slow-moving feature of the

¹²As the main dependent variables refer to 2009, all the balance-sheet indicators are computed as average values for the years 2007-2009. Estimation results are robust to the inclusion of balance-sheet information taken in 2007.

firm-bank relationship, as they are strongly driven by structural aspects such as the physical distance between bank and the borrower, the size of the firm, or the bank’s organizational structure (Berger and Udell, 2002; Agarwal and Hauswald, 2010). In addition to this, our econometric specification controls for a rich set of factors that could affect credit rationing, including firm-level characteristics, industry and country fixed effects. This should reduce the risk of omitting factors correlated with both lending technologies and credit decisions.

The aim of our empirical investigation is to analyze the impact of lending technologies and soft information production on the probability of firms being credit rationed during the crisis. Hence, we first estimate whether firms coupling with transactional and relationship main banks have different likelihood of experiencing credit restrictions. Then, in order to assess the role played by the production of soft information, we estimate the interaction effects between the lending technologies and the soft information variables.

4 Results

4.1 Baseline estimates: Lending technologies and credit rationing

The estimation results about the impact of transactional and relationship lending on credit rationing are displayed in Table 4. Columns (1)-(3) report the marginal effects for the estimations with our main explanatory variables, i.e. Transactional Lending and Relationship Lending; columns (4)-(6) present the estimation results obtained by employing the alternative measures of lending technologies, i.e. Transactional Lending 2 and Relationship Lending 2; columns (7)-(9) show the stand-alone impact of collateral guarantees (Collateral) on the probability of firms experiencing credit restrictions; columns (10)-(12) report the estimation results obtained with the adoption of balance sheet data in 2007.

Starting with our main transactional lending indicator, the marginal effects reported in columns (1)-(3) indicate that firms matching with banks employing transactional lending technologies are significantly more likely to end up rationed during a crisis. More specifically, a one-unit increase in the transactional lending variable increases by 11.6 percent the probability of Rationing, by 12.6 percent the probability of Rationing-Wide, and by 6.7 percent the probability of Rationing - Willingness to Pay More (all statistically significant at 99 percent). This result confirms the adverse effect of transactions-based lending technologies on credit rationing during recession periods. Consistently with Sette and Gobbi (2015) and Bolton et al. (2016), banks employing more impersonal and standardized lending techniques are more likely to reduce credit availability during a financial crisis.

When we turn to the relationship lending indicator, however, estimation results show that the probability of experiencing credit restrictions is not reduced when the firm couples with

a bank using relationship lending. The marginal effects of the Relationship Lending variable, reported in columns (1)-(3), are always not statistically significant. This result, although contrasting with Sette and Gobbi (2015) and Bolton et al. (2016), is in line with Carvalho et al. (2015) and Li et al. (2018).¹³

Looking at the other firm-specific characteristics, consistently with the current literature (Petersen and Rajan, 1994; Ferri and Murro, 2015), we find that firms holding a higher share of liquid assets (Liquidity Ratio) and displaying a lower indebted financial structure (Debt Ratio) are significantly less likely to be credit rationed. Similarly, more profitable (Diff. ROS) and productive firms (Labour Productivity) are associated with a reduced probability of experiencing credit restrictions.

In order to test the robustness of these findings, in columns (4)-(6) of Table 4 we employ two alternative measures of transactional and relationship lending technologies: Transactional Lending 2, computed as the average of balance sheet information and historical records dummies (alternatives b and e of question F16), and Relationship Lending 2, computed as the average of interviews and business plan (alternatives c and d of question F16). Estimation results broadly reproduce our main findings. The marginal effects of the transactional lending indicator are positive and statistically significant, although with lower magnitudes. More specifically, a one-unit increase in the transactional lending variable increases by 4.5 percent the probability of Rationing, and by 2.6 percent the probability of Rationing - Willingness to Pay More (statistically significant at 99 and 95 percent, respectively). Conversely, the relationship lending indicator does not significantly affect the probability of firms experiencing credit restrictions, independently of the definition of credit rationing employed. Overall, these results confirm our main findings: while transactional lending technologies are positively associated with the probability of firms experiencing credit restrictions, relationship lending techniques do not significantly impact on firms' access to credit.

Berger and Udell (2002) suggest that fixed-assets lending technique, i.e. the ones based on the provision of collateral guarantees, have very different underwriting processes, contract structures, and monitoring mechanisms with respect to the other transactional lending technologies. Hence, in columns (7)-(9) of Table 4 we estimate the stand-alone impact of the collateral dummy on the credit rationing status of the surveyed firms. The estimated marginal effects are all positive and statistically significant. Firms providing collateral guarantees are 7.4 more likely to experience Rationing, 9.4 percent more likely to experience Rationing-Wide, and 4.4 percent more likely to experience Rationing - Willingness to Pay More (all statistically

¹³A plausible explanation for the non significant effect of relationship lending technologies on credit availability during the crisis is that we estimate simultaneously the impact of both transactional and relationship lending techniques, instead of considering them alternatively as done by Sette and Gobbi (2015) and Bolton et al. (2016).

significant at 99 percent).¹⁴

Finally, as the balance sheet indicators computed as three-years averages across the 2007-2009 periods may raise endogeneity concerns, in columns (10)-(12) of Table 4, we report the estimation results obtained by employing balance sheet data from 2007 to construct the Debt Ratio, Liquidity Ratio, Diff. ROS, Capital Intensity and Labour Productivity variables. As indicated by the estimated marginal effects, the impact of transactional and relationship lending technologies on firms' credit rationing remains substantially unchanged.¹⁵

4.2 The production of soft information

In the previous section, we have analyzed whether different lending technologies affect firms' access to credit during a financial crisis; here, we investigate how the production of soft information enters in this picture. In particular, we first estimate whether the adoption of soft information by banks reduces the probability of firms experiencing credit restrictions, as demonstrated by the current literature (see, e.g., Bartoli et al., 2013, D'Aurizio et al., 2015, Cosci et al., 2016, and Cucculelli et al., 2018). Then, in order to study the hardening of soft information phenomenon, we analyze the combined effect of bank lending technologies and soft information production on firms' rationing status. Estimation results are presented in Table 5.

Starting with the production of soft information, the estimated marginal effects reported in columns (1)-(3) of Table 5 indicate that firms producing soft information are less likely to experience credit restrictions. More specifically, a one-unit increase in the soft information indicator (Soft Information) reduces by 2.1 percent the probability of Rationing, and by 1.6 percent the probability of Rationing - Willingness to Pay More, both statistically significant at 90 percent. This result is even stronger when the lending technology indicators are included in the regressions. In this case, a one-unit increase in the soft information variable reduces by 3.1 percent the probability of Rationing, and by 2.2 percent the probability of Rationing

¹⁴This result is consistent with the large literature showing that aggregate shocks that erode collateral asset values depress total investment by hindering firms' access to external finance (Kiyotaki and Moore, 1997; Buera and Moll, 2015; Araujo et al., 2018).

¹⁵The reader might wonder whether differences in the effects of the global financial crisis across countries could affect our results. For example, banks located in countries that were more exposed to the financial crisis could have been less inclined to adopt relationship lending technologies. For this reason, in columns (1)-(6) of Table A3, we run our baseline regressions by classifying sample firms on the basis of their geographical location distinguishing between Core countries (Austria, France, Germany and United Kingdom) and Periphery countries (Italy, Spain and Hungary). The estimation results confirm our baseline findings, although transactional lending technologies seem to have a larger impact on credit rationing for the subsample of firms located in the Periphery countries. In order to control for the different intensity of the crisis at the regional level, in columns (7)-(9) of Table A3, we also perform our regressions by adding a control variable (Differential Growth) defined as the difference between the growth rate of the region where the firm operates (at the NUTS-1 level) and the average growth rate of the country where the company is located. The estimation results remain virtually unchanged.

- Willingness to Pay More, both statistically significant at 99 percent (columns 4-6). These findings seem to confirm previous empirical results: coherently with Bartoli et al. (2013) and D'Aurizio et al. (2015), we show that soft information production mitigates asymmetric information problems and improves firms' access to credit.

Regarding the lending technology indicators, the marginal effects reported in columns (4)-(6) of Table 5 confirm that transactional lending technologies are positively associated with the credit rationing status. In particular, a one-unit increase in the Transactional Lending variable increases by 11.8 percent the probability of Rationing, by 12.9 percent the probability of Rationing-Wide, and by 6.8 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent. On the contrary, in line with our previous estimation results, the relationship lending technology indicator (Relationship Lending) is never statistically significant in explaining firms' access to credit.

Moving on to the hardening of soft information test, in columns (7)-(9) of Table 5 we estimate the combined effect of bank lending technologies and soft information production. Although soft information is usually incorporated in relationship lending techniques, the recent literature has shown that the extent of credit rationing may be reduced when soft information is used in combination with transactions-based lending technologies (Frame et al., 2001; Berger et al., 2005a; Berger and Frame, 2007). The estimation results presented in Table 5 seem to support this view: while firms coupling with banks employing transactional lending technologies alone (Transactional Lending) are more likely to be credit restricted, the probability of rationing is somewhat reduced when transactional lending technologies incorporate qualitative data (Soft Information * Transactional Lending). These findings are statistically significant and economically sizeable for all the credit rationing proxies. More specifically, a one-unit increase in the Transactional Lending variable increases by 13.4 percent the probability of Rationing, by 15.1 percent the probability of Rationing-Wide, and by 7.9 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent. Conversely, a one-unit increase in the interaction term Soft Information * Transactional Lending reduces by 3.6 percent the probability of Rationing, by 4.8 percent the probability of Rationing-Wide, and by 2.7 percent the probability of Rationing - Willingness to Pay More, statistically significant at 95, 90 and 95 percent, respectively.

Looking at the Relationship Lending variable, estimation results indicate that soft information production does not significantly affect the impact of this variable on credit rationing. The interaction effect of the Relationship Lending indicator and the Soft Information variable is never statistically significant in explaining the probability of firms experiencing credit restrictions.

In order to check the robustness of these findings, we then employ a set of alternative measures of soft information production. As the exclusivity and the length of the credit

relationship may measure the experience garnered by the main bank about the borrowing firm (Petersen and Rajan, 1994), in Panels A-D of Table 6, we study the impact of soft information production on credit rationing by employing the following alternative proxies of soft information: (i) Inverse of Num. Banks, computed as the inverse of the number of banking relationships enjoyed by the surveyed firms; (ii) One Bank, a dummy variable equal to one if the firm has one banking relationship, and zero otherwise (Panel B); (iii) Financing Share, equal to the financing share of the firm’s main bank (Panel C); (iv) Duration, given by the length of the firm’s main credit relationship (Panel D).

The estimated marginal effects broadly confirm our baseline results. First, as shown in columns (1)-(3) of Table 6, all the alternative proxies of soft information production significantly reduce the probability of firms experiencing credit restrictions. In particular, a one-unit increase in the Inverse of Num. Banks indicator reduces by 6.1 percent the probability of Rationing, by 8.7 percent the probability of Rationing - Wide, and by 5.9 percent the probability of Rationing - Willingness to Pay More, statistically significant at 99, 95 and 99 percent, respectively (Panel A, columns 1-3). Similar results are found for the One Bank dummy: firms enjoying exclusive lending relationships are 3.4 percent less likely to experience Rationing, 5.7 percent less likely to experience Rationing - Wide, and 2.3 percent less likely to experience Rationing - Willingness to Pay More, statistically significant at 95 and 99 percent, respectively (Panel B, columns 1-3). Second, the interactions between the alternative proxies of soft information and the Transactional Lending variable seem to confirm the existence of the hardening of soft information phenomenon (Panels A-D, columns 7-9). When transactional lending technologies are used in combination with soft information production, the extent of credit rationing is mitigated.

4.3 The role of bank type and firm size

According to the prevailing view, large banks hold a comparative advantage in transactions lending and hard information processing, while small-sized and local banks have an edge in relationship lending and soft information production (Berger et al., 2005b; Liberti and Mian, 2009; Berger and Black, 2011). Moreover, while transactional lending technologies are more apt to screen large, transparent firms, relationship lending techniques are more desirable for opaque borrowers with asymmetric information problems. In order to provide some insights about these issues, in this section we investigate whether the impact of transactional and relationship lending technologies on firms’ access to credit is affected by the nature of the firm’s main bank and by the firm’s size.

Starting with the nature of banks, the marginal effects presented in Panel A of Table 7 provide several intuitions. First, the adoption of transactional lending technologies is posi-

tively associated with the probability of firms experiencing credit restrictions, both for firms matching with local banks and for firms coupling with national financial intermediaries. In particular, for the subsample of firms dealing with local banks, a one-unit increase in the Transactional Lending variable increases by 13.3 percent the probability of Rationing, by 16.2 percent the probability of Rationing - Wide, and by 7.8 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent (columns 1-3). Similarly, when the analysis is carried out on the subsample of companies enjoying lending relationships with national banks, a one-unit increase in the Transactional Lending indicator increases by 12.4 percent the probability of Rationing, by 11.9 percent the probability of Rationing- Wide, and by 7 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent (columns 4-6).

Second, consistently with our previous findings (Sections 4.1 and 4.2), relationship lending technologies do not significantly affect the probability of firms experiencing credit restrictions, neither for the subsample of companies matching with local banks (columns 1-3), nor for the firms coupling with large, national financial institutions (columns 4-6).

From a theoretical point of view, it is particularly interesting to find no differences in the effect of transactional and relationship lending technologies across bank types. Whereas the current literature has strongly emphasized the advantages of large banks in transactional lending, and the edge of local financial institutions in relationship lending (Berger et al., 2005b; Agarwal and Hauswald, 2010), our results suggest that it is not the nature of banks, but the technology used that matters.

Finally, regarding the combined effect of bank lending technologies and soft information production, the estimation results reported in Panel A indicate that the production of soft information improves firms' access to credit when the firm deals with a national banks employing transactional lending technologies. The marginal effects of the interaction term Soft Information * Transactional Lending are negative and statistically significant at 90 percent for both Rationing (column 4) and Rationing - Willingness to Pay More (column 6). These findings are consistent with the emerging literature on the hardening of soft information (Berger, 2015; Filomeni et al., 2016): as larger banks are the most concerned with the problems associated to the production and transmission of information and the most able to manage complex credit scoring models, during a financial crisis they have the greatest incentive to efficiently combine transactional lending techniques and soft qualitative data in order to assess borrowers' creditworthiness. On the contrary, small local banks, usually relying on relational lending technologies, are not able to efficiently exploit the benefits associated with the combined adoption of transactional lending techniques and soft information. These results are also consistent with the anecdotal evidence that during the crisis large banks partially changed their business model by relying more on soft information and increasing the degree of autonomy of local loan

officers (see, e.g., Rotondi, 2013).

Moving on to the role of firm size, the estimation results are presented in Panel B of Table 7. As indicated by the reported marginal effects, transactional lending technologies do not affect the probability of large firms to experience credit restrictions (columns 7-9), whereas significantly impact on the rationing status of small and medium-sized businesses (columns 1-6). In particular, for the subsample of small firms, a one-unit increase in the Transactional Lending variable increases by 13.1 percent the probability of Rationing, by 13.9 percent the probability of Rationing - Wide, and by 7 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent (columns 1-3). Accordingly, when the regressions are run on the subsample of medium-sized enterprises, a one-unit increase in the Transactional Lending indicator increases by 13.5 percent the probability of Rationing, by 16.8 percent the probability of Rationing - Wide, and by 9.1 percent the probability of Rationing - Willingness to Pay More, all statistically significant at 99 percent (columns 4-6). Contrary to the current paradigm (Berger and Black, 2011), we also find that relationship lending technologies do not affect the probability of small and medium firms to experience credit restrictions. The marginal effects of the Relationship Lending variable are not statistically significant for the subsamples of small and medium-sized enterprises.

These findings, consistently with Ferri and Murro (2015), suggest that while large firms benefit from coupling with transactional main banks, small businesses should enjoy stronger lending relationships with relational financial intermediaries in order not to increase the probability of experiencing credit restrictions, especially during a financial crisis.

With regard to the hardening of soft information process, estimation results indicate that only small firms benefit from the combination of transactional lending technologies and soft information production. In particular, for the subsample of small businesses, a one-unit increase in the Soft Information * Transactional Lending variable reduces by 3.9 percent the probability of Rationing, and by 2.7 percent the probability of Rationing - Willingness to Pay More, both statistically significant at 95 percent (columns 1 and 3). On the contrary, the production of soft information, whether combined with transactional or relational lending technologies, is found to not affect the rationing status of medium and large firms (columns 4-9). Consistently with Berger and Udell (2006) and Bartoli et al. (2013), these results support the idea that soft information production is more useful with small and more opaque borrowers, than with large and more transparent firms. Hence, during the last financial crisis, the exacerbation of SMEs' information asymmetries have led transactional banks to adopt soft qualitative information to better assess small borrowers' creditworthiness and try to ease their access to bank lending.

4.4 Exploring the nature of lending technologies

Following Berger and Udell (2002), in this section we exploit the richness of our database to unbundle the multidimensional nature of transactional and relationship lending technologies. In particular, by relying on question F16 of the EFIGE survey (see Section 3.2.1), we split our aggregate indicators of lending technologies (i.e. Transactional Lending and Relationship Lending) in six different lending techniques: (i) Collateral; (ii) Historical Records; (iii) Balance Sheet Info; (iv) Interviews with Management; (v) Business Plan; (vi) Brand Recognition. Then, in order to investigate whether the adoption of these specific lending technologies affected differently credit availability during the last financial crisis, we estimate the impact of these variables on the credit rationing status of the surveyed firms. The estimation results are reported in Table 8. Column (1) presents the results for the full sample of companies; columns (2)-(3) show the marginal effects for the subsamples of firms dealing with local and national banks; columns (4)-(6) report the estimation results for the subsamples of small, medium, and large businesses.

Starting with the transactional lending components, the results presented in Table 8 provide several intuitions. First, consistently with our previous findings, the provision of collateral guarantees positively affects the probability of firms experiencing credit restrictions. This is true for the full sample of firms, for companies dealing with local and national banks, and for small and medium-sized enterprises (columns 1-5).¹⁶ Conversely, the marginal effect of the Collateral dummy is not statistically significant for the subsample of large companies (column 6). Second, in line with the literature on lending technologies and banks' organizational structures (Liberti and Mian, 2009; Agarwal and Hauswald, 2010; Berger and Black, 2011), we find that the use of historical records to screen and monitor borrowers increases the probability of firms experiencing credit restrictions for the full sample of firms, and for companies dealing with local banks (columns 1-2). On the contrary, companies operating with large, national financial institutions do not suffer from more credit constraints because of this lending technology (column 3). Finally, although transactional lending technologies should be more appropriate for large and transparent firms, we find that the use of historical records reduces firms' credit availability both for small businesses and large corporations (columns 4 and 6). The estimated marginal effects are 0.021 and 0.049 for the subsamples of small and large firms, respectively, both statistically significant at 95 percent.

Regarding the relationship lending technologies, we find opposite results among the different components of this lending technique. The adoption of direct interviews with the

¹⁶The probability of credit rationing increases by 6.8 percent for the full sample of firms, by 6.6 percent for the subsample of companies dealing with local banks, by 7 percent for the subsample of firms operating with national financial institutions, by 6.8 percent for the subsample of small businesses, and by 5.6 percent for the subsample of medium-sized enterprises, all statistically significant at 99 percent.

firm’s management (Interviews with Managers) as lending technology significantly reduces the probability of firms experiencing credit restrictions, both for the full sample of companies, for small enterprises, and for firms dealing with local banks (columns 1-2 and 4).¹⁷ This result confirms the findings of Sette and Gobbi (2015), Bolton et al. (2016), and Beck et al. (2018) about the beneficial effect of relationship lending on small businesses’ credit availability during the last financial crisis. Moreover, we support the paradigm according to which local banks have an edge in relationship lending in comparison to large financial institutions (Berger and Udell, 2014). The findings for the Brand Recognition dummy further confirm this result. Although not statistically significant in the full sample estimation, the use of brand recognition as lending technology reduces by 2.3 percent the probability of small firms to be financially constrained (column 5). Contrary results are found with respect to business plan adoption. As indicated by the estimated marginal effects, the use of this lending technology increases the probability of firms experiencing credit restrictions for the full sample of firms, for companies coupling with local banks, and for small and medium-sized enterprises (columns 1-2 and 4-5).¹⁸

Overall, these results suggest that banks and firms may not have equal advantages in all the individual transactional or relationship lending techniques. About transactional lending technologies, the bank focus on historical records is negative only when the main bank is a local bank, while the emphasis on collateral makes transactional lending hard to perform during a crisis (regardless of the nature of the bank). Regarding relationship lending, interviews with the firm’s management and the evaluation of brand recognition help small businesses to access bank credit, while business plans work in the opposite way. These mixed effects translate in a non-significant coefficient of our aggregate indicator of relationship lending in the previous sections.

5 Conclusions

This paper examined the impact of lending technologies and soft information on firms’ credit availability during the global financial crisis. By using a detailed questionnaire on European manufacturing firms, we found that the use of transactional lending technologies increased the probability of credit rationing. On the contrary, we uncovered no significant evidence of a supposed positive role of relationship lending on credit availability. Estimation results also

¹⁷The probability of credit rationing reduces by 2 percent for the full sample of firms, by 3.2 percent for the subsample of companies dealing with local banks, and by 1.8 percent for the subsample of small businesses, statistically significant at 95, 99, and 95 percent, respectively.

¹⁸The probability of credit rationing increases by 2.7 percent for the full sample of firms, by 3.3 percent for the subsample of companies matching with local banks, by 2.3 percent for the subsample of small firms, and by 3.9 percent for the subsample of medium enterprises.

revealed that the production of soft information reduced the probability of firms experiencing credit restrictions. With regard to the hardening of soft information process, estimation results indicate that the probability of firms being credit rationed was somewhat reduced when soft information was used in combination with transactions-based lending technologies. While firms coupling with transactional banks not relying on soft information were more likely to be credit restricted during the crisis, the probability of rationing marginally reduced when firms matched with a transactional bank employing soft qualitative data. In the last part of the paper, we also examined whether firm and bank characteristics played a role in the interaction between soft information and lending technologies. SMEs are found to benefit more when their transactional main banks use soft information. Correspondingly, by bank type, large banks were more effective at incorporating soft information in transactional technologies, partially healing the credit crunch.

Overall, our findings support prior literature indicating that, also during a deep recession such as that of 2007-2009, lending technologies play an important role in determining firms' access to credit (Berger and Udell, 2006; Bartoli et al., 2013). In a policy perspective, these results suggest that during a financial crisis, regulations enabling banks to increase the discretionary power of loan officers could favor firms' access to liquidity. This might be achieved by either relying more on relationship lending technologies or incorporating soft information in credit scoring models.

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Tables

Table 1: Summary statistics

| | Mean | Median | Std. Dev | Obs. |
|--|-------|--------|----------|--------|
| <i><u>Lending technologies and soft information:</u></i> | | | | |
| Transactional Lending | 0.60 | 0.67 | 0.30 | 6,875 |
| Relationship Lending | 0.40 | 0.33 | 0.34 | 6,870 |
| Transactional Lending 2 | 0.62 | 0.50 | 0.33 | 6,875 |
| Relationship Lending 2 | 0.52 | 0.50 | 0.43 | 6,868 |
| Collateral | 0.55 | 1 | 0.50 | 6,855 |
| Soft Information | 0.29 | 0.00 | 0.35 | 8,910 |
| Number of Banks | 3.10 | 2.00 | 2.65 | 14,655 |
| Inverse of Num. Banks | 0.49 | 0.50 | 0.30 | 14,655 |
| One Bank | 0.22 | 0 | 0.41 | 14,655 |
| Financing Share | 58.95 | 60 | 33.08 | 6,873 |
| Duration | 15.85 | 12.00 | 13.81 | 6,757 |
| <i><u>Credit rationing:</u></i> | | | | |
| Rationing | 0.09 | 0.00 | 0.28 | 6,837 |
| Rationing - Wide | 0.19 | 0.00 | 0.39 | 6,837 |
| Rationing - WtPM | 0.05 | 0.00 | 0.23 | 6,605 |
| <i><u>Firm characteristics:</u></i> | | | | |
| Age | 26.50 | 21.00 | 22.58 | 14,759 |
| Size (Number of Employees) | 71.63 | 26.00 | 142.92 | 11,442 |
| Debt Ratio | 66.16 | 66.45 | 27.69 | 13,844 |
| Liquidity Ratio | 1.54 | 1.04 | 1.73 | 13,322 |
| Differential ROS | 0.00 | 0.00 | 0.08 | 9,827 |
| Capital Intensity | 38.37 | 18.88 | 53.72 | 10,884 |
| Labour Productivity | 51.31 | 45.75 | 27.67 | 9,645 |
| Group | 0.22 | 0.00 | 0.41 | 14,759 |
| Foreign | 0.10 | 0.00 | 0.29 | 14,302 |
| <i><u>Countries:</u></i> | | | | |
| Austria | 0.03 | 0.00 | 0.17 | 14,759 |
| Germany | 0.20 | 0.00 | 0.40 | 14,759 |
| France | 0.20 | 0.00 | 0.40 | 14,759 |
| Hungary | 0.03 | 0.00 | 0.18 | 14,759 |
| Italy | 0.20 | 0.00 | 0.40 | 14,759 |
| Spain | 0.20 | 0.00 | 0.39 | 14,759 |
| United Kingdom | 0.14 | 0.00 | 0.35 | 14,759 |

Notes: Balance-sheet indicators refer to the period 2007-2009. Extreme values are recoded at the 1st and 99th percentiles because of outliers.

Table 2: Correlation matrix

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
|-----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| (1) Rationing | 1.000 | | | | | | | | | | |
| (2) Rationing-Wide | 0.633 | 1.000 | | | | | | | | | |
| (3) Rationing-WtPM | 1.000 | 0.544 | 1.000 | | | | | | | | |
| (4) Transactional Lending | 0.128 | 0.109 | 0.107 | 1.000 | | | | | | | |
| (5) Relationship Lending | -0.012 | 0.015 | 0.000 | 0.320 | 1.000 | | | | | | |
| (6) Transactional Lending 2 | 0.066 | 0.060 | 0.056 | 0.839 | 0.286 | 1.000 | | | | | |
| (7) Relationship Lending 2 | -0.008 | 0.016 | 0.001 | 0.286 | 0.939 | 0.246 | 1.000 | | | | |
| (8) Collateral | 0.144 | 0.117 | 0.120 | 0.697 | 0.197 | 0.193 | 0.190 | 1.000 | | | |
| (9) Soft Information | -0.027 | -0.054 | -0.028 | -0.041 | 0.074 | -0.027 | 0.072 | -0.038 | 1.000 | | |
| (10) Inverse of Num. Banks | -0.124 | 0.043 | -0.113 | 0.069 | 0.074 | 0.027 | 0.070 | 0.086 | -0.170 | 1.000 | |
| (11) One Bank | -0.092 | 0.058 | -0.075 | 0.069 | 0.054 | 0.050 | 0.054 | 0.056 | -0.125 | 0.917 | 1.000 |
| (12) Financing Share | -0.072 | 0.016 | -0.071 | 0.120 | 0.105 | 0.076 | 0.105 | 0.114 | -0.057 | 0.439 | 0.329 |
| (13) Duration | -0.054 | -0.028 | -0.051 | -0.037 | 0.018 | -0.037 | -0.002 | -0.020 | 0.119 | 0.013 | -0.022 |
| (14) Age | -0.044 | -0.028 | -0.039 | -0.032 | 0.068 | -0.028 | 0.060 | -0.023 | -0.067 | -0.052 | -0.051 |
| (15) Size | -0.016 | 0.016 | 0.019 | -0.028 | 0.216 | 0.003 | 0.211 | -0.053 | -0.121 | -0.093 | -0.012 |
| (16) Debt Ratio | 0.142 | 0.105 | 0.126 | 0.124 | 0.036 | 0.069 | 0.041 | 0.136 | -0.044 | -0.044 | -0.022 |
| (17) Liquidity Ratio | -0.107 | -0.079 | -0.095 | -0.062 | -0.016 | -0.036 | -0.022 | -0.070 | -0.162 | 0.086 | 0.046 |
| (18) Diff. ROS | -0.083 | -0.076 | -0.073 | -0.034 | -0.024 | -0.015 | -0.030 | -0.040 | 0.002 | -0.024 | -0.017 |
| (19) Capital Intensity | 0.019 | 0.013 | 0.000 | 0.019 | -0.022 | 0.051 | -0.017 | -0.033 | -0.024 | -0.167 | -0.092 |
| (20) Labour Productivity | -0.091 | -0.065 | -0.085 | -0.103 | 0.051 | -0.035 | 0.049 | -0.138 | -0.050 | -0.072 | -0.037 |
| (21) Group | -0.004 | 0.000 | 0.001 | -0.074 | 0.108 | -0.069 | 0.101 | -0.045 | 0.019 | 0.000 | 0.018 |
| (22) Foreign | -0.018 | 0.012 | -0.008 | -0.016 | 0.074 | -0.011 | 0.064 | -0.018 | -0.046 | 0.075 | 0.071 |

| | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) |
|--------------------------|--------|--------|--------|--------|--------|--------|--------|-------|-------|-------|-------|
| (12) Financing Share | 1.000 | | | | | | | | | | |
| (13) Duration | 0.033 | 1.000 | | | | | | | | | |
| (14) Age | -0.003 | 0.371 | 1.000 | | | | | | | | |
| (15) Size | -0.107 | 0.005 | 0.170 | 1.000 | | | | | | | |
| (16) Debt Ratio | -0.036 | -0.110 | -0.112 | -0.012 | 1.000 | | | | | | |
| (17) Liquidity Ratio | 0.064 | 0.096 | 0.103 | -0.025 | -0.458 | 1.000 | | | | | |
| (18) Diff. ROS | 0.019 | -0.001 | 0.010 | -0.001 | -0.260 | 0.150 | 1.000 | | | | |
| (19) Capital Intensity | -0.105 | -0.001 | 0.056 | 0.065 | -0.017 | -0.100 | 0.116 | 1.000 | | | |
| (20) Labour Productivity | -0.124 | 0.059 | 0.119 | 0.112 | -0.210 | 0.212 | 0.353 | 0.367 | 1.000 | | |
| (21) Group | -0.081 | -0.081 | -0.014 | 0.399 | -0.016 | -0.018 | -0.003 | 0.080 | 0.198 | 1.000 | |
| (22) Foreign | -0.020 | -0.072 | -0.009 | 0.282 | -0.021 | 0.023 | -0.009 | 0.033 | 0.156 | 0.469 | 1.000 |

Table 3: Univariate tests

| | Rationing | | | Rationing - Wide | | | Rationing - WtPM | | |
|---|-----------|-------|---------------------|------------------|-------|---------------------|------------------|-------|---------------------|
| | Yes | No | <i>t-statistics</i> | Yes | No | <i>t-statistics</i> | Yes | No | <i>t-statistics</i> |
| <i>Lending technologies and soft information:</i> | | | | | | | | | |
| Transactional Lending | 0.72 | 0.59 | -11.78 | 0.67 | 0.59 | -9.22 | 0.73 | 0.59 | -9.55 |
| Relationship Lending | 0.38 | 0.40 | 0.97 | 0.41 | 0.40 | -1.24 | 0.40 | 0.40 | 0.03 |
| Transactional Lending 2 | 0.69 | 0.62 | -5.76 | 0.67 | 0.62 | -5.03 | 0.70 | 0.62 | -4.72 |
| Relationship Lending 2 | 0.51 | 0.52 | 0.67 | 0.53 | 0.52 | -1.29 | 0.52 | 0.52 | -0.09 |
| Collateral | 0.78 | 0.53 | -14.03 | 0.67 | 0.52 | -10.12 | 0.79 | 0.53 | -11.73 |
| Soft Information | 0.36 | 0.39 | 2.30 | 0.35 | 0.40 | 4.56 | 0.35 | 0.39 | 2.30 |
| Number of Banks | 4.69 | 3.63 | -7.96 | 3.67 | 3.74 | 0.75 | 5.11 | 3.63 | -7.89 |
| Inverse of Num. Banks | 0.30 | 0.43 | 13.71 | 0.44 | 0.41 | -3.32 | 0.29 | 0.43 | 12.68 |
| One Bank | 0.05 | 0.17 | 11.86 | 0.20 | 0.15 | -4.42 | 0.04 | 0.17 | 10.16 |
| Financing Share | 51.34 | 59.73 | 6.55 | 60.11 | 58.75 | -1.32 | 49.34 | 59.73 | 6.51 |
| Duration | 13.43 | 16.07 | 5.27 | 15.11 | 16.01 | 2.06 | 13.06 | 16.07 | 4.76 |
| <i>Firm characteristics:</i> | | | | | | | | | |
| Age | 22.49 | 25.47 | 4.00 | 24.12 | 25.47 | 2.34 | 22.13 | 25.47 | 3.66 |
| Size (Number of Employees) | 59.38 | 64.91 | 1.01 | 68.24 | 63.60 | -0.99 | 71.35 | 64.91 | -0.83 |
| Debt Ratio | 81.49 | 69.23 | -12.86 | 75.60 | 69.06 | -8.40 | 82.68 | 69.23 | -11.23 |
| Liquidity Ratio | 0.77 | 1.18 | 12.51 | 0.96 | 1.18 | 7.61 | 0.73 | 1.18 | 15.67 |
| Differential ROS | -0.02 | 0.00 | 5.22 | -0.01 | 0.00 | 5.24 | -0.02 | 0.00 | 4.31 |
| Capital Intensity | 47.79 | 44.01 | -1.37 | 46.04 | 44.02 | -0.96 | 44.06 | 44.01 | -0.02 |
| Labour Productivity | 41.79 | 49.44 | 7.85 | 45.16 | 49.44 | 4.83 | 40.70 | 49.44 | 7.96 |
| Group | 0.19 | 0.19 | 0.31 | 0.19 | 0.19 | 0.03 | 0.20 | 0.19 | -0.10 |
| Foreign | 0.05 | 0.07 | 1.60 | 0.07 | 0.06 | -0.92 | 0.06 | 0.07 | 0.65 |

Notes: The table reports univariate statistics. All of the variables are defined in Table [A1](#). Accounting figures are expressed in thousands of Euros. Balance-sheet indicators refer to the period 2007-2009. Extreme values are recoded at the 1st and 99th percentiles because of outliers.

Table 4: Baseline estimates

| | Main results | | | Robustness checks: Alternative measures of lending technologies | | | | Robustness checks: Balance sheet data in 2007 | | | | |
|-------------------------|----------------------|----------------------|----------------------|---|----------------------|----------------------|----------------------|---|----------------------|----------------------|----------------------|----------------------|
| | Rationing Wide | Rationing Wide | Rationing WtPM | Rationing Wide | Rationing Wide | Rationing WtPM | Rationing Wide | Rationing Wide | Rationing WtPM | Rationing Wide | Rationing WtPM | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Transactional Lending | 0.116*** (0.016) | 0.126*** (0.025) | 0.067*** (0.012) | | | | | | | 0.147*** (0.020) | 0.150*** (0.027) | 0.093*** (0.014) |
| Relationship Lending | -0.005 (0.012) | -0.012 (0.017) | -0.002 (0.007) | | | | | | | 0.002 (0.013) | 0.010 (0.020) | 0.002 (0.008) |
| Transactional Lending 2 | | | | 0.045*** (0.017) | 0.030 (0.022) | 0.026** (0.012) | | | | | | |
| Relationship Lending 2 | | | | 0.012 (0.010) | 0.008 (0.014) | 0.006 (0.006) | | | | | | |
| Collateral | | | | | | | 0.074*** (0.008) | 0.094*** (0.012) | 0.044*** (0.007) | | | |
| Age | 0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | 0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | 0.000 (0.000) | -0.000 (0.001) | -0.000 (0.000) |
| Size | 0.003 (0.004) | -0.000 (0.006) | 0.008*** (0.003) | -0.000 (0.005) | -0.004 (0.006) | 0.007** (0.003) | 0.005 (0.004) | 0.002 (0.006) | 0.009*** (0.003) | 0.005 (0.005) | -0.000 (0.006) | 0.011*** (0.003) |
| Debt Ratio | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.002*** (0.000) | 0.002*** (0.000) | 0.001*** (0.000) |
| Liquidity Ratio | -0.057*** (0.008) | -0.042*** (0.011) | -0.038*** (0.006) | -0.062*** (0.009) | -0.044*** (0.012) | -0.042*** (0.006) | -0.053*** (0.008) | -0.039*** (0.011) | -0.035*** (0.006) | -0.044*** (0.013) | -0.041*** (0.014) | -0.027*** (0.008) |
| Diff. ROS | -0.136*** (0.049) | -0.189** (0.084) | -0.059* (0.032) | -0.140*** (0.051) | -0.190** (0.085) | -0.065* (0.034) | -0.142*** (0.049) | -0.196** (0.084) | -0.066** (0.032) | 0.002 (0.059) | 0.016 (0.092) | -0.010 (0.046) |
| Capital Intensity | 0.012* (0.007) | 0.022** (0.008) | 0.003 (0.004) | 0.014** (0.007) | 0.024*** (0.008) | 0.005 (0.005) | 0.012* (0.006) | 0.020** (0.008) | 0.004 (0.004) | 0.000 (0.000) | 0.000* (0.000) | 0.000 (0.000) |
| Labour Productivity | -0.061*** (0.023) | -0.094*** (0.032) | -0.041*** (0.015) | -0.074*** (0.024) | -0.106*** (0.032) | -0.050*** (0.016) | -0.053*** (0.023) | -0.082*** (0.031) | -0.035*** (0.015) | -0.000** (0.000) | -0.001*** (0.000) | -0.000 (0.000) |
| Group | 0.016 (0.012) | 0.017 (0.017) | 0.007 (0.008) | 0.016 (0.012) | 0.017 (0.016) | 0.008 (0.009) | 0.013 (0.012) | 0.014 (0.017) | 0.005 (0.008) | 0.027* (0.014) | 0.022 (0.018) | 0.009 (0.011) |
| Foreign | 0.011 (0.016) | 0.025 (0.022) | 0.003 (0.011) | 0.010 (0.016) | 0.026 (0.023) | 0.003 (0.011) | 0.013 (0.016) | 0.027 (0.022) | 0.003 (0.011) | 0.008 (0.019) | 0.030 (0.026) | 0.006 (0.014) |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,630 | 4,657 | 4,454 | 4,630 | 4,657 | 4,454 | 4,630 | 4,657 | 4,454 | 3,985 | 3,990 | 3,826 |
| Pseudo R2 | 0.139 | 0.071 | 0.153 | 0.119 | 0.061 | 0.133 | 0.146 | 0.079 | 0.160 | 0.124 | 0.069 | 0.139 |

Notes: The table reports Probit marginal effects. Three, two and one star (*) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include industry and country dummies not reported for reasons of space. All of the variables are defined in Table A1. The variable Size is expressed in logarithm. In columns (1)-(9), balance-sheet indicators refer to the period 2007-2009. In columns (10)-(12), balance-sheet indicators refer to the year 2007.

Table 5: The role of soft information production

| | Soft information and lending technologies | | | | | | Hardening of soft information | | |
|--|---|----------------------|----------------------|----------------------|----------------------|----------------------|-------------------------------|----------------------|----------------------|
| | Rationing Wide | | Rationing WtPM | | Rationing Wide | | Rationing Wide | | Rationing WtPM |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Soft Info | -0.021** (0.010) | -0.007 (0.013) | -0.016** (0.008) | -0.031*** (0.010) | -0.019 (0.013) | -0.022*** (0.007) | 0.134*** (0.019) | 0.151*** (0.032) | 0.079*** (0.014) |
| Transactional Lending | | | | 0.118*** (0.016) | 0.129*** (0.025) | 0.068*** (0.012) | 0.008 (0.016) | -0.005 (0.023) | 0.004 (0.011) |
| Relationship Lending | | | | 0.001 (0.012) | -0.008 (0.018) | 0.001 (0.007) | -0.036** (0.015) | -0.048* (0.028) | -0.027** (0.012) |
| Soft Information * Transactional Lending | | | | | | | -0.018 (0.021) | -0.003 (0.039) | -0.007 (0.016) |
| Soft Information * Relationship Lending | | | | | | | 0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) |
| Age | -0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | 0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) |
| Size | 0.001 (0.004) | -0.003 (0.006) | 0.007*** (0.003) | 0.003 (0.004) | -0.001 (0.006) | 0.008*** (0.003) | 0.003 (0.004) | -0.001 (0.006) | 0.008*** (0.003) |
| Debt Ratio | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) | 0.001*** (0.000) |
| Liquidity Ratio | -0.063*** (0.009) | -0.045*** (0.012) | -0.042*** (0.006) | -0.057*** (0.008) | -0.042*** (0.011) | -0.038*** (0.006) | -0.057*** (0.008) | -0.042*** (0.011) | -0.038*** (0.006) |
| Diff. ROS | -0.150*** (0.051) | -0.196** (0.084) | -0.074** (0.035) | -0.137*** (0.048) | -0.189** (0.084) | -0.062** (0.032) | -0.142*** (0.049) | -0.193** (0.084) | -0.065** (0.032) |
| Capital Intensity | 0.014** (0.007) | 0.026*** (0.008) | 0.005 (0.005) | 0.011* (0.006) | 0.022** (0.008) | 0.003 (0.004) | 0.011* (0.006) | 0.021** (0.008) | 0.003 (0.004) |
| Labour Productivity | -0.073*** (0.024) | -0.106*** (0.031) | -0.050*** (0.016) | -0.060*** (0.023) | -0.093*** (0.032) | -0.040*** (0.015) | -0.060*** (0.023) | -0.093*** (0.032) | -0.040*** (0.015) |
| Group | 0.015 (0.012) | 0.017 (0.017) | 0.007 (0.009) | 0.015 (0.012) | 0.018 (0.017) | 0.006 (0.008) | 0.015 (0.012) | 0.017 (0.017) | 0.006 (0.008) |
| Foreign | 0.009 (0.016) | 0.025 (0.023) | 0.002 (0.012) | 0.013 (0.016) | 0.027 (0.022) | 0.004 (0.011) | 0.014 (0.017) | 0.028 (0.022) | 0.005 (0.011) |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,630 | 4,657 | 4,454 | 4,630 | 4,656 | 4,454 | 4,630 | 4,656 | 4,454 |
| Pseudo R-squared | 0.114 | 0.060 | 0.130 | 0.142 | 0.071 | 0.157 | 0.143 | 0.072 | 0.157 |

Notes: The table reports Probit marginal effects. Three, two and one star (*, **, ***) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include industry and country dummies not reported for reasons of space. All of the variables are defined in Table A1. The variable Size is expressed in logarithm. Balance-sheet indicators refer to the period 2007-2009.

Table 6: Alternative measures of soft information

| Panel A: Inverse of number of banks | | | | | | | | | |
|---|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|
| | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Inverse of Num. Banks | -0.061*** (0.023) | -0.087** (0.034) | -0.059*** (0.016) | -0.050** (0.022) | -0.078** (0.035) | -0.049*** (0.014) | | | |
| Transactional Lending | | | | 0.115*** (0.015) | 0.125*** (0.025) | 0.064*** (0.012) | 0.144*** (0.023) | 0.161*** (0.033) | 0.085*** (0.015) |
| Relationship Lending | | | | -0.007 (0.012) | -0.016 (0.017) | -0.004 (0.007) | -0.014 (0.017) | 0.012 (0.025) | -0.002 (0.012) |
| Inverse of Num. Banks * Trans. Lending | | | | | | | -0.095** (0.042) | -0.107 (0.068) | -0.068** (0.030) |
| Inverse of Num. Banks * Relat. Lending | | | | | | | 0.030 (0.049) | -0.094 (0.068) | -0.007 (0.038) |
| Observations | 4,627 | 4,656 | 4,451 | 4,627 | 4,654 | 4,451 | 4,627 | 4,654 | 4,451 |
| Pseudo R-squared | 0.115 | 0.062 | 0.134 | 0.141 | 0.072 | 0.158 | 0.142 | 0.074 | 0.159 |
| Panel B: Exclusive lending relationships | | | | | | | | | |
| One Bank | -0.034** (0.014) | -0.057*** (0.022) | -0.023*** (0.009) | -0.028* (0.015) | -0.052** (0.022) | -0.019** (0.009) | | | |
| Transactional Lending | | | | 0.115*** (0.016) | 0.125*** (0.025) | 0.066*** (0.012) | 0.118*** (0.016) | 0.128*** (0.024) | 0.068*** (0.012) |
| Relationship Lending | | | | -0.005 (0.012) | -0.014 (0.017) | -0.003 (0.007) | -0.006 (0.012) | -0.009 (0.018) | -0.002 (0.007) |
| One Bank * Trans. Lending | | | | | | | -0.070* (0.042) | -0.040 (0.063) | -0.028 (0.026) |
| One Bank * Relat. Lending | | | | | | | 0.029 (0.051) | -0.102 (0.079) | -0.006 (0.036) |
| Observations | 4,627 | 4,656 | 4,451 | 4,627 | 4,654 | 4,451 | 4,627 | 4,654 | 4,451 |
| Pseudo R-squared | 0.114 | 0.062 | 0.130 | 0.140 | 0.072 | 0.155 | 0.140 | 0.072 | 0.154 |
| Panel C: Main bank financing share | | | | | | | | | |
| Financing Share | -0.020 (0.013) | -0.009 (0.019) | -0.021** (0.010) | -0.020* (0.012) | -0.010 (0.019) | -0.019** (0.009) | | | |
| Transactional Lending | | | | 0.116*** (0.016) | 0.125*** (0.025) | 0.065*** (0.012) | 0.131*** (0.022) | 0.159*** (0.032) | 0.081*** (0.016) |
| Relationship Lending | | | | -0.006 (0.012) | -0.014 (0.017) | -0.004 (0.007) | -0.004 (0.020) | -0.047 (0.035) | -0.004 (0.013) |
| Financing Share * Trans. Lending | | | | | | | -0.031 (0.023) | -0.065* (0.036) | -0.033** (0.016) |
| Financing Share * Relat. Lending | | | | | | | -0.005 (0.035) | 0.063 (0.056) | -0.000 (0.022) |
| Observations | 4,610 | 4,638 | 4,434 | 4,610 | 4,636 | 4,434 | 4,610 | 4,636 | 4,434 |
| Pseudo R-squared | 0.114 | 0.061 | 0.133 | 0.141 | 0.071 | 0.158 | 0.141 | 0.071 | 0.159 |
| Panel D: Length of the lending relationship | | | | | | | | | |
| Duration | -0.001*** (0.000) | -0.001*** (0.000) | -0.001*** (0.000) | -0.001*** (0.000) | -0.001** (0.000) | -0.000*** (0.000) | | | |
| Transactional Lending | | | | 0.116*** (0.016) | 0.125*** (0.025) | 0.067*** (0.012) | 0.122*** (0.017) | 0.149*** (0.028) | 0.071*** (0.011) |
| Relationship Lending | | | | -0.007 (0.012) | -0.016 (0.018) | -0.003 (0.007) | 0.006 (0.017) | -0.009 (0.027) | 0.006 (0.013) |
| Duration * Trans. Lending | | | | | | | -0.000 (0.001) | -0.002 (0.001) | -0.000 (0.001) |
| Duration * Relat. Lending | | | | | | | -0.001 (0.001) | -0.000 (0.002) | -0.001 (0.001) |
| Observations | 4,570 | 4,596 | 4,396 | 4,570 | 4,595 | 4,396 | 4,570 | 4,595 | 4,396 |
| Pseudo R-squared | 0.114 | 0.063 | 0.130 | 0.140 | 0.072 | 0.156 | 0.140 | 0.073 | 0.156 |

Notes: The table reports Probit marginal effects. Three, two and one star (*) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include control variables, industry and country dummies not reported for reasons of space. All of the variables are defined in Table [AI](#)

Table 7: The role of bank type and firm size

| Panel A: The role of bank type | | | | | | |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | Local banks | | | National banks | | |
| | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Trasactional Lending | 0.133*** (0.022) | 0.162*** (0.039) | 0.078*** (0.016) | 0.124*** (0.021) | 0.119*** (0.034) | 0.070*** (0.018) |
| Relationship Lending | 0.004 (0.024) | -0.033 (0.036) | -0.013 (0.014) | 0.015 (0.024) | 0.053 (0.036) | 0.024 (0.018) |
| Soft Information | -0.025 (0.020) | -0.049 (0.035) | -0.022 (0.014) | -0.059* (0.034) | -0.034 (0.054) | -0.035* (0.021) |
| * Trans. Lending | -0.019 (0.030) | 0.033 (0.047) | 0.006 (0.018) | -0.007 (0.051) | -0.090 (0.081) | -0.021 (0.033) |
| * Relat. Lending | | | | | | |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,114 | 3,114 | 2,997 | 1,508 | 1,525 | 1,449 |
| Pseudo R-squared | 0.143 | 0.069 | 0.158 | 0.170 | 0.105 | 0.208 |

| Panel B: The role of firm size | | | | | | | | | |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|-------------------|-------------------|
| | Small firms | | | Medium firms | | | Large firms | | |
| | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Trasactional Lending | 0.131*** (0.022) | 0.139*** (0.037) | 0.070*** (0.015) | 0.135*** (0.035) | 0.168*** (0.063) | 0.091*** (0.029) | 0.028 (0.046) | 0.184 (0.129) | 0.039 (0.029) |
| Relationship Lending | -0.003 (0.021) | -0.025 (0.030) | -0.003 (0.012) | 0.029 (0.029) | 0.055 (0.051) | 0.036 (0.025) | 0.070* (0.036) | 0.093 (0.088) | 0.025 (0.020) |
| Soft Information | -0.039** (0.017) | -0.054 (0.034) | -0.027** (0.012) | -0.067 (0.056) | -0.027 (0.096) | -0.019 (0.050) | 0.061 (0.064) | 0.025 (0.162) | 0.011 (0.035) |
| * Trans. Lending | -0.018 (0.030) | -0.002 (0.053) | -0.013 (0.020) | 0.007 (0.059) | -0.020 (0.106) | -0.013 (0.053) | -0.102* (0.056) | -0.022 (0.137) | -0.027 (0.033) |
| * Relat. Lending | | | | | | | | | |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,649 | 3,649 | 3,492 | 734 | 736 | 719 | 225 | 247 | 221 |
| Pseudo R-squared | 0.141 | 0.071 | 0.157 | 0.173 | 0.092 | 0.165 | 0.341 | 0.214 | 0.389 |

Notes: The table reports Probit marginal effects. Firms are classified as dealing with Local (National) banks if their main bank is a local (national) bank. Firms are classified as: (i) Small, if they have less than 50 employees; (ii) Medium, if they have more than 50 and less than 250 employees; (iii) Large, if they have more than 250 employees. Three, two and one star (*) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include control variables, industry and country dummies not reported for reasons of space. All of the variables are defined in Table [A1](#)

Table 8: The nature of lending technologies

| | Dependent variable: Rationing | | | | | |
|-------------------------|-------------------------------|----------------------|---------------------|---------------------|---------------------|--------------------|
| | Full sample | Bank type | | Firm size | | |
| | | Local banks | National banks | Small | Medium | Large |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Collateral | 0.068*** (0.007) | 0.066*** (0.009) | 0.070*** (0.011) | 0.068*** (0.008) | 0.056*** (0.018) | 0.015 (0.016) |
| Historical Records | 0.025*** (0.009) | 0.029** (0.013) | 0.014 (0.012) | 0.021** (0.011) | 0.021 (0.017) | 0.049** (0.025) |
| Balance Sheet Info | 0.002 (0.011) | 0.005 (0.010) | -0.010 (0.026) | 0.002 (0.011) | 0.018 (0.026) | -0.122 (0.080) |
| Interview with Managers | -0.020** (0.008) | -0.032*** (0.010) | 0.006 (0.018) | -0.018** (0.009) | -0.022 (0.018) | -0.028 (0.023) |
| Business Plan | 0.027*** (0.010) | 0.033*** (0.011) | 0.015 (0.017) | 0.023** (0.009) | 0.039*** (0.017) | 0.017 (0.014) |
| Brand Recognition | -0.010 (0.009) | -0.009 (0.013) | -0.011 (0.015) | -0.023** (0.010) | 0.007 (0.022) | 0.028 (0.021) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,630 | 3,114 | 1,508 | 3,649 | 734 | 225 |
| Pseudo R-squared | 0.154 | 0.158 | 0.178 | 0.154 | 0.178 | 0.412 |

Notes: The table reports Probit marginal effects. Firms are classified as dealing with Local (National) banks if their main bank is a local (national) bank. Firms are classified as: (i) Small, if they have less than 50 employees; (ii) Medium, if they have more than 50 and less than 250 employees; (iii) Large, if they have more than 250 employees. Three, two and one star (*) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include control variables, industry and country dummies not reported for reasons of space.

Appendix

Table A1: Variable definitions

| Variable | Definition |
|---|--|
| Rationing | Dummy variable equal to one if the firm unsuccessfully applied for credit, and zero otherwise. (Source: EU-EFIGE survey) |
| Rationing - Wide | Dummy variable equal to one if the firm was willing to increase its borrowing, and zero otherwise. (Source: EU-EFIGE survey) |
| Rationing - WtPM Willingness to Pay More | Dummy variable equal to one if the firm unsuccessfully applied for credit and was willing to pay a higher rate of interest, and zero otherwise. (Source: EU-EFIGE survey) |
| Transactional Lending | Average of collateral, balance sheet information and historical records dummies. (Source: EU-EFIGE survey) |
| Relationship Lending | Average of interviews with management, business plan and brand recognition dummies. (Source: EU-EFIGE survey) |
| Transactional Lending 2 | Average of balance sheet information and historical records dummies. (Source: EU-EFIGE survey) |
| Relationship Lending 2 | Average of interviews with management and business plan dummies (Source: EU-EFIGE survey) |
| Soft Information | Average of consultancy service and long-lasting relationship dummies. (Source: EU-EFIGE survey) |
| Number of Banks | Total number of firm's banking relationships. (Source: EU-EFIGE survey) |
| Inverse of Num. Banks | One over the number of banking relationships enjoyed by the firm. (Source: EU-EFIGE survey) |
| One Bank | Dummy variable equal to one if the firm has one banking relationship, and zero otherwise. (Source: EU-EFIGE survey) |
| Financing Share | Financing share of the firm's main bank. (Source: EU-EFIGE survey) |
| Duration | Length (in number of years) of the bank-firm relationship. (Source: EU-EFIGE survey) |
| Age | Number of years from firm's inception. (Source: EU-EFIGE survey) |
| Size | Logarithm of the number of workers employed in the firm. (Source: Bvd-Amadeus) |
| Debt Ratio | Ratio of total debt to total assets. (Source: Bvd-Amadeus) |
| Liquidity Ratio | Ratio of current assets to current liabilities. (Source: Bvd-Amadeus) |
| Differential ROS | Difference between firm i return on sales and the median return on sales of its industry (at the size class and regional level). (Source: Bvd-Amadeus) |
| Capital Intensity | Ratio of tangible fixed assets to number of employees. (Source: Bvd-Amadeus) |
| Labour Productivity | Ratio of value added to number of employees. (Source: Bvd-Amadeus) |
| Group | Dummy variable equal to one if firm i is part of a group, and zero otherwise. (Source: EU-EFIGE survey) |
| Foreign | Dummy variable equal to one if the main shareholder of the firm i is foreign. (Source: EU-EFIGE survey) |

Table A2: Lending technologies - Summary statistics

| | Mean | Std. Dev. | Obs. |
|--|------|-----------|-------|
| <i>Transactional lending technologies:</i> | | | |
| Collateral | 0.55 | 0.50 | 6,855 |
| Balance Sheet Info | 0.84 | 0.36 | 6,874 |
| Historical Records | 0.40 | 0.49 | 6,865 |
| <i>Relationship lending technologies:</i> | | | |
| Interview with Managers | 0.56 | 0.50 | 6,863 |
| Business Plan | 0.48 | 0.50 | 6,864 |
| Brand Recognition | 0.15 | 0.36 | 6,855 |

Table A3: Controlling for differential effects of the global financial crisis

| | Periphery: Italy - Spain - Hungary | | | Core: Austria - France - Germany - UK | | | Additional control: Differential Growth (NUTS-1) | | |
|-----------------------|---------------------------------------|----------------------|----------------------|--|--------------------|----------------------|---|----------------------|----------------------|
| | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM | Rationing | Rationing Wide | Rationing WtPM |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Transactional Lending | 0.165*** (0.026) | 0.185*** (0.034) | 0.099*** (0.019) | 0.031*** (0.010) | 0.023 (0.029) | 0.020*** (0.008) | 0.107*** (0.014) | 0.113*** (0.022) | 0.066*** (0.011) |
| Relationship Lending | -0.011 (0.015) | -0.019 (0.020) | -0.003 (0.009) | -0.000 (0.016) | -0.004 (0.030) | -0.006 (0.010) | 0.002 (0.013) | 0.005 (0.023) | 0.002 (0.009) |
| Age | -0.000 (0.001) | -0.000 (0.001) | -0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) | -0.000 (0.000) |
| Size | 0.006 (0.006) | 0.002 (0.007) | 0.013*** (0.004) | -0.001 (0.004) | -0.001 (0.009) | 0.000 (0.002) | -0.000 (0.005) | -0.002 (0.008) | 0.005 (0.003) |
| Debt Ratio | 0.001*** (0.000) | 0.002*** (0.000) | 0.001*** (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000 (0.000) | 0.000** (0.000) |
| Liquidity Ratio | -0.067*** (0.011) | -0.058*** (0.015) | -0.051*** (0.009) | -0.029*** (0.007) | -0.020* (0.012) | -0.015*** (0.005) | -0.046*** (0.009) | -0.041*** (0.012) | -0.026*** (0.007) |
| Diff. ROS | -0.180** (0.071) | -0.251** (0.104) | -0.082* (0.048) | -0.029 (0.051) | 0.026 (0.145) | -0.017 (0.035) | -0.120** (0.060) | -0.155 (0.101) | -0.045 (0.043) |
| Capital Intensity | 0.014 (0.009) | 0.023** (0.011) | 0.006 (0.006) | 0.015* (0.008) | 0.039* (0.021) | 0.002 (0.008) | 0.017* (0.009) | 0.019 (0.015) | 0.005 (0.007) |
| Labour Productivity | -0.072** (0.033) | -0.125*** (0.040) | -0.053** (0.022) | -0.051** (0.023) | -0.058 (0.043) | -0.027 (0.018) | -0.065*** (0.025) | -0.045 (0.036) | -0.050*** (0.018) |
| Group | 0.023 (0.018) | 0.025 (0.022) | 0.007 (0.013) | 0.002 (0.007) | -0.002 (0.022) | 0.006 (0.006) | 0.004 (0.012) | 0.007 (0.019) | 0.002 (0.009) |
| Foreign | 0.035 (0.029) | 0.051 (0.032) | 0.019 (0.021) | -0.006 (0.009) | 0.011 (0.025) | -0.005 (0.005) | 0.003 (0.021) | 0.003 (0.029) | -0.007 (0.012) |
| Differential Growth | | | | | | | 1.030** (0.413) | 1.263* (0.681) | 0.663** (0.294) |
| Industry Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Country Dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,438 | 3,438 | 3,282 | 1,192 | 1,219 | 1,172 | 2,708 | 2,733 | 2,626 |
| Pseudo R-squared | 0.123 | 0.086 | 0.138 | 0.153 | 0.054 | 0.153 | 0.166 | 0.062 | 0.180 |

Notes: The table reports Probit marginal effects. Three, two and one star (*) mean, respectively, a 99, 95 and 90 percent level of significance. Standard errors clustered at the regional level (NUTS-2) are in parentheses. All regressions include industry and country dummies not reported for reasons of space. All of the variables are defined in Table A1. The variable Size is expressed in logarithm. The variable Differential Growth is computed as the difference between the growth rate of the region where the firm operates (at the NUTS-1 level) and the average growth rate of the country where the company is located.