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Microevidence from the euro area*

by

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Heterogeneity and state dependence in firms' access to credit: Microevidence from the euro area

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Abstract

Using detailed firm-level longitudinal data, this paper analyses the main factors affecting firms' access to bank credit in eleven euro area countries over the period 2014-2018. We focus on firms' loan demand behaviour and on banks' actual credit granting decision, using alternative measures of financing constraints and controlling for endogenous sample selection and individual heterogeneity. Furthermore, we explicitly analyse the dynamics of firms' access to credit and account for state dependence in loan demand and credit rationing probabilities. Empirical results show that small and informationally opaque businesses, with deteriorated public support and credit history, experience greater difficulties in accessing to bank loans. Moreover, we provide evidence of significant state dependence in access to credit over time. In particular, firms having already experienced credit restrictions in the past are more likely to face further financing constraints, while enterprises that repeatedly recur to external financing seem to have an easier access to credit. Finally, focusing on the subset of firms that actually need bank financing, we find that previous credit restrictions significantly reduce current demand probability, thus providing evidence of a significant credit discouragement effect.

Keywords: Access to credit; Financing constraints; State dependence; Sample selection; Unobserved heterogeneity; Panel data.

JEL classification: G32; G21; D22; C23; C34.

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1. Introduction

Access to bank financing is one of the key drivers of firms' survival and growth especially in countries with bank-based financial systems, where the limited diffusion of alternative forms of external financing drastically increases firms' dependence on bank lending.

The increases in financial frictions that occurred during the global financial crisis have further exacerbated credit misallocation and financing constraints, hampering firm investment and growth also in the post crisis period (Schivardi et al., 2017). Previous studies have provided large empirical evidence on firms' credit access conditions, by assessing the determinants of loan demand and financing constraints mainly in a static context (see, among others, Beck et al., 2006; Brown et al., 2011; Ferrando and Mulier, 2015; Ferrando et al., 2017). Constraints in the access to external financing, either in the form of loan rejection or restrictions in the quantity and price dimensions, lead the firm to resize or renounce its original investment project and have negative impacts on production and sales, which may in turn trap the firm in a credit restriction state due to a self-reinforcing deterioration of its collateralisable net worth (Gertler and Gilchrist, 1994). However, as discussed in Pignini et al. (2016), very limited attention has been devoted in the literature to whether credit access difficulties and financial frictions tend to persist over time, as restricted firms may be more prone to be constrained again and locked into a long-lasting credit trap.

The aim of this paper is to examine the drivers of firms' access to bank credit in the euro area during the post crisis period. We focus our analysis on bank credit given the extremely bank-oriented nature of the euro area financial system in which financial intermediaries represent the most relevant source of external financing and the use of alternative funding sources is particularly limited, especially among micro and small enterprises (Cœuré, 2013). The empirical analysis is carried out on a large panel of firms from 11 euro area countries for the period 2014-2018. Firm-level data come from "Survey on Access to Finance of Enterprises" (SAFE), which provides detailed information on firms' characteristics and financial structure and on their use of bank financing. This information allows to define direct indicators of access to finance and to analyse the main determinants of actual loan demand behaviour by firms and banks' credit granting decisions. Furthermore, the longitudinal structure of the data allows us to investigate time persistence in credit demand and financing constraints.

To the aims of our analysis, we first consider a static panel probit model with endogenous sample selection, accounting for unobserved heterogeneity by means of a random-effects approach. Credit demand and rationing probabilities are estimated jointly, allowing non-zero correlation between the processes governing the request for banking finance and the lender's decision of granting or denying these funds. Then, we extend the modeling framework to implement a dynamic specification for both the

equations of the model. In order to handle the initial conditions problem, we use the approach proposed by Wooldridge (2005) and generalised by Raymond et al. (2010) to binary models with sample selection.

This study contributes to the empirical literature on firms' access to credit in a number of ways. First, we analyse firms' financing conditions in a period characterised by a slow, but constant, recovery after the outburst of the global financial crisis, in which access to bank lending should represent a financial accelerator mechanism for firms' investments. Second, exploiting the information on loan application outcomes provided by the SAFE survey, we analyse access to credit using alternative indicators of credit rationing accounting for different degrees of financing constraints in terms of both credit rejection and quantity restrictions. Third, to the best of our knowledge, ours is the first study to fully address the issue of time persistence in access to credit. Extending the analysis of Pignini et al. (2016), we focus on the issue of time persistence and provide strong evidence in favour of true state dependence in both credit demand and financing constraints. In particular, we find that credit rationing exerts its effects not only in the current period, leading to the loss of current business opportunities, but it reduces firms' future net worth and the likelihood of obtaining new credit in the following periods. Furthermore, past loan demand not only increases the probability of applying for additional financing in the future, but it also contributes to reduce the probability of rationing. This evidence supports the view that the information acquired over time through repeated interactions with the firm allows banks to address the informational opacity problems typical of small business lending and contributes to mitigate credit rationing. Finally, we point out a significant credit discouragement effect when we focus the analysis on those firms that are actually in need of additional bank financing: in this subsample, past credit restrictions appear to significantly curb firms' current credit demand.

The remainder of the paper is organised as follows. Section 2 reviews the relevant literature on firm's access to credit. Section 3 describes the dataset and the variables included in our empirical specifications. Section 4 presents the econometric methods, while estimation results are reported and discussed in Section 5. Section 6 provides several robustness checks on the main empirical results and Section 7 offers some concluding remarks.

2. Literature overview

2.1 Imperfect information and financial frictions in credit markets

The banking system represents the main source of external financing in most European countries. The analysis of the drivers of banks' credit allocation decisions have received renewed attention since the outburst of the global financial crisis and also during the sovereign debt crises that have amplified

financial frictions and constraints in credit markets. In Eurozone countries, difficulties in firms' access to bank financing have thus raised increasing concerns, as credit availability is a key factor for firms' growth and for general economic prosperity. This issue is particularly relevant to small and medium enterprises representing the core of the European economic systems. Hassan et al. (2017) highlight that financial capital misallocation represents an important determinant of low productivity and growth characterising the Eurozone periphery.

Theoretical literature has emphasised the role of imperfect information issues and credit market frictions in causing asymmetries between lenders and borrowers (Akerlof, 1970; Williamson, 1975). Asymmetric information has been a prominent factor in theoretical and empirical analyses on financing constraints. Lenders are able to reduce information asymmetries by screening and monitoring borrowers' activities. Typically, firms and banks are not in the same informative condition when a new transaction sets up and the costs of searching for information is unbalanced between lenders and borrowers (Stigler, 1961). In this view, the time spent producing and collecting information is of key importance. Keeton (1979) proposed one of the first classifications of credit constraints distinguishing between two types of rationing. The first type ("*Type I rationing*") occurs when applicants do not receive the full amount of credit they have applied for, even if they are willing to pay the quoted price. In the second type ("*Type II rationing*") some borrowers are completely denied credit by lenders although they are apparently identical to applicants who obtain the full amount of the loan. This classification is based on the assumptions that banks can observe the expected return of the project but borrower's probability of default is unknown. Thus, lender may deny credit for different reasons from creditworthiness. Jaffe and Stiglitz (1990) accounts for the relationship linking loan size and indebtedness to price terms associated to a greater credit risk. In an additional hypothesis, banks can know both borrowers' probability of default and the expected return of the project. Decisions of granting credit are based on the risk-return relationship and investments presenting a lower return with respect to their risk profile are rationed. The information the bank can access fosters the identification of those borrowers characterised by higher moral hazard and adverse selection risks (Diamond, 1984; Berger and Udell, 2002). Further, the quality and timeliness of the information is crucial for succeeding in the credit market (Elsas and Krahn, 1998; Lehmann and Neuberger, 2001; Elsas, 2005). When adverse selection issues are not mitigated with the use of appropriate instruments, banks may decide to reduce the supply of financing, being unable to properly assess the quality of investment projects (Jaffee and Russell, 1976; Stiglitz and Weiss, 1981). This has appeared as the most pressing issue since the onset of the global financial crisis when the drastic reduction in financial institutions' available resources turned into exacerbated creditworthiness assessments.

2.2 Persistence in firms' access to credit

Information on past negative ratings and credit restrictions can be easily retrieved by banks and used in their creditworthiness tests. Due to information imperfections and screening technology frictions, a bad credit history might strongly affect banks' future credit decisions, even though a firm's perspectives and growth opportunities may have significantly improved since their previous negative assessment. The stickiness of bank screening technologies, together with information opaqueness, represent an upfront barrier to carry out new investments projects that cannot be funded using retained earnings or internal cash flows. Due to the lack of longitudinal data, previous empirical literature on firms' financing constraints has not properly addressed this issue and has investigated the determinants of credit demand, discouragement and rationing mainly in a static framework (Brown et al., 2011; Cenni et al., 2015; Cole and Sokolyk, 2016; Angori et al., 2019). Very limited attention has been paid to the possibility of lock-in effects due to the persistence of credit restrictions over time. An exception is Pigini et al. (2016), who investigate credit access conditions in Italy and provide robust empirical evidence of state dependence in financing constraints, showing that this phenomenon is particularly relevant to medium and large firms.

Persistence in credit demand and financing constraints over time might depend on observable firm characteristics affecting access to credit as well as on unobserved heterogeneity and true state dependence. Firms' access to credit may be in fact affected by unmeasured firm-specific variables that are not influenced by past credit experiences. If these unobserved factors are correlated over time and are not properly controlled, they give rise to spurious state dependence (Heckman, 1981): past demand and financing constraints may appear to affect current access to external finance only because they reflect the effect of temporally persistent unobserved heterogeneity. True state dependence refers instead to the fact that past credit access conditions have a genuine behavioural effect: a firm that applied for credit or that experienced a credit restriction will have a higher demand probability or will be more likely to face credit access difficulties in the future than an otherwise identical firm that did not apply or was not constrained, respectively. In particular, as discussed in Pigini et al. (2016), true state dependence in credit restriction can be explained by the negative impact of financing constraints on firms' net worth and by the adverse signalling about firms' creditworthiness. A restricted access to credit lead firms to cancel or postpone planned investments and reduce their ability to pursue attractive investment opportunities (Levenson and Willard, 2000; Campello et al., 2010). At the same, financial constraints lead borrowers to cut off their production and this determines a decline in the net worth of collateralisable assets, further reducing the probability of obtaining credit in the future. A second mechanism depends on frictions in information transmission and screening technologies, which make

banks' screening and scoring technologies to be characterised by a significant degree of memory. This implies that the expected quality of the borrower having applied for credit in the past is linked to the score of previous creditworthiness tests and, in absence of an adequate assessment on firms' future growth opportunities, these scores may strongly affect current credit granting decisions by banks.

2.3 Credit discouragement and self-selection into credit demand

A recent strand of literature on credit rationing focuses on the demand side and analyses borrowers' choice of not applying for credit, even when they need external capital, because they believe their application will be turned down (Mac an Bhaird et al., 2016; Ferrando and Mulier, 2017). The possibility to empirically ascertain the role of past credit constraints in affecting firms' likelihood to refrain from applying for further financial capital discloses new insights on this strand of literature. Jiménez et al. (2012) investigate whether credit restrictions operates as discouraging drivers, finding that firms are not able to successfully apply for additional loans and offset credit rejections through the recourse to other banks.

Credit discouragement theory has been formalised by Kon and Storey (2003), who point out that application costs for borrowers, imperfect screening by banks due to information asymmetries and interest rates play a crucial role in determining credit discouragement. Specifically, under imperfect information banks do not know the quality of borrowers and some creditworthy ("good") firms may choose not to apply for credit because the cost of application is too high and the return is no longer sufficient to cover borrowing costs.

Han et al. (2009) argue that discouragement can also be viewed as a self-rationing mechanism in the application decision, which can be efficient when bad borrowers are discouraged, but inefficient when good borrowers do not enter credit demand (and/or when bad borrowers apply for credit). Based on US data, they find that creditworthy borrowers have lower probabilities of discouragement, especially when banking markets are concentrated and when financial relationships are relatively longer, and point out that discouragement is an efficient self-rationing mechanism. Similarly, Freel et al. (2012) analyse firms' desire for bank credit in the UK and focus on the distinction between latent and actual credit demand. Their empirical results point out that discouraged borrowers differ from loan applicants in a number of dimensions; in particular, smaller firms, those pursuing cost-focused strategies and those without strong banking relationships are more likely to be discouraged.

The interpretation of credit discouragement as a self-rationing mechanism is strictly intertwined with the discussion on the importance of addressing self-selection into credit demand for the analysis

of banks' actual credit granting decisions. In this respect, Brown et al. (2011) and Aristei and Gallo (2016) highlight that controlling for endogenous selection effects at the loan application stage is essential in analysing the determinants of loan rejection. Specifically, they find that there is a substantial self-selection effect among firms that do not apply for credit and point out that those firms which are more likely to have an application rejected are less likely to apply in the first place.

2.4 Measuring financing constraints

The empirical literature has proposed different measures of credit constraints, either indirectly inferred from firms' financial statements or directly defined on firms' perceived and actual financing constraints. The differences between these indicators are not trivial and the literature is divided on which of these best capture financial restrictions.

Traditional indicators of credit rationing indirectly infer financing constraints from firms' financial statements and/or from their observed characteristics (see, among others, Fazzari et al. (1988), Kaplan and Zingales (1997), Lamont et al. (2001), Whited and Wu (2006) and Hadlock and Pierce (2010)). Farre-Mensa and Ljungqvist (2015) question the reliability of these indirect measures of financing constraints and highlight that firms typically classified as constrained actually behave as if they were unconstrained, having no trouble in raising debt and using proceeds of equity issues to increase pay-outs to shareholders. Results based on such indirect measures should be thus interpreted cautiously, as they may reflect differences in firms' growth and financing policies instead of capturing the impact of financing constraints.

Survey data allow instead deriving more precise measures of financial constraints based on firms' perceived or actual obstacles to credit access. On the one hand, studies focusing on perceived financing constraints classify as constrained those firms indicating access to credit as a relevant issue for their activities (see Beck et al. (2006), Ferrando and Grieshaber (2011) and Canton et al. (2012)). It is worth remarking that, since the reply is based on the general perception of the respondent that may be distorted by his/her degree of optimism or pessimism, these measures may in some cases be discordant with actual financial constraints (Ferrando and Mulier, 2015). On the other hand, several studies derive direct measures of financing constraints from the results on firms' actual applications to external financing (see Brown et al. (2011), Minetti and Zhu (2011) and Ferrando et al. (2017; 2019)). Differently from indicators derived from perceptions or financial statements, measures of financing constraints based on firms' actual experience of credit restrictions allow capturing directly financing constraints, without the possible biases of the indirect rationing proxies discussed above.

3 Data and measurement

3.1 Data sources

We use firm-level data from the European Central Bank and the European Commission within “*Survey on Access to Finance of Enterprises*” (SAFE), run jointly by the European Commission (EC) and the European Central Bank (ECB). Since 2009, the survey is carried out every six months and provides detailed microdata on firms’ access to credit in the euro area, as well as (mostly qualitative) information on a wide variety of firm characteristics (e.g., age, size, ownership, management, profitability). The survey mainly focuses on firms’ external financing and allows to distinguish between the use of bank credit and the recourse to alternative external financial sources. Furthermore, it also provides information on enterprises’ experiences and views on general economic conditions and on factors affecting the availability of external financing.¹

The sample is composed of non-financial firms, randomly chosen from the Dun & Bradstreet Business Register, and is stratified by country, firm size class and economic activity. Since the SAFE survey mainly focuses on SMEs, the sample allocation across size classes is defined to offer comparable precision for micro, small and medium-sized enterprises. In addition, a sample of large enterprises is included to compare developments for SMEs with those of large firms. In order to obtain more accurate estimators of semester-to-semester changes, the sample includes a rotating panel of enterprises, which are interviewed in at least two not necessarily consecutive waves. The panel component represents between the 50 and 60% of the entire sample, depending on the wave.

Here, we focus on firms from 11 Eurozone countries (Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherland and Portugal) and exploit nine waves of the survey (from wave 11 to wave 19, the last available at the time of the analysis, covering the period from April 2014 to September 2018). In our analysis, we use unbalanced panels of firms in order to maximise the number of observations and limit potential survivorship bias. Finally, we integrate SAFE survey data with additional data from the ECB Statistical Data Warehouse and from the European Association of Co-operative Banks (EACB) in order to account for credit market characteristics at the country-level.

3.2 Measurement

3.2.1 Credit access variables

SAFE survey provides detailed information on firms’ financial structure and on their use of external financing. We focus our analysis on bank credit, which is the main source of financing for firms in the

¹ Further information on the SAFE dataset and on the structure of the questionnaire are available on the ECB’s website: www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html

Eurozone, differently from other countries like the US, in which stock market capitalisation is larger and debt securities issued by the corporate sector play a more prominent role (Ehrmann et al. 2003). Moreover, the specific focus on bank lending is essential to highlight the factors affecting the financial structure and the growth opportunities of SMEs. This category of firms, which represents the backbone of the economy in most euro area countries, turn more often to banks for their external financing than large firms, but at the same time they are generally more likely to experience greater difficulties in obtaining funds (Cœuré, 2013).

Given the specific structure of the SAFE questionnaire, questions related to firms' actual bank loan demand and application outcome are asked only to those firms replying '*Relevant*' to questions Q4.b) ('*Are bank loans relevant to your enterprise, that is, have you used them in the past or considered using them in the future?*') and Q4.d) ('*Are grants or subsidised bank loans relevant to your enterprise, that is, have you used them in the past or considered using them in the future?*'). For this reason, we have to restrict the sample to those firms indicating as relevant at least one source of external financing between grants or subsidised bank loans and bank loans. The estimation sample thus reduces to about 46200 observations and 17400 firms.

Conditional on recurring to bank lending, we define variables of actual credit demand and rationing based on firms' answers to questions Q7A_a ('*Have you applied for a bank loan in the past six months?*') and Q7B_a ('*If you applied and tried to negotiate for a bank loan over the past six months, what was the outcome?*'). In particular, we build a binary of actual credit demand (*Credit demand*) equal to one if the firm applied for a loan in the past six months. Conditional on credit demand, we define three binary variables accounting for different degrees of credit constraints. We first define a dummy variable (*Rationing*) identifying those firms having their loan application completely rejected by banking intermediaries (i.e. those firms replying '*Was rejected*' to question Q7B_a). Second, we create a broader indicator (*Rationing 2*) equal to one for those firms whose loan application was completely rejected or if they only received a limited part of the amount requested (i.e. those replying '*Was rejected*' or '*Received below 75%*' to question Q7B_a). Finally, we build a third binary variable (*Rationing 3*) identifying all those firms whose loan application was not completely accepted (i.e. those replying '*Was rejected*' or '*Received below 75%*' or '*Received 75% or above*' to question Q7B_a). As discussed in García-Posada Gómez (2019), these two latter indicators allow extending the definition of financing constraints to account for different degrees of restrictions in the quantity of credit granted by banks (i.e., quantity rationing).

Finally, it is worth remarking that, differently from some previous studies (see e.g. Casey and O’Toole, 2014), we analyse actual credit restrictions by banks following a loan application and we do not consider as rationed those firms needing more credit, but deciding not to apply for it (discouraged borrowers).² Thus, firms choosing not to apply for additional external financing, either because they are discouraged from applying or because they do not need additional external funds, are classified as non-demanding firms (for which, *Credit demand* is equal to zero) and included in the estimation sample of the selection equation.³ In this way, we are able to properly analyse actual credit demand behaviour by firms and the conditional probability of credit restrictions against the probability of obtaining additional bank financing.⁴ For the same reason, we do not include in the estimation sample those firms that, after their application, refused the bank’s price terms and conditions because the cost was too high. This decision depends on firms choosing self-rationing and it does not properly reflect an effective measure of external constraints.

From Table 1 we notice that the countries with the highest level of applications for loans over time are France, Italy and Spain, whereas Ireland, the Netherlands and Greece show the lowest application rates. The Netherlands as well as Greece and Ireland present the highest difficulties in access to credit. Rationing is particularly burdensome for Greek firms, whose rejection rates range from 15 to more than 41% when weakly quantity rationed applications are considered, reflecting the impact of the ongoing sovereign debt crisis that has contributed to destabilise the internal banking system. Italy, Spain, the Netherlands, Ireland and Portugal are characterised by remarkable levels of partially rejected applications with respect to Austria, Belgium and Germany displaying the lowest denial rates. Firms, in economies that faced the financial crisis with more difficulties, are also more prone to be credit constrained.

[Table 1 about here]

Figure 1 presents the time patterns of the proportions of credit demanding and credit rationed firms over sample period. We notice that the proportion of loan applications remained constant around

² Cole and Sokolyk (2016) highlight that discouraged firms are significantly different from firms that actually applied for external financing and were denied credit on a number of dimensions. Additionally, their counterfactual analysis displays that about one third of the discouraged borrowers would have received credit if they had applied for.

³ Specifically, we consider as “non-demanding” those firms that replied “*Did not apply because of possible rejection*”, “*Did not apply because of sufficient internal funds*” or “*Did not apply for other reasons*” to question Q7A_a.

⁴ Previous empirical analyses face this issue in alternative ways. Becchetti et al. (2010) consider as rationed also discouraged firms needing additional funds and deciding not to apply for. Conversely, Cenni et al. (2015) assume that credit rationing should be identified as bank’s decision to deny credit and argue that discouraged enterprises cannot be considered as constrained simply because they did not apply for additional external financing.

34% over the entire period considered; conversely, the proportion of firms facing financial constraints has remarkably decreased in recent periods. In particular, the proportion of completely rejected applications has notably reduced since the beginning of 2014 and a similar decreasing pattern also characterises the two other indicators of credit rationing, which take into account quantity restrictions. This trend is indicative of the slow but evident economic recovery characterising the euro area, which has contributed to improve credit access conditions.

[Figure 1 about here]

Table 2 reports transition probabilities of credit demand and rationing between $t-1$ and t . The cross tabulations show high percentages on the diagonal suggesting that loan demand and credit rationing tend to persist over time. Around 76.4% of the firms that did not apply for a bank loan at $t-1$ did not enter the credit market at time t , whereas 55% of businesses that resorted to bank credit at time $t-1$ did the same at time t . Credit rationing is characterised by high persistence over time too: about 98% of the firms whose applications were fully granted in $t-1$ remained in the initial state, while 59% of the firms that experienced a credit rejection at time $t-1$ were rejected again in t . Accordingly, we find similar transition probabilities when we consider the *Rationing 2* and *Rationing 3* indicators.

[Table 2 about here]

This evidence highlights that both credit demand and financing constraints are fairly persistent, which may be due to the influence of both observed and unobserved heterogeneity and state dependence. In order to distinguish between spurious and true state dependence, we consider a dynamic random-effects probit model with sample selection, accounting for unobserved individual effects correlated with the initial conditions, as discussed in Section 4.2.

3.2.2 Control variables

With the aim of accurately analysing the main drivers of firms' access to credit in Eurozone countries, we consider a wide set of controls for firms' characteristics.

First, we account for firm dimension and age as standard drivers of information asymmetries. We control for firm size by means of a set of binary variables, using the staff headcount criterion to distinguish *Micro* (less than 10 employees), *Small* (from 10 to 49 employees) *Medium* (from 50 to 249 employees) and *Large* (250 or more employees) firms. With respect to firm age, we include a dummy for firms that

set up in the two years before the survey in order to identify possible age discrimination due to opacity and banks' difficulties in assessing the potentiality of younger firms (Hyytinen and Pajarinen, 2008).

Furthermore, we include a dummy indicating whether the firm is an autonomous profit-oriented enterprise, making independent financial decisions, and control for firms' corporate governance. In particular, given the large diffusion of individual and family-managed firms in some of the Eurozone countries of our sample, such as Italy, Spain and Germany, we add two dummies identifying whether the owner is an individual or a family.

Firms' internationalisation is captured by a dummy indicating whether the firm exported part of its production during the previous semester. Literature highlights that exporters are more efficient than non-exporters (Bernard and Jensen, 2004). On the one hand, exporters need relevant internal financing sources, abilities and knowledge to set up a business in the target foreign country. On the other hand, internationalised firms are able to develop new competences and skills by exploiting foreign markets' externalities. Thus, exporter could be less likely to face obstacles in access to credit.

We account for firms' innovative activity by means of a binary variable indicating whether businesses are requesting credit for developing and launching new products and services. Due to the significant financial resources needed for carrying out such projects and to the high uncertainty characterising such activities, banks could be unwilling to provide financial support to innovative firms introducing completely new products or services (Lee et al., 2015). By contrast, banking institutions could be better disposed to grant credit when it is aimed at financing tangible and more collateralisable investments (Hall and Lerner, 2010). In order to control for the type of investment project, we add a binary variable equal to one if the firm applies for a bank loan to finance a fixed investment, expecting a negative impact on credit rationing probability.

Since the amount of loan requested by borrowers may significantly affect banks' credit granting decisions, we consider a categorical variable that classifies loans into five classes according to their size.⁵ On the one hand, when credit demand increases banks could be unwilling to satisfy the entire application. The intensification of weak rationing represents the bank's attempt to reduce default risk associated with a unique borrower (Jaffee and Russell, 1976). On the other hand, applications for large loans are typical of large companies which are more likely to be solid and well-established in the market (Shumway, 2001). Thus, these larger applications, typical of larger and more credit-worthy businesses, could face less difficulties in being granted.

⁵ Specifically, we distinguish whether a firm applied for a *Micro loan* (up to 25000 euro), a *Small loan* (more than 25000 and less than 100000 euro), a *Medium loan* (more than 100000 and less than 250000), a *Medium-large loan* (more than 250000 and less than 1 million), a *Large loan* (over 1 million).

We account for firms' ability to generate income and we expect enterprises reporting low or decreased levels of turnover to show a higher propensity to demand additional funds. Low performances are also indicative of difficulties in the market and firms whose sales have decreased may find increasing obstacles in the access to credit. In order to take into account firms' indebtedness structure, we include two dummies indicating whether the debt-asset ratio decreased or remained unchanged in the past six months. Banks' credit constraints are not independent on the level of the firm's actual indebtedness and credit risk increases in businesses' financial exposure. Accordingly, following Ferrando et al. (2017; 2019), we include an additional control for changes in the firm's credit history. The availability of information on the evolution of creditworthiness is not trivial and banks' assessments are strictly linked to the firm's ability in serving its existing debts and the rating obtained in the past. We also consider a dummy indicating whether a firm received public financial support. The inclusion of this variable is aimed at alleviating concerns that the observed firm's credit demand behaviour and access to finance may be driven by possible government subsidies designed to correct any failure or bias occurring in credit markets (Mascia and Rossi, 2017). The injection of liquid public funds may reduce a firm's demand for bank credit, but it increases its stability as well as its future business opportunities.

With respect to country-level credit market characteristics, we use the asset-based Herfindahl-Hirschman concentration index to control for the degree of competition of the banking market. In concentrated markets, few banking groups, whose headquarters are often far from the local context, may exploit their monopolistic power. For this reason, a high level of concentration could be associated with a reduction of granted sources. We also include the share of non-performing loans (NPLs) on total gross loans in order to capture the general health of banking markets. A reduction in credit access possibilities is expected in those countries characterised by a high level of NPLs. Furthermore, we control for the share of cooperative banks. Banking systems with a larger share of credit cooperative banks, characterised by a local orientation and by a relationship-banking business model, are expected to be characterised by lower financing constraints.

Finally, we control for sector-level heterogeneity by means of macro-sector dummies, while unobserved heterogeneity at the country level and aggregate common shocks are taken into account by means of country-group and survey wave dummies, respectively.

Table A1 in the Appendix provides complete variable definitions, while Tables A2 and A3 report descriptive statistics and pairwise correlations for all explanatory variables, respectively.

4. Econometric methods

4.1 A static random-effects probit model with sample selection

According to our definition of credit rationing, we can observe (full or partial) credit restrictions by banks only if the firm has actually applied for a loan. This may cause an endogenous selectivity bias arising from the non-random decision to apply for additional bank financing: firms that are more likely to have an application rejected or restricted may also be more likely to refrain from applying in the first place (Brown et al., 2011). In order to cope with this selectivity issue, we recur to a sample selection probit model (Wynand and van Praag, 1981) and model credit rationing probability accounting for endogenous selectivity into loan demand. Furthermore, in implementing the model, we take the panel structure of our sample into account and model time-invariant unobserved heterogeneity by means of a random-effects approach. Formally:

$$\begin{aligned} D_{it} &= \mathbf{1}(\mathbf{Z}'_{it}\boldsymbol{\gamma} + \eta_i + \mu_{it} > 0) \\ R_{it} &= \mathbf{1}(\mathbf{X}'_{it}\boldsymbol{\beta} + \alpha_i + \varepsilon_{it} > 0) \end{aligned} \quad (1)$$

where $i = 1, \dots, N$, $t = 0_i, \dots, T_i$ and $\mathbf{1}(\cdot)$ is an indicator function equal to 1 if the expression in parentheses is true and zero otherwise. The first equation is the selection equation and the outcome variable R_{it} is observed only if $D_{it} = 1$. \mathbf{X}_{it} and \mathbf{Z}_{it} are vectors of time-varying and time-invariant explanatory variables at the firm and market level, with \mathbf{Z}_{it} including at least one regressor not included in \mathbf{X}_{it} to improve model identifiability, and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are the corresponding vectors of parameters. α_i and η_i capture individual unobserved heterogeneity, while μ_{it} and ε_{it} are idiosyncratic error terms. In particular, we assume that $\mu_{it}, \varepsilon_{it} | x_{it}, z_{it}, \eta_i, \alpha_i \sim N(\mathbf{0}, \Sigma_{\varepsilon\mu})$ and $\eta_i, \alpha_i | x_{it}, z_{it} \sim N(\mathbf{0}, \Sigma_{\alpha\eta})$, where $\Sigma_{\varepsilon\mu}$ and $\Sigma_{\alpha\eta}$ are given by:

$$\Sigma_{\varepsilon\mu} = \begin{pmatrix} 1 & \rho_{\varepsilon\mu} \\ \rho_{\varepsilon\mu} & 1 \end{pmatrix}, \quad \Sigma_{\alpha\eta} = \begin{pmatrix} \sigma_\alpha^2 & \rho_{\alpha\eta}\sigma_\alpha\sigma_\eta \\ \rho_{\alpha\eta}\sigma_\alpha\sigma_\eta & \sigma_\eta^2 \end{pmatrix} \quad (2)$$

Selectivity operates through correlation of the error terms (Greene, 2012). As discussed in Raymond et al. (2010), equations of model (1) are correlated through the idiosyncratic errors ($\rho_{\varepsilon\mu}$) and the individual effects ($\rho_{\alpha\eta}$), and the “total” correlation between the two equations can be computed as:

$$\rho_{tot} = \frac{\rho_{\alpha\eta}\sigma_\alpha\sigma_\eta + \rho_{\varepsilon\mu}}{\sqrt{(\sigma_\alpha^2 + 1)(\sigma_\eta^2 + 1)}} \quad (3)$$

If $\rho_{tot} = 0$ (i.e., if $\rho_{\alpha\eta} = \rho_{\varepsilon\mu} = 0$), the parameters of model (1) can be estimated by means of two standard univariate random-effects probit models: one for the probability of requiring credit and another one for the probability of being rationed, estimated on the sub-sample of firms having applied for. Conversely, when $\rho_{tot} \neq 0$ (i.e., when $\rho_{\alpha\eta} \neq 0$ and/or $\rho_{\varepsilon\mu} \neq 0$) the sub-sample of credit rationed firms cannot be considered as a random draw from the underlying population and equations of model

(1) should be estimated jointly allowing for a correlation between the processes governing loan demand and credit rationing probabilities to avoid endogenous selectivity bias.

Following Raymond et al. (2010) and Plum (2016), the likelihood function for the i -th individual can be written as:

$$L_i = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \prod_{t=0_i}^T L_{it}(D_{it}, R_{it} | \eta_i, \alpha_i) g(\eta_i, \alpha_i) d\eta_i d\alpha_i \quad (4)$$

where $\prod_{t=0_i}^T L_{it}(D_{it}, R_{it} | \eta_i, \alpha_i)$ is the likelihood function of individual i conditional on the individual effects and $g(\eta_i, \alpha_i)$ is the bivariate normal density function of the random-effects error terms. In particular, the likelihood function of individual i at time t conditional on the individual effects consists of two parts and is given by:

$$L_{it}(D_{it}, R_{it} | \eta_i, \alpha_i) = \begin{cases} \text{Prob}(D_{it} = 0 | \eta_i, \alpha_i) & \text{if } D_{it} = 0 \\ \text{Prob}(D_{it} = 1, R_{it} = r_{it} | \eta_i, \alpha_i) & \text{if } D_{it} = 1 \end{cases} \quad (5)$$

with $r_{it} = \{0, 1\}$. Ignorability of selection implies the factorisation of the marginal likelihood (4) and selection and outcome equations can be estimated separately, without any bias or loss of efficiency. Despite the double integral in (4) cannot be solved analytically, (adaptive) Gaussian quadratures can be used to integrate the likelihood over the unobserved random effects (Raymond et al., 2010).

4.2 Modelling the dynamics of credit demand and rationing

We extend the static model to a dynamic specification in order to control for the effects of past credit demand and financing constraints on current firms' loan applications and on banks' loan granting decisions. Formally, the dynamic extension of the static model (1) can be written as:

$$\begin{aligned} D_{it} &= \mathbf{1}(R_{it-1}^* \gamma_1 + D_{it-1} \gamma_2 + \mathbf{Z}'_{it} \boldsymbol{\gamma}_3 + \eta_i + \mu_{it} > 0) \\ R_{it} &= \mathbf{1}(R_{it-1}^* \beta_1 + D_{it-1} \beta_2 + \mathbf{X}'_{it} \boldsymbol{\beta}_3 + \alpha_i + \varepsilon_{it} > 0) \end{aligned} \quad (6)$$

where D_{it-1} and R_{it-1}^* represent the lagged indicators of loan demand and rationing. In our case, since the lagged restriction outcome cannot be observed for those firms that did not apply in $t-1$, we follow Pignini et al. (2016) and recode missing values to zero. The lagged credit rationing variable R_{it-1}^* thus takes value 1 for firms that applied for credit and experienced a restriction in credit supply in $t-1$ and zero both for non-rejected applicants and for firms which did not apply for credit in $t-1$.

Coefficients γ_2 and β_1 in model (6) measure, respectively, the effect of past demand behaviour on the current loan application probability and the impact of past credit restrictions on the conditional probability of being credit denied. Positive and statistically significant estimates of γ_2 and β_1 identify the presence of state dependence in credit demand and rationing, respectively, that may be due to true or spurious state dependence (Heckman, 1981). True state dependence in access to external financing arises

when past credit demand and rationing significantly increase the probability of applying for credit and of being rationed, respectively. Spurious state dependence occurs instead when the intertemporal relationship is determined by time-persistent unobserved effects.

In order to distinguish true state dependence from spurious state dependence,⁶ it is necessary to properly account for unobserved effects that are correlated over time as well as for the endogeneity of the initial conditions. Following Raymond et al. (2010) and Mosthaf (2017), we extend the approach to the initial conditions problem proposed by Wooldridge (2005) to a dynamic bivariate binary choice model with endogenous selectivity. We model the distribution of the unobserved effects of model (6) conditional on the initial value of the corresponding dependent variable and on exogenous explanatory variables by specifying the following auxiliary models:

$$\eta_i = b_{10} + b_{11}D_{i0_i} + \mathbf{X}_i^{+'} \mathbf{b}_{12} + a_{1i} \quad (7)$$

$$\alpha_i = b_{20} + b_{21}R_{i0_i}^* + \mathbf{Z}_i^{+'} \mathbf{b}_{22} + a_{2i} \quad (8)$$

where $R_{i0_i}^*$ and D_{i0_i} are the initial values of the dependent variables, $\mathbf{X}_i^+ = (\mathbf{X}'_{i0_{i+1}}, \dots, \mathbf{X}'_{iT_i})'$ and $\mathbf{Z}_i^+ = (\mathbf{Z}'_{i0_{i+1}}, \dots, \mathbf{Z}'_{iT_i})'$ represent the history of the observations of the explanatory variables, a_{1i} and a_{2i} denote the projection errors assumed to be orthogonal to R_{i0_i} , D_{i0_i} , \mathbf{X}_i , \mathbf{Z}_i , μ_{it} and ε_{it} . The ancillary parameters b_{10} , b_{11} , \mathbf{b}_{12} , b_{20} , b_{21} and \mathbf{b}_{22} have to be estimated alongside the parameters of interest. Specifically, b_{11} and b_{21} capture the dependence of the individual effects on the initial conditions. It is also worth noticing that, if the equations of model (6) include an intercept term, only the sum of these intercepts with b_{10} and b_{20} can be identified. Moreover, if the explanatory variables are time-invariant or do not show a sufficient within variation, then the coefficients $\boldsymbol{\gamma}_3$ and \mathbf{b}_{12} and $\boldsymbol{\beta}_3$ and \mathbf{b}_{22} cannot be separately identified. For this reason, we include in equations (7) and (8) only sufficiently time-varying explanatory variables. Furthermore, in order to reduce the number of parameters to be estimated, we decide to substitute \mathbf{X}_i^+ and \mathbf{Z}_i^+ with the within-means $\bar{\mathbf{X}}_i^+ = \frac{1}{T_i} \sum_{t=1_i}^{T_i} \mathbf{X}_i^+$ and $\bar{\mathbf{Z}}_i^+ = \frac{1}{T_i} \sum_{t=1_i}^{T_i} \mathbf{Z}_i^+$ computed excluding the initial-period explanatory variables $\mathbf{X}_{i0_i}^+$ and $\mathbf{Z}_{i0_i}^+$ (Rabe-Hesketh and Skrondal, 2013).⁷ Finally, as in Raymond et al. (2015), we assume that

$\mu_{it}, \varepsilon_{it} |_{D_{it-1}, R_{it-1}, \eta_i, \alpha_i} \sim N(\mathbf{0}, \Sigma_{\varepsilon\mu})$ and $a_1, a_2 |_{D_{i0_i}, R_{i0_i}} \sim N(\mathbf{0}, \Sigma_{a_1 a_2})$, where $\Sigma_{\varepsilon\mu}$ and $\Sigma_{a_1 a_2}$ are given by:

$$\Sigma_{\varepsilon\mu} = \begin{pmatrix} 1 & \rho_{\varepsilon\mu} \\ \rho_{\varepsilon\mu} & 1 \end{pmatrix}, \quad \Sigma_{a_1 a_2} = \begin{pmatrix} \sigma_{a_1}^2 & \rho_{a_1 a_2} \sigma_{a_1} \sigma_{a_2} \\ \rho_{a_1 a_2} \sigma_{a_1} \sigma_{a_2} & \sigma_{a_2}^2 \end{pmatrix} \quad (9)$$

⁶ In the remainder of the paper, when the term state dependence is used without any further explanation, it is to be understood as true state dependence.

⁷ Rabe-Hesketh and Skrondal (2013) show that the popular constrained version of Wooldridge's (2005) approach to the initial conditions problem, which includes within-means of time-varying explanatory variables based on all the periods including the first one, can be severely biased in short panels and propose alternative ways to avoid this issue. Their simulation results show that the specification using the within-means of the regressors computed omitting the initial-period values performs well.

The individual likelihood function of the dynamic random-effects probit model with endogenous selection, conditional on regressors and initial conditions, can be written as:

$$L_i = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \prod_{t=0_i+1}^T L_{it}(D_{it}, R_{it} | D_{i0_i}, D_{it-1}, \mathbf{X}_i, R_{i0_i}^*, R_{it-1}^*, \mathbf{Z}_i, a_{1i}, a_{2i}) g(a_{1i}, a_{2i}) da_{1i} da_{2i} \quad (10)$$

where $\prod_{t=0_i+1}^T L_{it}(D_{it}, R_{it} | D_{i0_i}, D_{it-1}, \mathbf{X}_i, R_{i0_i}^*, R_{it-1}^*, \mathbf{Z}_i, a_{1i}, a_{2i})$ is the likelihood function of the i -th individual conditional on the individual effects and $g(a_{1i}, a_{2i})$ is the bivariate normal density function of $(a_{1i}, a_{2i})'$. The approach adopted to solve the initial conditions problem simply leads to the likelihood function for the static random-effects probit with sample selection in (4) with the lagged and initial-period dependent variables and the history of the time-varying explanatory variables (or the corresponding within means computed excluded the initial period) as additional regressors. As discussed in Raymond et al. (2010), numerical methods can be used to evaluate the likelihood function of the bivariate dynamic model in equation (10).

Given the unbalanced structure of our panel dataset, in order to identify the parameters of the lagged dependent variables in model (6) and those of the individual effects in equations (7) and (8), we need at least three observations over time for some of the firms, two (or more) of which need to be consecutive. As discussed in Raymond (2010), the inclusion of firms with only two consecutive observations available, for which the lagged value of the dependent variable coincides with the initial conditions, increases the number of observations without harming the identification of model parameters, provided that there are some firms with at least three observations.

4.2.1 State dependence in access to credit, discouragement and past demand effects

The bivariate dynamic model (6) allows accounting for the issues of state dependence in firms' access to credit, as well as the effect on current credit demand arising from previous credit access difficulties and the effect of past demand behaviour on current rationing probability.

In order to properly assess the magnitude and significance of state dependence, discouragement and past demand effects, following Cappellari and Jenkins (2004) and Pignini et al. (2016), we estimate the impact of the lagged variables in terms of average partial effects on demand and rationing probabilities, deriving from past demand behaviour and past credit restrictions.

In our bivariate dynamic model, we have two lagged variables in each equation (R_{it} and D_{it}) and we are thus able to identify the direct impact of the lagged dependent variable and the cross-effects, coming from the inclusion of past credit restrictions in the selection equation and of past demand behaviour in the outcome equation. We define the direct effects as measures of true state dependence in credit demand and rationing probabilities, whereas cross-effects allow investigating the existence of possible credit discouragement effects as well as the impact of past loan demand on the likelihood of obtaining additional financing.

Specifically, for each firm we calculate state dependence in credit demand as the difference between the predicted probability of applying for credit conditional on having demanded in the previous period and the predicted probability of applying for conditional on not having demanded in the previous period and, then, we take the average across all N firms:

$$\bar{D}_{D_{t-1}} = \frac{1}{N} \sum_{i=1}^N [P(D_{it} = 1 | D_{it-1} = 1) - P(D_{it} = 1 | D_{it-1} = 0)] \quad (11)$$

Similarly, state dependence in credit rationing is computed as the average difference between the predicted probability of being rationed conditional on having been rationed in the previous period and the predicted probability of being rationed conditional on not having been rationed in the previous period:

$$\bar{R}_{R_{it-1}^*} = \frac{1}{N} \sum_{i=1}^N [P(R_{it} = 1 | D_{it} = 1, R_{it-1}^* = 1, D_{it-1} = 1) - P(R_{it} = 1 | D_{it} = 1, R_{it-1}^* = 0, D_{it-1} = 1)] \quad (12)$$

Turning to cross-effects, we compute the discouragement effect as the average difference between the predicted probability of applying for credit conditional on having been rationed in the previous period and the predicted probability of applying for credit conditional on not having been rationed in the previous period:

$$\bar{D}_{R_{it-1}^*} = \frac{1}{N} \sum_{i=1}^N [P(D_{it} = 1 | R_{it-1}^* = 1, D_{it-1} = 1) - P(D_{it} = 1 | R_{it-1}^* = 0, D_{it-1} = 1)] \quad (13)$$

Despite state dependence and discouragement in firms' access to credit have been already analysed in the literature (Kon and Storey, 2003; Han et al., 2009; Pignini et al., 2016), the role of past demand behaviour on credit restrictions has received limited attention. Our model allows explicitly accounting for the possibility that an intensive recourse to external financing over time may be a driver for reducing information asymmetries and setting up strong firm-bank relationships, thus contributing to alleviate financing constraints. In particular, the effect of past demand behaviour on the current probability of being rationed for each individual can be measured as the average difference between the predicted probability of being rationed conditional on having applied for credit in the previous period and the probability of being rationed conditional on not having applied for in the previous period:

$$\bar{R}_{D_{t-1}} = \frac{1}{N} \sum_{i=1}^N [P(R_{it} = 1 | D_{it} = 1, D_{it-1} = 1) - P(R_{it} = 1 | D_{it} = 1, D_{it-1} = 0)] \quad (14)$$

It is worth remarking that these measures of state dependence and cross-effects of lagged variables ensure that individual heterogeneity is properly taken into account, as they are functions of differences in individual probabilities that are then averaged over the whole sample (Cappellari and Jenkins, 2004).

5 Estimation results and discussion

5.1 Modelling credit demand and rationing in a static context

Table 3 presents estimation results of three alternative specifications of the static sample selection model (1): the baseline model (Model *a*), which focuses only on the effects of firm-level characteristics, and of two extended specifications (Models *b*) and *c*), which include loan dimension and credit market factors as drivers of firm’s access to credit. These models are estimated on an unbalanced sample consisting of 17418 firms with at least two (not necessarily consecutive) observations over time, for a total of 46241 firm-wave observations.

[Table 3 about here]

The significance and negative sign of $\rho_{\varepsilon\mu}$ highlights that the presence of endogenous self-selectivity in estimating the rationing probability needs to be properly accounted for. Coherently with the findings of Brown et al. (2011), Aristei and Gallo (2015) and Pignini et al. (2016), the negative value of the correlation coefficient between credit demand and rationing equations suggests that firms expecting to have a high probability of being denied credit are also more likely to refrain from applying for additional external financing. Neglecting this selection mechanism leads to severely biased estimates in our outcome equation. In order to capture enterprises’ unobserved propensity to apply for and be denied we account for individual effects in each equation of the model. A comparison between pooled (i.e., not accounting for unobserved heterogeneity) estimates and static random-effects estimates reveals that the signs and significance levels of the coefficients are not very different across models.⁸ Coherently with Bettin and Lucchetti (2016), this near-constancy in parameter estimates suggests that individual time-invariant factors α_i and η_i can be considered as substantially orthogonal to observable factors and thus represent a distinct source of persistence. Moreover, the estimated variances of α_i and η_i are highly significant, pointing out that individual time-invariant heterogeneity cannot be neglected when we model the probabilities of applying for and of being credit rationed. We also find that the correlation of the random effects in the two equations $\rho_{\alpha\eta}$ is significant and negative in all the specifications, suggesting that there are time-invariant unobserved characteristics affecting both individual probability of applying for credit and being rationed. Finally, we compute the total correlation between the two equations using (3) and the overall evidence confirms the negative and statistically significant correlation between the processes governing credit demand and rationing.

Tables 3 shows that large companies are more likely to apply for bank financing and their loan applications are less likely to be turned down. The evidence highlights the inverse relationship between

⁸ Estimates of the pooled probit models with sample selection are reported in Table S1 of the Supplementary Appendix.

firm size and rationing probability consistently with the extensive literature on firms' credit constraints (Beck et al., 2005, 2006; Ferri and Murro, 2015). Autonomous profit-oriented firms, making independent financial decisions, seem to be perceived as more creditworthy by banks and face lower credit access issues. Credit demand and rationing significantly depend on turnover dynamics. Enterprises with low levels of sales and contractions in the growth rate are more likely to stay out of the credit market. These findings suggest the presence of a low performance-credit trap involving firms in a vicious circle (Banerjee and Duflo, 2014). Turnover movements represent one of the main screening criteria in banks' assessments. Low performances are indicative of firms' difficulties in the market and banks are often not indifferent from the potential risk it may entail. Constrained businesses have in turn to limit their investments projects and this may further lower their future for raising the performances up and it further moves them in a worse credit condition. Another factor affecting significantly firms' access to credit is public support. Our evidence suggests those businesses that have not obtained grants or other forms of financial public from public sources are also more likely to face difficulties in access to bank credit. This evidence may be related to a non-random distribution of public funds aimed at incentivising more efficient businesses. As in Grundy and Verwijmeren (2017), the characteristics of the investment for which external financing is used contribute significantly affect access to credit, depending on the risk and collateral value of the investment. Consistently with Myers and Majluf (1984), we find that businesses are more likely to apply for bank loans if the financing is used for fixed investments. These projects, which can be easily collateralised, are also less likely to be restricted. An opposite evidence is obtained when financing is used for developing and launching new products or services. In line with the trade-off theory, which predicts that investments with highly volatile payoffs are more likely to be financed with alternative financial instruments rather than with bank financing (Mayers, 1998), we find that the higher riskiness and uncertainty of innovative investment projects affect negatively the probability of applying for bank loans and increase the likelihood of credit rejections. Finally, we point out a significant relationship between changes in a firm's creditworthiness and its rationing probability: enterprises whose credit history has recently deteriorated are characterised by a higher probability of being constrained. This remarks that a firm's access to finance significantly depends on its credit reputation built over the years.

As regards sectoral heterogeneity, we do not find significant effects, except for the services sector where firms display a lower loan demand. Conversely, country-group fixed effects show that firms in Continental and Mediterranean areas present a higher demand and they are less likely to be denied with respect to firms operating in Northern European countries.

Model *b*) in Table 3 extends the baseline specifications with the inclusion of loan size indicators in the credit rationing equation in order to control for the role of financing dimension. Even though, loan size does not seem to exert a significant effect on rationing probability, controlling for financing dimension contributes to reduce omitted variable issues. The parameters of loan demand and rationing equations preserve their directions with respect to the baseline specification and their statistical significance remains unchanged.

The empirical model is further extended to include credit market characteristics at the country-level (Model *c*) in Table 3). In line with Accornero et al. (2017), we find that the increase of non-performing loans in the European banking sector is forcing intermediaries to assume more conservative lending policies, leading to a contraction in the supply of credit. Results also highlight that bank concentration increases financing obstacles, discouraging loan demand and reducing the quantity of lending in the market. As in Beck et al. (2004), our findings are supportive of the “structure-performance hypothesis”, supporting the negative effects of bank power on firms’ access to credit. Moreover, coherently with Angelini et al., (1998), the presence of cooperative banks, characterised by a “relationship banking” business model, significantly contributes to improve firms’ access to credit.

The static specification *c*) is also re-estimated using alternative credit rationing measures, which account for quantity restrictions, as the dependent variable in the outcome equation.⁹ The comparison of results allows to assess whether the determinants of credit access vary significantly when broader definitions of financing constraints are considered. Estimation results are robust across specifications. The standard errors and the cross-equation correlation of the individual effects remain statistically and the correlation of the idiosyncratic error terms is negative and significant, confirming the necessity of accounting for both unobserved firm heterogeneity and endogenous self-selectivity. The sign and statistical significance of the estimated coefficients corroborate the evidence discussed above. Specifically, results obtained using the *Rationing 2* indicator, which identifies rejected or strongly quantity restricted applications, are particularly close to those reported in Table 3. Even considering the broadest indicator (*Rationing 3*), identifying rejected and strongly restricted or not fully granted loan applications, the direction of the effects is confirmed, highlighting that the factors affecting bank’s choice of denying or restricting credit seem to be similar. Furthermore, considering the *Rationing 3* indicator, we find that firms applying for medium-sized loans are more likely to be restricted than those applying for micro loans. This evidence, together with the non-significance of loan size when more stringent definitions of rationing are used, suggests that banks are more prone to partially constrain certain types of applications

⁹ Complete estimation results are reported in Table S2 of the Supplementary Appendix.

instead of completely rejecting them. This may be due to the fact that applications for large financing are more likely to come from medium or large businesses, which are potential users of non-lending products and services. Thus, in order to maintain relationships with valuable customers, banks may choose to restrict the amount of credit granted rather than to turn down their applications.

5.2 *The dynamics of credit demand and credit rationing*

We now explicitly address the issue of state dependence in credit demand and rationing over time, which represents one of the key contributions of this paper. In Table 4 we present estimates of three alternative specifications of the dynamic model (6) (namely, Models *dyn_a*), *dyn_b*) and *dyn_c*). In order to exploit all the information available in the data and limit survivorship bias, the models are estimated on an unbalanced sample of 8107 firms with at least two consecutive observations over time (15525 firm-wave observations).

The lower part of Table 4 shows the estimated coefficients of the initial conditions, the standard deviations of the individual effects, and the cross-equation correlations. We notice that the estimated standard deviations of the individual effects are significant at the 1% level, confirming that individual time-invariant heterogeneity cannot be disregarded when modelling firms' access to credit. When the dynamics of credit demand and rationing is taken into account, the correlation between the unobserved individual effects of the two equations ($\rho_{\alpha\eta}$) is not statistically significant. Conversely, idiosyncratic error terms remain significantly and negatively correlated in all the specifications. The estimated cross-equation total correlation coefficients, despite being lower in absolute terms than those of the static models, are negative and significant at the 1% level, providing further support to the necessity of accounting for endogenous sample selection in modelling credit rationing probability. Furthermore, the high statistical significance of the initial values of the credit demand and rationing indicators (D_{i0_i} and $R_{i0_i}^*$) in the selection and outcome equations, respectively, clearly indicates that the endogeneity of initial conditions should be properly accounted for when estimating the dynamic model (6).

[Table 4 about here]

With respect to the effects of firm-level control variables, results from the dynamic models largely confirm the evidence obtained in the static models. Moving to a dynamic framework, we find that current loan demand behaviour and credit rationing are significantly influenced by past access to finance conditions. In all the dynamic specifications, the parameter associated to R_{t-1}^* in the credit rationing equation is positive and statistically significant, highlighting that, once a firm has been restricted in access to credit in the previous period, the probability of experiencing new restrictions is higher than that of a firm that was not restricted or did not apply for a loan in $t - 1$. Accordingly, the

sign and statistical significance of the parameter associated to D_{t-1} in the selection equation provide evidence of strong state dependence in credit demand behaviour too. Furthermore, we find that past credit restrictions do not affect demand behaviour at time t and do not contribute to discourage firms from applying for additional bank financing. Conversely, the coefficient of the lagged loan demand indicator in the rationing equation is negative and statistically significant, suggesting that repeated firm-bank interactions over time tend to alleviate financing constraints.

In order to properly assess the magnitude and significance of state dependence, discouragement and past demand effects, in Table 5 we present the estimated average partial effects of lagged dependent variables on the probability of applying for credit and of being constrained for the three empirical specifications.

[Table 5 about here]

On average, firms that were rationed in the last period are around 7% more likely to be credit denied than borrowers which were not restricted in the previous semester ($\bar{R}_{R_{t-1}}$). Two major drivers may foster these difficulties in access to credit once the borrower has been restricted. First of all, the effects of financial restrictions on firm's net worth operate as a trap in which constrained firms, having to reduce their investments, may miss business opportunities. Difficulties in access to credit additionally determine a direct contraction of assets in the case that the borrower is unable to secure liquid sources to repay short-term liabilities. Our results thus provide support to the negative signalling of past credit restrictions about firm's creditworthiness, especially under imperfect screening technologies, as well as to the fact that banks' decision processes are characterised by a significant degree of memory.

Conversely, we do not find evidence of any significant discouragement effect: $\bar{D}_{R_{t-1}}$ is negative, but not statistically significant in all the three specifications, suggesting that having experienced financing constraints in the past does not significantly reduce the firm's current demand behaviour. This evidence is partially in line with the findings of Pignini et al. (2016), who point out that discouragement effects tended to decrease during the crisis as a consequence of the crucial importance of obtaining access to external finance in this period.

Our empirical results also point out that firms that have already applied for credit in the past are more likely to apply again in the next period. This significant state dependence in credit demand is not surprising, as bank credit represents the main (or the unique) source of firm financing in the euro area.

Finally, we find a significant positive relationship between past recourse to bank loans and the probability of being currently constrained: firms that applied for external financing in $t - 1$ are around 1.5% less likely to be credit denied in t with respect to those businesses which did not apply for credit in the previous period ($\bar{R}_{D_{t-1}}$). A continuous recourse to bank financing is not simply indicative of a firm's dependence on the banking system, but it may underlie possible experience effects and/or strong

firm-bank relationships coming from repeated transactions. Firms that repeatedly recur to external financing become familiar with application procedures and the experience gained over time improve their efficiency in facing banks' assessments. At the same time, through repeated interactions, banks accumulate knowledge on firm's credit history, which contributes to decrease businesses' opacity. A constant recourse to external financing and/or renewals of the contracts over time can lead firms to create stronger banking relationships reducing typical informational asymmetries. Furthermore, the awareness of being dependent on external financing and the potential future necessity of facing new credit assessments may represent an incentive for the borrower to maintain a certain degree of transparency in order to overcome banks' future screening procedures.

5.3 Analysing the dynamics of firms' access to credit using alternative credit rationing definitions

As done previously for the static model, we re-estimate the dynamic specification (*dyn_c*) using the two alternative indicators of credit rationing (*Rationing 2* and *Rationing 3*).¹⁰

When broader measures of credit rationing are considered, the correlation between the idiosyncratic errors of the two equations remains negative and statistically significant, confirming the presence of endogenous self-selection. Accordingly, the standard errors of the individual effects are significant at the 1% level, while the cross-equation correlation of the individual effects is not statistically significant. The parameters of the initial conditions are again positive and statistically significant at the 1% level in both the equations.

Estimated coefficients are quite similar to the evidence of the previous dynamic models of credit rejection. The relevance of firm size decreases when quantity constraints to external financing are considered. Furthermore, firms perceiving that their credit history has recently deteriorated are more likely to be restricted when we take into account quantity constraints. This evidence suggests that, when the firm starts being economically and financially distressed, banks choose to restrict the amount of credit granted, instead of rejecting the application, in order to avoid the conclusion of the lending relationship.

Estimates also confirm that both credit demand and rationing probabilities significantly depend on past credit access conditions. Thus, in order to correctly evaluate the magnitude of both state dependence and cross-effects of past credit demand and rationing, in Table 6 we report the average partial effects of the lagged dependent variables, using two broader indicators of financing constraints.

[Table 6 about here]

¹⁰ Complete estimation results are reported in Table S3 of the Supplementary Appendix.

Results highlight that state dependence in being credit constrained is even more incisive when also partial quantity restrictions are considered. The probability of experiencing new credit restrictions increases to 9.16 and 11.23% when we use *Rationing 2* and *Rationing 3* indicators, respectively. Considering the overall expansion of the European economy over the period considered (European Commission, 2019), the increasing magnitude of the effect with respect to the one reported in Table 5 suggests that rationing operates markedly *via* quantity restrictions when the general economic outlook improves. This form of rationing may represent a solution to avoid shutting credit down in the case of borrowers in a situation of momentary instability and this practice may allow keeping on firm-bank relationships with a view to future positive perspectives of growth. The past demand effect on the likelihood of being rationed is higher when we consider both credit denied and strongly quantity constrained firms in the rationing indicator, whereas the effect is not significant when weakly restricted applications are included in the definition of credit constraints. Finally, state dependence in credit demand remains very significant and the effects preserve their magnitude, around 16%.

5.4 Firm size and the dynamics of access to credit

Table 7 shows average partial effects of the lagged terms on the probability of applying for bank loans and of being rationed, comparing estimates on sub-samples defined by firm size group for all the three rationing indicators.¹¹

Overall, we find evidence of a significant impact of lagged credit restrictions on current rationing decisions by banks. The effect is increasing when we progressively take into account strong and weak quantity restrictions in the definition of rationing. In the case of the analysis on micro, small and medium enterprises, the effect ranges between 7.49 and 11.95%. The magnitude of the impact is greater when we focus on the sub-sample of micro and small firms, increasing on average by 3 percentage points, pointing out a higher state dependence in credit restrictions affecting this size class rather than medium enterprises. This evidence is indicative of a particularly cautious lending behaviour by banks when dealing with micro and small enterprises. The stronger state dependence in credit restrictions that characterise small business lending is consistent with the findings of Mills and McCarthy (2016), who highlight the existence of a significant and persistent gap in access to credit for small firms that has been exacerbated by the global financial crisis.

[Table 7 about here]

¹¹ Estimation results, reported in Tables S4, S5 and S6 of the Supplementary Appendix, point out that the estimated effects of the control variables, as well as the correlation structure of the error terms, are consistent across the specifications.

A significant state dependence in firms' credit demand behaviour is evident across sub-samples. The effect of lagged demand on the current probability of applying for a bank loan ranges between 16 and 20% and it is slightly more pronounced for medium-sized firms. This group of firms also displays a significant discouragement effect when we base the definition of credit rationing only on loan rejection. This evidence highlights that credit denial, being the strongest form of rationing, not only reduces investment opportunities and survivorship chances, but have a strong impact on firms' perceptions and self-initiative. In particular, medium-sized firms having experienced strong credit restrictions are 13% more likely to refrain from applying for a bank loan. Finally, the sub-sample analysis on micro and small firms confirms a significant and negative effect of lagged loan demand on the current probability of facing credit restrictions. This result suggests that the effects of experience and of strong firm-bank relationships are particularly relevant in reducing opacities and mitigating frictions in information transmission between financial institutions and smaller businesses. Micro and small firms are around 3% less likely to face restrictions when they maintain a constant recourse to bank credit over time, whereas this effect tends to disappear in the sub-sample of medium firms.

6. Robustness analyses

In this Section we carry out a number of additional analyses aimed at assessing the robustness of our main empirical findings.¹²

First, we re-estimate all the static random-effects specifications (Models *a*), *b*) and *c*)) on the sub-sample of firms observed for at least two consecutive periods (i.e., the estimation sample of the dynamic model). We obtain again high variances of the random effects and high cross-equation correlations between both the unobserved individual effects and the idiosyncratic error terms of the two equations. This result suggests that the reduction in the estimated variance and covariance components of the individual effects that we observed in the dynamic model (see Table 4) is mainly the results to the modelling of true state dependence and it is not due to potential selectivity issues related to the restriction of the estimation sample.

Second, we test the robustness of the results by focusing on those firms that actually need credit. As pointed out by Presbitero et al. (2014), a possible concern in the analysis of credit rationing probability is the inclusion in the estimation sample of those firms that do not demand additional credit as they do not need it. For this reason, as in García-Posada Gómez (2019) and Ferrando and Mulier (2017), we re-estimate the dynamic random-effects probit model with endogenous selection on the sub-sample obtained

¹² Complete estimation results of all these robustness checks are reported in Tables S7, S8, S9 and S10 of the Supplementary Appendix.

by excluding those firms that did not apply for bank loans because of sufficient internal funds. Table 8 reports the average partial effects of lagged dependent variables on current credit demand and rationing probabilities, obtained from the estimation of the extended dynamic model *dyn_c*) by alternatively using each of the three indicators of credit rationing as dependent variable in the outcome equation.

[Table 8 about here]

We find that state dependence in credit demand remains highly statistically significant, even though its magnitude declines to around 4%. The estimated effects of the lagged rationing indicators on banks' decisions on credit restrictions preserve their magnitude ranging between 7.7 and 12.7%. Moreover, we provide evidence of a significant discouragement effect across models emerging when we focus on the subsample of businesses that actually need additional credit. In particular, firms which experienced a credit rejection are 7% less likely to apply for a bank loan. This effect slightly decreases when quantity restrictions are included in the definition of rationed applications. As regards the past demand effect on banks' decision to operate credit restrictions, it remains negative and significant in the model considering complete credit denials and in the one adding strong quantity restrictions in the definition of the rationing indicator.

Finally, as in Raymond (2010), we assess the robustness of our results to the time dimension of the panel. To this aim, we re-estimate the dynamic model *dyn_c*) on the sub-sample of firms with at least four not necessarily consecutive observations over time (4482 firms for a for a total of 11393 firm-wave observations) and on the subsample of firms with at least three consecutive observations over time (3954 firms, 11041 firm-wave observations). It is firstly worth remarking that the variances of the individual effect, as well as the error correlation structures, are consistent with the ones obtained on the unbalanced sample of firms with at least two consecutive observations. Furthermore, the average partial effects reported in Table 9 show that state dependence in credit rationing is still significant across models, ranging between 6.7 and 12.6% and between 4.8 and 8% in the two subsamples, respectively. Its increasing trend when strong and weak quantity restrictions are included in the definition of the credit rationing remains confirmed. Similarly, state dependence in credit demand is significant in all the models and around 16 and 15 percentage points in the two subsamples, respectively. Finally, the effect of past credit demand on the current probability of experiencing credit rejection or strong quantity restrictions is still negative and significant, providing further support to the beneficial effect of a repeated lending interactions over time on firms' access to credit.

[Table 9 about here]

7. Conclusions

This study provides insights on the main factors affecting firms' loan demand and financing constraints in the euro area. We first estimate a static panel probit model with sample selection, in order to highlight the impacts of firm-level and market determinants, and then we consider a dynamic specification focusing on the issue of persistence in both credit demand and credit access conditions. We use three indicators of credit rationing, which progressively include completely rejected, severely and weakly quantity restricted applications, in order to verify whether our empirical results depend on different definitions of financing constraints. We find robust evidence across these three indicators suggesting that the type and intensity of rationing depend on similar drivers. Banks' choice to grant credit is affected by firms' size, management and ownership structure as well as the type of investments, which plays a key role in mitigating credit risk. Furthermore, the inclusion of loan size allows us to control for the role of transacted volumes on credit rationing probability. Despite it is hardly ever statistically significant, the use of this proxy is relevant to consider the borrower's credit risk profile in modelling banks' decisions in order to reduce potential omitted variable issues.

Overall, our results provide support to the significant role of both firm characteristics and market-level factors in affecting firms' access to credit. However, the differences in external financing conditions cannot be solely attributed to observable discrepancies across firms: unobserved firm heterogeneity plays a crucial role and therefore it must be properly modelled. Furthermore, accounting for the dynamics of credit demand and rationing is essential to the understanding of both firms' loan demand behaviour and banks' credit granting choices. In this latter respect, our empirical findings provide strong support to the existence of state dependence in firms' access to credit. This suggests that banks' decision processes are characterised by a significant degree of memory: banks tend to keep negative creditworthiness assessments from one period to the other, potentially locking the firm in a bad assessment state. Credit restrictions may impair firms' solidity and creditworthiness and thus reduce their likelihood of obtaining additional financing. This causes businesses to fall into a credit trap: the inability to borrow forces firms to reduce their investment and production levels and this in turn lowers their future net worth and financial solvency. Moreover, deepening the analysis by firm size, we highlight that the negative impact of past credit restrictions is particularly strong for micro and small businesses. Borrowers that experienced a credit restriction are not only more likely to be credit denied again in the future, but they may also be discouraged from applying for a loan as they anticipate a

further rejection. Our findings highlight the presence of a significant discouragement effect for medium-sized enterprises and for the subsample of firms that actually need credit. Finally, we document that repeated lending interactions over time, by increasing firms' experience on application procedures and reducing informational opacity, significantly contribute to mitigate financing constraints. Businesses that have already been screened by banks are characterised by lower information asymmetries with respect to new applicants and this represents an advantage for high quality borrowers.

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Tables

Table 1 – Proportions of credit demanding and constrained firms by country

	<i>Credit demand</i>	<i>Rationing</i>	<i>Rationing 2</i>	<i>Rationing 3</i>
Austria	29.25	2.55	7.56	12.20
Belgium	38.00	3.99	8.49	12.66
Germany	28.61	2.29	4.59	8.01
Spain	38.82	4.39	14.15	25.43
Finland	28.81	5.70	9.46	11.71
France	42.72	4.82	8.11	11.98
Greece	26.65	15.00	28.73	41.09
Ireland	20.38	7.75	13.54	22.30
Italy	41.16	5.05	12.03	19.76
Netherlands	20.84	10.58	14.82	20.96
Portugal	29.11	3.87	11.69	19.49
Total	34.76	4.50	9.80	15.90

Notes: Proportions are expressed in percentage terms and are calculated using sample weights. Credit rationing rates are computed on the subsample of firms that have applied for a loan (for which *Credit demand*=1).

Table 2 – Transition probabilities: persistence in credit demand and credit rationing

<i>1) Credit demand</i>		<i>2) Credit rationing (if Credit demand = 1)</i>							
		<i>2a) Rationing</i>		<i>2b) Rationing 2</i>		<i>2c) Rationing 3</i>			
<i>D_t</i>		<i>R_t</i>		<i>R_t</i>		<i>R_t</i>			
0 1		0 1		0 1		0 1			
<i>D_{t-1}</i> 0	76.39 23.61	<i>R_{t-1}</i> 0	97.84 2.16	<i>R_{t-1}</i> 0	95.14 4.86	<i>R_{t-1}</i> 0	91.35 8.65		
1	44.99 55.01	1	41.18 58.82	1	44.31 55.69	1	40.67 59.33		

Notes: Transition probabilities are expressed in percentage terms. $D_t=1$ indicates that the firm applied for credit at time t , $R_t=1$ indicates that the firm was credit rationed (according to the specific definition considered, namely *Rationing*, *Rationing 2* or *Rationing 3*) at time t . Transition probabilities for credit rationing are computed for those firms that have applied for a loan.

Table 3 – The determinants of firms' access to credit – Static models

	<i>Model a)</i>		<i>Model b)</i>		<i>Model c)</i>	
	Rationing	Credit demand	Rationing	Credit demand	Rationing	Credit demand
Small	-0.2129*** (0.0803)	0.1746*** (0.0368)	-0.2176*** (0.0803)	0.1744*** (0.0350)	-0.1990** (0.0792)	0.1701*** (0.0349)
Medium	-0.3846*** (0.1097)	0.2342*** (0.0493)	-0.3989*** (0.1105)	0.2334*** (0.0469)	-0.3917*** (0.1095)	0.2299*** (0.0468)
Large	-0.9155*** (0.1670)	0.4124*** (0.0639)	-0.8844*** (0.1721)	0.4117*** (0.0614)	-0.8807*** (0.1700)	0.4093*** (0.0612)
Autonomous firm	-0.3131*** (0.0971)	0.3042*** (0.0432)	-0.3126*** (0.0974)	0.3041*** (0.0416)	-0.3175*** (0.0966)	0.3039*** (0.0416)
Individual owner	0.1602 (0.0977)	0.0009 (0.0416)	0.1928** (0.0950)	0.0009 (0.0399)	0.1859** (0.0937)	0.0014 (0.0398)
Family managed	-0.0242 (0.0861)	0.0491 (0.0378)	0.0095 (0.0861)	0.0491 (0.0363)	0.0076 (0.0853)	0.0504 (0.0363)
Young	0.1628 (0.2403)	0.0580 (0.1148)	0.1750 (0.2379)	0.0578 (0.1093)	0.1800 (0.2339)	0.0597 (0.1090)
Exporter	-0.0322 (0.0656)	0.0616** (0.0278)	-0.0535 (0.0631)	0.0616** (0.0266)	-0.0551 (0.0626)	0.0641** (0.0266)
Low turnover	0.4580*** (0.0872)	-0.2213*** (0.0389)	0.4917*** (0.0883)	-0.2216*** (0.0371)	0.4856*** (0.0877)	-0.2201*** (0.0371)
Turnover down	0.1375* (0.0750)	-0.0295 (0.0344)	0.1562** (0.0733)	-0.0298 (0.0328)	0.1408* (0.0726)	-0.0251 (0.0328)
Turnover unchanged	0.0207 (0.0716)	-0.0489* (0.0295)	0.0211 (0.0692)	-0.0490* (0.0284)	0.0238 (0.0685)	-0.0474* (0.0283)
Public support down	0.5961*** (0.1745)	0.1077*** (0.0387)	0.6014*** (0.0785)	0.1072*** (0.0355)	0.5596*** (0.0778)	0.1153*** (0.0357)
Public support unchanged	0.1765** (0.0856)	-0.0095 (0.0287)	0.1556** (0.0727)	-0.0096 (0.0276)	0.1674** (0.0718)	-0.0108 (0.0276)
Credit history down	0.4177*** (0.1572)	0.1498*** (0.0485)	0.4305*** (0.0889)	0.1496*** (0.0452)	0.4317*** (0.0873)	0.1511*** (0.0450)
Credit history unchanged	0.1179* (0.0672)	-0.0688** (0.0282)	0.1225* (0.0665)	-0.0686** (0.0271)	0.1058 (0.0658)	-0.0669** (0.0271)
Fixed investment	-0.6905*** (0.0660)	0.5874*** (0.0265)	-0.6916*** (0.0598)	0.5876*** (0.0254)	-0.6888*** (0.0595)	0.5879*** (0.0254)
New products investment	0.3097*** (0.0767)	-0.1431*** (0.0339)	0.3325*** (0.0685)	-0.1430*** (0.0322)	0.3211*** (0.0679)	-0.1381*** (0.0321)
Small loan			-0.0588 (0.0898)		-0.0710 (0.0882)	
Medium loan			0.1395 (0.1005)		0.1131 (0.0986)	
Medium-large loan			0.1240 (0.1074)		0.0877 (0.1058)	
Large loan			0.0092 (0.1321)		-0.0278 (0.1313)	
Construction	0.1371 (0.1093)	-0.0595 (0.0495)	0.1687 (0.1045)	-0.0597 (0.0472)	0.1656 (0.1023)	-0.0627 (0.0471)
Trade	-0.0053 (0.0861)	-0.0019 (0.0387)	0.0042 (0.0853)	-0.0018 (0.0369)	-0.0218 (0.0851)	-0.0007 (0.0370)
Services	0.1110 (0.0824)	-0.0991*** (0.0360)	0.1263 (0.0820)	-0.0989*** (0.0345)	0.1321 (0.0806)	-0.1034*** (0.0345)
Continental	-0.2374*** (0.0652)	0.1944*** (0.0267)	-0.3237*** (0.0637)	0.1942*** (0.0258)	-0.1866** (0.0818)	0.1791*** (0.0355)
Mediterranean	-0.3655*** (0.0785)	0.4891*** (0.0266)	-0.4048*** (0.0614)	0.4893*** (0.0256)	-0.5100*** (0.0791)	0.5529*** (0.0332)
Cooperative					0.0059*** (0.0019)	-0.0022*** (0.0008)
HHI					1.6558*** (0.4428)	-0.0960 (0.2107)
NPL					0.0152*** (0.0039)	-0.0061*** (0.0017)
Perceived growth obstacles		-0.0109 (0.0257)		-0.0100 (0.0251)		-0.0095 (0.0253)
Alternative funding use		0.0745** (0.0301)		0.0748** (0.0299)		0.0766** (0.0298)
Alternative financing demand		0.5546*** (0.0297)		0.5547*** (0.0278)		0.5514*** (0.0277)
Intercept		-1.7014*** (0.0876)	-0.2836 (0.2097)	-1.7010*** (0.0840)	-0.6494*** (0.2184)	-1.6102*** (0.0905)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
<i>Random effects</i>						
σ_α		1.0682*** (0.1130)		1.0885*** (0.0417)		1.0738*** (0.0406)
σ_η		0.7711*** (0.0137)		0.7711*** (0.0134)		0.7700*** (0.0134)
$\rho_{\alpha\eta}$		-0.5166*** (0.1318)		-0.4943*** (0.0389)		0.5020*** (0.0384)
<i>Idiosyncratic errors</i>						
$\rho_{\varepsilon\mu}$		-0.8025*** (0.1709)		-0.8084*** (0.0248)		-0.8184*** (0.0246)
Total correlation (ρ_{tot})		-0.6646*** (0.1428)		-0.6554*** (0.0103)		-0.6660*** (0.0100)
Number of observations		46241		46241		46241
Log-likelihood		-27887.62		-27736.30		-27703.13

Notes: the Table reports the estimated coefficients of the baseline model (Model *a*), then loan size is included in the outcome equation (Model *b*) and the complete specification with macro-variables (Model *c*). Standard errors are reported in parentheses. *Micro firms*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 4 – The determinants of firms’ access to credit – Dynamic models

	<i>Model dyn_a)</i>				<i>Model dyn_b)</i>				<i>Model dyn_c)</i>			
	Rationing		Credit demand		Rationing		Credit demand		Rationing		Credit demand	
$R_{i,t}^*$	1.3035***	(0.1972)	-0.0893	(0.0969)	1.3330***	(0.1881)	-0.0995	(0.0958)	1.3213***	(0.1853)	-0.1019	(0.0960)
$D_{i,t}$	-0.4213***	(0.1165)	0.5060***	(0.0378)	-0.4253***	(0.0851)	0.5067***	(0.0376)	-0.4121***	(0.0857)	0.5065***	(0.0377)
Small	-0.2036*	(0.1174)	0.0930**	(0.0461)	-0.1889	(0.1204)	0.0931**	(0.0460)	-0.1739	(0.1207)	0.0906**	(0.0461)
Medium	-0.3633**	(0.1613)	0.1014*	(0.0604)	-0.3893**	(0.1689)	0.1015*	(0.0602)	-0.4040**	(0.1712)	0.1015*	(0.0603)
Large	-0.5694***	(0.2208)	0.2341***	(0.0778)	-0.5248**	(0.2461)	0.2341***	(0.0777)	-0.5448**	(0.2470)	0.2362***	(0.0777)
Autonomous firm	-0.6920**	(0.3007)	0.1501	(0.2194)	-0.6774**	(0.2976)	0.1526	(0.2179)	-0.6742**	(0.2911)	0.1529	(0.2178)
Individual owner	0.2989	(0.3847)	0.2760*	(0.1669)	0.3628	(0.4013)	0.2756*	(0.1669)	0.3845	(0.4032)	0.2763*	(0.1668)
Family managed	0.7658**	(0.3192)	0.1331	(0.1458)	0.7768**	(0.3296)	0.1328	(0.1452)	0.8177**	(0.3324)	0.1322	(0.1452)
Young	-1.2006**	(0.5473)	0.2557	(0.2745)	-1.2507**	(0.5223)	0.2547	(0.2725)	-1.2718**	(0.5224)	0.2562	(0.2730)
Exporter	0.0899	(0.2202)	-0.0006	(0.0825)	0.0241	(0.2224)	-0.0008	(0.0824)	0.0191	(0.2225)	0.0002	(0.0825)
Low turnover	0.2209	(0.3174)	0.0000	(0.1386)	0.2308	(0.3178)	0.0008	(0.1383)	0.2432	(0.3261)	-0.0006	(0.1385)
Turnover down	-0.1665	(0.1522)	0.0024	(0.0615)	-0.1362	(0.1540)	0.0025	(0.0613)	-0.1419	(0.1544)	0.0037	(0.0614)
Turnover unchanged	0.0787	(0.1385)	-0.0428	(0.0516)	0.0834	(0.1397)	-0.0433	(0.0516)	0.0912	(0.1405)	-0.0427	(0.0516)
Public support down	0.3892**	(0.1773)	0.0453	(0.0703)	0.3550**	(0.1745)	0.0445	(0.0702)	0.3409**	(0.1737)	0.0447	(0.0703)
Public support unchanged	0.2208	(0.1421)	-0.0421	(0.0491)	0.1757	(0.1409)	-0.0424	(0.0491)	0.1619	(0.1402)	-0.0425	(0.0491)
Credit history down	0.0767	(0.1812)	0.1083	(0.0857)	0.0179	(0.1835)	0.1088	(0.0855)	0.0198	(0.1817)	0.1103	(0.0856)
Credit history unchanged	-0.0843	(0.1275)	-0.0515	(0.0486)	-0.1282	(0.1275)	-0.0514	(0.0485)	-0.1398	(0.1287)	-0.0508	(0.0485)
Fixed investment	-0.4229***	(0.1401)	0.4507***	(0.0478)	-0.3874***	(0.1324)	0.4503***	(0.0477)	-0.4078***	(0.1330)	0.4512***	(0.0477)
New products investment	0.1701	(0.1486)	-0.1661***	(0.0594)	0.2130	(0.1477)	-0.1658***	(0.0593)	0.2126	(0.1489)	-0.1653***	(0.0594)
Small loan					-0.0099	(0.3090)			-0.0276	(0.3048)		
Medium loan					-0.0180	(0.3400)			-0.0241	(0.3394)		
Medium-large loan					0.0503	(0.3663)			0.0485	(0.3661)		
Large loan					0.0135	(0.4223)			0.0170	(0.4245)		
Construction	0.1946	(0.1469)	0.0207	(0.0600)	0.2052	(0.1487)	0.0204	(0.0599)	0.2294	(0.1482)	0.0214	(0.0601)
Trade	0.0046	(0.1148)	0.0136	(0.0449)	0.0099	(0.1168)	0.0129	(0.0448)	0.0149	(0.1203)	0.0156	(0.0451)
Services	0.0283	(0.1121)	-0.0340	(0.0420)	0.0693	(0.1132)	-0.0342	(0.0419)	0.0687	(0.1143)	-0.0351	(0.0421)
Continental	-0.0887	(0.0917)	0.0823**	(0.0327)	-0.1838**	(0.0936)	0.0820**	(0.0327)	-0.1178	(0.1152)	0.0497	(0.0444)
Mediterranean	-0.2132**	(0.0980)	0.4147***	(0.0320)	-0.2455***	(0.0919)	0.4147***	(0.0320)	-0.2852**	(0.1181)	0.4209***	(0.0415)
Cooperative									0.0074***	(0.0028)	-0.0009	(0.0010)
HHI									2.2717***	(0.6622)	-0.4603*	(0.2709)
NPL									0.0060	(0.0055)	-0.0020	(0.0021)
Perceived growth obstacles			-0.0070	(0.0304)			-0.0068	(0.0305)			-0.0144	(0.0309)
Alternative funding use			0.0563	(0.0348)			0.0559	(0.0348)			0.0570	(0.0349)
Alternative financing demand			0.4869***	(0.0334)			0.4869***	(0.0332)			0.4835***	(0.0334)
Intercept	-1.8379***	(0.4446)	-1.7069***	(0.1084)	-1.9713***	(0.3496)	-1.7066***	(0.1082)	-2.4081***	(0.3683)	-1.6118***	(0.1172)
Time dummies	Yes		Yes		Yes		Yes		Yes		Yes	
<i>Initial conditions:</i>												
Rationing ₀	0.5953***	(0.2014)			0.6317***	(0.1997)			0.6670***	(0.1965)		
Credit demand ₀			0.4287***	(0.0372)			0.4286***	(0.0373)			0.4277***	(0.0373)
<i>Random effects</i>												
σ_α		0.6179***				0.5967***				0.5858***		
		(0.1258)				(0.0720)				(0.0716)		
σ_η		0.4805***				0.4806***				0.4811***		
		(0.0227)				(0.0227)				(0.0227)		
$\rho_{\alpha\eta}$		-0.1353				-0.0660				-0.0346		
		(0.2695)				(0.2005)				(0.2062)		
<i>Idiosyncratic errors</i>												
$\rho_{e\mu}$		-0.3451***				-0.3473***				-0.3486***		
		(0.1025)				(0.0593)				(0.0594)		
<i>Total correlation (ρ_{tot})</i>												
		-0.2954***				-0.2835***				-0.2786***		
		(0.0752)				(0.0391)				(0.0389)		
Number of observations		15525				15525				15525		
Log-likelihood		-9242.52				-9191.01				-9178.1		

Notes: the Table reports the estimated coefficients of the dynamic models, obtained by adding lagged dependent variables to the static Models a), b) and c). Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 5 – State dependence in access to credit, discouragement and past demand effects

	<i>Model dyn_a)</i>	<i>Model dyn_b)</i>	<i>Model dyn_c)</i>
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1536*** (0.0111)	0.1689*** (0.0122)	0.1689*** (0.0122)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0760*** (0.2532)	0.0657*** (0.0097)	0.0693*** (0.0095)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0271 (0.0294)	-0.0332 (0.0319)	-0.0340 (0.03199)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0171* (0.0112)	-0.0151*** (0.0044)	-0.0144*** (0.0044)

Notes: the Table reports the average partial effects of the lagged credit demand and rationing indicators on the predicted probabilities of applying for credit and of being constrained at time t. Standard errors are reported in parentheses.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 6 – State dependence in access to credit, discouragement and past demand effects using alternative credit rationing definitions

	<i>Rationing 2</i>	<i>Rationing 3</i>
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1666*** (0.0124)	0.1648*** (0.0127)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0916*** (0.0134)	0.1123*** (0.0174)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0020 (0.0236)	0.0074 (0.0200)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0203*** (0.0074)	-0.0163 (0.0105)

Notes: the Table reports the average partial effects of the lagged credit demand and rationing indicators on the predicted probabilities of applying for credit and of being constrained at time t . Standard errors are reported in parentheses.
***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 7 – State dependence in access to credit, discouragement and past demand effects by firm size group

	<i>Rationing</i>	<i>Rationing 2</i>	<i>Rationing 3</i>
<i>Micro, small and medium enterprises</i>			
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1746*** (0.0126)	0.1721*** (0.0128)	0.1705*** (0.0130)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0749*** (0.0108)	0.0959*** (0.0154)	0.1195*** (0.0195)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0291 (0.0317)	0.0050 (0.0238)	0.0093 (0.0206)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0149*** (0.0051)	-0.0224*** (0.0084)	-0.0144 (0.0117)
<i>Micro and small firms</i>			
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1635*** (0.0155)	0.1601*** (0.0158)	0.1582*** (0.0161)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.1047*** (0.0148)	0.1218*** (0.0220)	0.1535*** (0.0250)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0001 (0.0353)	0.0230 (0.0273)	0.0253 (0.0243)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0210*** (0.0079)	-0.0366*** (0.0125)	-0.0326** (0.0161)
<i>Medium firms</i>			
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.2018*** (0.0201)	0.2007*** (0.0205)	0.1996*** (0.0210)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0587*** (0.0158)	0.0926*** (0.0199)	0.0905*** (0.0278)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.1303** (0.0624)	-0.0279 (0.0445)	-0.0293 (0.0366)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0047 (0.0057)	-0.0072 (0.0110)	0.0074 (0.0161)

Notes: the Table reports the average partial effects of the lagged credit demand and rationing indicators on the predicted probabilities of applying for credit and of being constrained at time t . Estimates are computed on sub-samples defined by firm size group. Standard errors are reported in parentheses.
***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 8 – Robustness analysis: marginal effects of lagged dependent variables excluding firms that do not need additional bank financing

	<i>Rationing</i>	<i>Rationing 2</i>	<i>Rationing 3</i>
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.0422*** (0.0084)	0.0484*** (0.0087)	0.0475*** (0.0091)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0770*** (0.0115)	0.1071*** (0.0155)	0.1270*** (0.0194)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0700*** (0.0146)	-0.0612*** (0.0122)	-0.0503*** (0.0118)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0158*** (0.0055)	-0.0220** (0.0088)	-0.0161 (0.0119)

Notes: the Table reports the average partial effects of the lagged credit demand and rationing indicators on the predicted probabilities of applying for credit and of being constrained at time t . Standard errors are reported in parentheses.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table 9 – Robustness analysis: marginal effects of lagged dependent variables for the sub-samples of firms with at least four not necessarily consecutive and three consecutive observations over time

a) *Subsample of firms with at least four not necessarily consecutive observations*

	<i>Rationing</i>	<i>Rationing 2</i>	<i>Rationing 3</i>
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1670*** (0.0138)	0.1650*** (0.0140)	0.1626*** (0.0143)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0669*** (0.0099)	0.1023*** (0.0143)	0.1259*** (0.0186)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	0.0179 (0.0419)	0.0266 (0.0298)	0.0316 (0.0253)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0160*** (0.0049)	-0.0195** (0.0084)	-0.0175 (0.0120)

b) *Subsample of firms with at least three consecutive observations*

	<i>Rationing</i>	<i>Rationing 2</i>	<i>Rationing 3</i>
$\bar{D}_{D_{t-1}}$ (<i>state dependence in demand</i>)	0.1532*** (0.0150)	0.1530*** (0.0152)	0.1514*** (0.0143)
$\bar{R}_{R_{t-1}}$ (<i>state dependence in rationing</i>)	0.0483*** (0.0104)	0.0736*** (0.0151)	0.0802*** (0.0210)
$\bar{D}_{R_{t-1}}$ (<i>discouragement effect</i>)	-0.0295 (0.0451)	-0.0119 (0.0318)	0.0003 (0.0271)
$\bar{R}_{D_{t-1}}$ (<i>past demand effect</i>)	-0.0119*** (0.0047)	-0.0194** (0.0082)	-0.0073 (0.0126)

Notes: the Table reports the average partial effects of the lagged credit demand and rationing indicators on the predicted probabilities of applying for credit and of being constrained at time t . Standard errors are reported in parentheses.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Figures



Figure 1 – Proportions of credit demanding and credit rationed firms by survey wave

Notes: Proportions are expressed in percentage terms and are calculated using sample weights. Credit rationing rates are computed on the subsample of firms that have applied for a loan (for which Credit demand=1) “Credit rejected” refers to those firms whose loan application was rejected; “Strongly credit restricted” indicate those firms that received below 75% of the amount requested and “Weakly credit restricted” those that received 75% and above. 2014H1 (Wave 11) refers to the period from April to September 2014, 2014H2 (Wave 12) refers to the period from October 2014 to March 2015 and so forth until 2018H1 (Wave 19), which refers to the period from April to September 2018.

Appendix

Table A1 – Variable definitions

Variable	Definition
<i>Dependent variables</i>	
Credit demand	Equal to 1 if the firm has applied for bank loan in the past six months, 0 otherwise
Rationing	Equal to 1 if the firm applied for bank loan, but its application was completely rejected, 0 otherwise
Rationing 2	Equal to 1 if the firm applied for bank loan, but its application was completely rejected or it received below 75%, 0 otherwise
Rationing 3	Equal to 1 if the firm applied for bank loan, but its application was completely rejected or it received below 75% or it receive 75% and above, 0 otherwise
<i>Firm's characteristics</i>	
Small	Equal to 1 if the firm has 10 employees or more and less than 49, 0 otherwise
Medium	Equal to 1 if the firm has 49 employees or more and less than 249, 0 otherwise
Large	Equal to 1 if the firm has 249 employees or more, 0 otherwise
Autonomous firm	Equal to 1 if the firm is an autonomous profit-oriented enterprise, making independent financial decisions, 0 otherwise
Individual owner	Equal to 1 if the owner is one individual natural person, 0 otherwise
Family managed	Equal to 1 if the owner is a family or a group of entrepreneurs, 0 otherwise
Young	Equal to 1 if the firm is less than 2 years old, 0 otherwise
Export	Equal to 1 if the firm is an exporter, 0 otherwise
Low turnover	Equal to 1 if firm's turnover was lower than 2 millions euro in last year, 0 otherwise
Turnover down	Equal to 1 if firm's turnover decreased over the past six months, 0 otherwise
Turnover unchanged	Equal to 1 if firm's turnover remained unchanged over the past six months, 0 otherwise
Fixed investment	Equal to 1 if the firm has used the financing for investments in property, plant or equipment during the past six months, 0 otherwise
New product investment	Equal to 1 if the firm has used the financing for developing or launching new products or services during the past six months, 0 otherwise
Public support down	Equal to 1 if firm's access to public funds, including guarantees, decreased over the past six months, 0 otherwise
Public support unchanged	Equal to 1 if firm's access to public funds, including guarantees, remained unchanged over the past six months, 0 otherwise
Credit history down	Equal to 1 if firm's credit history has deteriorated over the past six months, 0 otherwise
Credit history unchanged	Equal to 1 if firm's credit history remained unchanged over the past six months, 0 otherwise
Small loan	Equal to 1 if the amount of firm's last bank loan requested or obtained was more than euro 25000 and up to 100000, 0 otherwise
Medium loan	Equal to 1 if the amount of firm's last bank loan requested or obtained was more than euro 100000 and up to 250000, 0 otherwise
Medium-large loan	Equal to 1 if the amount of firm's last bank loan requested or obtained was more than euro 250000 and up to 1000000, 0 otherwise
Large loan	Equal to 1 if firm's last bank loan was more than 1000000 euro, 0 otherwise
<i>Country-level and credit market characteristics</i>	
Cooperative	Co-operative banking sector share (Source: EACB)
HHI	Herfindahl-Hirschman index for credit institutions (based on total assets) (Source: ECB)
NPL	Bank nonperforming loans to total gross loans (Source: ECB)
<i>Identification variables</i>	
Perceived growth obstacles	Equal to 1 if firm perceives finding costumers, cost of production or labour, competition, availability of skilled staff or experienced managers and regulation restrictions as a relevant problem, 0 otherwise
Alternative funding use	Equal to 1 if firm used equity, debt securities or retained earnings or sale of assets in the past six months, 0 otherwise
Alternative financing demand	Equal to 1 if firm applied for trade credit or other external financing, 0 otherwise

Table A2 – Descriptive statistics

	All firms (N=46241)	Applying firms (N=14789)	Unrestricted firms (N=10286)	Credit denied firms (N=935)	Quantity restricted firms (N=1872)
Small	0.21	0.20	0.19	0.30	0.22
Medium	0.21	0.20	0.19	0.30	0.22
Large	0.33	0.42	0.45	0.11	0.39
Autonomous firm	0.84	0.85	0.85	0.90	0.85
Individual owner	0.25	0.19	0.18	0.38	0.20
Family managed	0.50	0.54	0.55	0.48	0.55
Young	0.01	0.01	0.01	0.03	0.01
Exporter	0.37	0.26	0.22	0.62	0.30
Low turnover	0.53	0.58	0.59	0.48	0.59
Turnover down	0.20	0.19	0.17	0.35	0.22
Turnover unchanged	0.32	0.29	0.29	0.28	0.30
Public support down	0.15	0.16	0.12	0.49	0.27
Public support unchanged	0.53	0.53	0.55	0.34	0.48
Credit history down	0.09	0.10	0.07	0.32	0.16
Credit history unchanged	0.56	0.52	0.53	0.44	0.48
Fixed investment	0.52	0.65	0.69	0.40	0.52
New products investment	0.20	0.19	0.19	0.23	0.20
Small loan		0.18	0.16	0.29	0.20
Medium loan		0.13	0.12	0.21	0.17
Medium-large loan		0.20	0.20	0.20	0.24
Large loan		0.40	0.44	0.13	0.31
Cooperative	27.77	29.63	30.65	29.93	24.44
HHI	0.07	0.07	0.06	0.08	0.08
NPL	7.24	7.51	6.69	9.91	10.08

Notes: the Table reports means computed on the full estimation sample and on the sub-samples of firms having demanded additional credit (i.e. *Credit demand*=1), unrestricted firms (i.e. *Credit demand*=1 and *Rationing* β =0), credit denied firms (i.e. *Credit demand*=1 and *Rationing*=1) and quantity restricted firms (i.e. *Credit demand*=1, *Rationing*=0 and *Rationing* β =1). Descriptive statistics are computed using sample weights.

Table A3 – Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Small	1											
(2) Medium	-0.24	1										
(3) Large	-0.37	-0.32	1									
(4) Autonomous firm	0.12	-0.03	-0.29	1								
(5) Individual owner	0.12	-0.02	-0.39	0.18	1							
(6) Family managed	0.01	0.01	0.04	0.17	-0.59	1						
(7) Young	0.00	-0.02	-0.04	0.01	0.05	-0.03	1					
(8) Exporter	0.09	-0.31	-0.52	0.26	0.36	-0.05	0.06	1				
(9) Low turnover	-0.08	0.08	0.27	-0.11	-0.19	0.10	-0.04	-0.33	1			
(10) Turnover down	0.00	-0.04	-0.08	0.01	0.04	-0.02	-0.01	0.10	-0.05	1		
(11) Turnover unchanged	0.03	0.00	-0.09	0.03	0.04	-0.01	0.01	0.08	-0.07	-0.34	1	
(12) Public support down	0.03	-0.04	-0.11	0.05	0.06	-0.01	0.01	0.14	-0.07	0.14	-0.02	1
(13) Public support unchanged	-0.04	0.02	0.10	-0.04	-0.07	0.02	-0.01	-0.09	0.06	-0.08	0.03	-0.45
(14) Credit history down	0.01	-0.04	-0.06	0.02	0.03	-0.01	0.00	0.08	-0.04	0.20	-0.04	0.17
(15) Credit history unchanged	0.00	-0.01	-0.04	0.01	-0.01	0.01	-0.01	0.04	-0.01	0.01	0.12	-0.04
(16) Fixed investment	-0.05	0.07	0.21	-0.07	-0.09	0.02	0.00	-0.21	0.08	-0.12	-0.04	-0.06
(17) New products investment	-0.04	-0.01	0.11	-0.02	-0.05	0.01	0.01	-0.08	0.18	-0.05	-0.04	0.00
(18) Small loan	0.09	-0.03	-0.15	0.08	0.07	0.01	0.01	0.15	-0.07	0.03	0.02	0.06
(19) Medium loan	0.10	0.05	-0.10	0.04	0.02	0.02	0.01	-0.02	-0.01	0.01	-0.01	0.02
(20) Medium-large loan	0.01	0.13	0.00	0.01	-0.05	0.05	-0.01	-0.14	0.05	-0.01	-0.02	0.00
(21) Large loan	-0.17	-0.03	0.40	-0.09	-0.19	0.03	-0.02	-0.29	0.15	-0.05	-0.06	-0.05
(22) Cooperative	0.00	-0.01	0.03	-0.11	0.04	-0.10	0.02	-0.02	-0.07	0.05	-0.01	0.02
(23) HHI	-0.02	-0.02	-0.05	-0.02	-0.02	0.00	0.00	0.06	-0.02	0.04	-0.04	0.08
(24) NPL	-0.01	-0.06	-0.15	0.09	-0.05	0.09	-0.01	0.18	-0.02	0.10	0.02	0.15

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(13) Public support unchanged	1											
(14) Credit history down	-0.08	1										
(15) Credit history unchanged	0.13	-0.35	1									
(16) Fixed investment	0.06	-0.07	-0.03	1								
(17) New products investment	0.03	-0.01	-0.03	0.10	1							
(18) Small loan	-0.03	0.05	-0.01	0.02	-0.03	1						
(19) Medium loan	-0.02	0.02	-0.02	0.03	-0.01	-0.05	1					
(20) Medium-large loan	0.00	-0.01	-0.01	0.07	-0.03	-0.07	-0.06	1				
(21) Large loan	0.03	-0.02	-0.05	0.17	0.04	-0.10	-0.09	-0.11	1			
(22) Cooperative	-0.01	0.05	0.00	0.05	-0.06	0.02	0.02	0.03	0.04	1		
(23) HHI	-0.07	0.00	0.02	-0.12	-0.01	-0.01	0.00	-0.02	-0.03	-0.21	1	
(24) NPL	-0.07	0.06	0.04	-0.15	-0.01	0.05	0.02	0.02	-0.04	-0.21	0.29	1

Notes: the Table reports pairwise correlation coefficients for all the explanatory variables. Correlations are computed using sample weights.

Supplementary Appendix

Heterogeneity and state dependence in firms' access to credit: Microevidence from the euro area

This Supplementary appendix reports the pooled estimated coefficients of the Models *a*), *b*) and *c*) (Table S1). Moreover, the values of the estimated loan demand and credit rationing probabilities of Model *c*) where Rationing 2 and 3 are substituted to Rationing 1 in the outcome equation of the static and dynamic models (Tables S2 and S3). The estimates of dynamic models estimated on subsamples split by firm size and using the three rationing indicators, alternatively, in the outcome equation (Tables S4-S6). The coefficients of specular specification to the Model *c*), estimated with random effects on the subsample of firms observed at least for two consecutive periods (i.e., the estimation sample of the dynamic model), used to compare results between a static and dynamic approach (Table S7). Finally, we report the estimates of dynamic models estimated on the subsample of firms needing external financing (Table S8) and on the subsamples of firms with at least 4 (not necessarily consecutive) observations and 3 consecutive observations over the survey waves 2014H1-2018H1 (Tables S9 and S10).

Table S1 – The role of loan size and credit market factors on firms’ access to credit: pooled estimator

	Model a)				Model b)				Model c)			
	Rationing		Loan demand		Rationing		Loan demand		Rationing		Loan demand	
Small	-0.1275***	(0.0468)	0.1294***	(0.0232)	-0.1324***	(0.0488)	0.1292***	(0.0232)	-0.1250**	(0.0491)	0.1284***	(0.0232)
Medium	-0.2841***	(0.0651)	0.1961***	(0.0310)	-0.3077***	(0.0679)	0.1958***	(0.0310)	-0.3106***	(0.0686)	0.1967***	(0.0310)
Large	-0.6848***	(0.0889)	0.3262***	(0.0384)	-0.6591***	(0.1008)	0.3262***	(0.0384)	-0.6695***	(0.1011)	0.3264***	(0.0384)
Autonomous firm	-0.3176***	(0.0719)	0.2784***	(0.0331)	-0.3017***	(0.0765)	0.2783***	(0.0331)	-0.2968***	(0.0767)	0.2766***	(0.0331)
Individual owner	0.1203*	(0.0629)	0.0137	(0.0296)	0.1344**	(0.0668)	0.0137	(0.0296)	0.1340**	(0.0666)	0.0126	(0.0296)
Family managed	-0.0332	(0.0595)	0.0707**	(0.0285)	-0.0240	(0.0630)	0.0706**	(0.0285)	-0.0203	(0.0629)	0.0691**	(0.0285)
Young	0.2106	(0.1462)	0.0628	(0.0855)	0.2015	(0.1509)	0.0628	(0.0856)	0.2051	(0.1515)	0.0643	(0.0856)
Exporter	0.0246	(0.0399)	0.0316	(0.0208)	0.0109	(0.0414)	0.0316	(0.0208)	0.0196	(0.0417)	0.0312	(0.0209)
Low turnover	0.4013***	(0.0493)	-0.2223***	(0.0252)	0.4354***	(0.0526)	-0.2225***	(0.0252)	0.4321***	(0.0531)	-0.2223***	(0.0252)
Turnover down	0.1202**	(0.0479)	-0.0317	(0.0259)	0.1423***	(0.0491)	-0.0319	(0.0259)	0.1401***	(0.0495)	-0.0316	(0.0259)
Turnover unchanged	-0.0032	(0.0438)	-0.0465**	(0.0218)	-0.0005	(0.0452)	-0.0467**	(0.0218)	0.0120	(0.0454)	-0.0490**	(0.0218)
Public support down	0.4494***	(0.0613)	0.0816***	(0.0265)	0.4451***	(0.0628)	0.0815***	(0.0265)	0.4210***	(0.0627)	0.0858***	(0.0267)
Public support unchanged	0.0906*	(0.0495)	-0.0247	(0.0214)	0.0792	(0.0510)	-0.0248	(0.0214)	0.0867*	(0.0518)	-0.0271	(0.0215)
Credit history down	0.3148***	(0.0610)	0.1199***	(0.0340)	0.3158***	(0.0625)	0.1203***	(0.0340)	0.3253***	(0.0629)	0.1190***	(0.0340)
Credit history unchanged	0.1062**	(0.0430)	-0.0646***	(0.0211)	0.1196***	(0.0438)	-0.0645***	(0.0211)	0.1141***	(0.0442)	-0.0640***	(0.0211)
Fixed investment	-0.4879***	(0.0399)	0.4508***	(0.0194)	-0.4795***	(0.0412)	0.4508***	(0.0194)	-0.4835***	(0.0412)	0.4484***	(0.0195)
New products investment	0.1754***	(0.0436)	-0.1331***	(0.0252)	0.2010***	(0.0440)	-0.1332***	(0.0252)	0.2050***	(0.0443)	-0.1338***	(0.0252)
Small loan					-0.0406	(0.0536)			-0.0411	(0.0537)		
Medium loan					0.1133*	(0.0596)			0.0997*	(0.0593)		
Medium-large loan					0.1734***	(0.0640)			0.1570**	(0.0643)		
Large loan					0.0176	(0.0889)			0.0008	(0.0905)		
Construction	0.0111	(0.0659)	-0.0260	(0.0334)	0.0442	(0.0673)	-0.0262	(0.0334)	0.0443	(0.0672)	-0.0243	(0.0334)
Trade	-0.0488	(0.0518)	0.0395	(0.0257)	-0.0336	(0.0529)	0.0394	(0.0257)	-0.0455	(0.0534)	0.0433*	(0.0258)
Services	-0.0013	(0.0533)	-0.0375	(0.0255)	0.0232	(0.0536)	-0.0377	(0.0255)	0.0209	(0.0536)	-0.0350	(0.0255)
Continental	-0.0451	(0.0426)	0.0669***	(0.0186)	-0.1058**	(0.0447)	0.0671***	(0.0186)	-0.0112	(0.0540)	0.0252	(0.0253)
Mediterranean	-0.2769***	(0.0458)	0.4619***	(0.0200)	-0.3129***	(0.0465)	0.4621***	(0.0200)	-0.3214***	(0.0577)	0.4372***	(0.0249)
Cooperative									0.0026**	(0.0013)	0.0006	(0.0006)
HHI									2.0364***	(0.3112)	-0.4456***	(0.1623)
NPL									0.0041	(0.0027)	0.0000	(0.0012)
Perceived growth obstacles			-0.0311	(0.0189)			-0.0298	(0.0190)			-0.0329*	(0.0192)
Alternative funding use			0.0737***	(0.0224)			0.0728***	(0.0225)			0.0724***	(0.0225)
Alternative financing demand			0.5166***	(0.0213)			0.5168***	(0.0213)			0.5173***	(0.0213)
Intercept	-0.0557	(0.1877)	-1.4004***	(0.0635)	-0.1148	(0.1993)	-1.4003***	(0.0635)	-0.4030*	(0.2133)	-1.3461***	(0.0682)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	[0.0339]	[0.0339]	[0.0339]	[0.0339]	[0.0349]	[0.0349]	[0.0349]	[0.0349]	[0.0509]	[0.0509]	[0.0509]	[0.0509]
Idiosyncratic error			-0.6918***				-0.6952***				-0.6934***	
			(0.0476)				(0.0452)				(0.0485)	
Number of observations			46241				46241				46241	
Log-likelihood			-31621.76				-31475.56				-31444.99	

Notes: the Table reports the estimated coefficients of baseline model (Model *a*), the extended pooled specifications, which enrich the baseline model to control for loan size (Model *b*) and also for macroeconomic factors (Model *c*). Standard errors are reported in parentheses. We use Rationing as indicator of financing constraints.

Micro firms, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S2 – The determinants of firms’ access to credit using alternative credit rationing definitions

	<i>Model c)</i>				<i>Model c)</i>			
	Rationing 2		Loan demand		Rationing 3		Loan demand	
Small	-0.1294**	(0.0616)	0.1689***	(0.0351)	-0.0832	(0.0621)	0.1678***	(0.0358)
Medium	-0.2668***	(0.0839)	0.2284***	(0.0468)	-0.1628**	(0.0827)	0.2279***	(0.0478)
Large	-0.4141***	(0.1179)	0.4056***	(0.0607)	-0.2326**	(0.1114)	0.4029***	(0.0618)
Autonomous firm	-0.2922***	(0.0765)	0.3034***	(0.0416)	-0.2918***	(0.0723)	0.3037***	(0.0421)
Individual owner	0.2329***	(0.0716)	0.0018	(0.0397)	0.2547***	(0.0704)	0.0011	(0.0404)
Family managed	0.0354	(0.0652)	0.0506	(0.0361)	0.0422	(0.0624)	0.0510	(0.0367)
Young	0.2560	(0.1701)	0.0592	(0.1087)	0.2831	(0.1810)	0.0568	(0.1115)
Exporter	-0.0154	(0.0482)	0.0638**	(0.0266)	0.0477	(0.0471)	0.0643**	(0.0271)
Low turnover	0.3337***	(0.0677)	-0.2215***	(0.0372)	0.2732***	(0.0669)	-0.2221***	(0.0380)
Turnover down	0.0906	(0.0556)	-0.0256	(0.0328)	0.0651	(0.0547)	-0.0257	(0.0335)
Turnover unchanged	0.0276	(0.0510)	-0.0475*	(0.0282)	0.0092	(0.0497)	-0.0473*	(0.0287)
Public support down	0.5607***	(0.0591)	0.1113***	(0.0358)	0.5195***	(0.0584)	0.1094***	(0.0366)
Public support unchanged	0.1787***	(0.0522)	-0.0109	(0.0274)	0.1065**	(0.0493)	-0.0106	(0.0279)
Credit history down	0.3926***	(0.0684)	0.1477***	(0.0451)	0.3628***	(0.0696)	0.1486***	(0.0464)
Credit history unchanged	0.0614	(0.0486)	-0.0663**	(0.0269)	0.0307	(0.0466)	-0.0655**	(0.0274)
Fixed investment	-0.6078***	(0.0443)	0.5885***	(0.0253)	-0.5281***	(0.0436)	0.5894***	(0.0258)
New products investment	0.2040***	(0.0534)	-0.1385***	(0.0322)	0.2132***	(0.0538)	-0.1386***	(0.0330)
Small loan	-0.0552	(0.0666)			0.0212	(0.0694)		
Medium loan	0.0534	(0.0763)			0.1723**	(0.0780)		
Medium-large loan	-0.0466	(0.0825)			0.0709	(0.0825)		
Large loan	-0.2163**	(0.0997)			-0.0665	(0.0958)		
Construction	0.0631	(0.0822)	-0.0635	(0.0472)	0.1590*	(0.0820)	-0.0627	(0.0483)
Trade	-0.0506	(0.0640)	-0.0024	(0.0369)	-0.0086	(0.0625)	-0.0016	(0.0377)
Services	0.0501	(0.0594)	-0.1043***	(0.0344)	0.0497	(0.0586)	-0.1045***	(0.0351)
Continental	-0.2438***	(0.0623)	0.1796***	(0.0353)	-0.3077***	(0.0611)	0.1784***	(0.0359)
Mediterranean	-0.2529***	(0.0592)	0.5521***	(0.0332)	-0.0951	(0.0582)	0.5499***	(0.0338)
Cooperative	-0.0012	(0.0014)	-0.0022***	(0.0008)	-0.0050***	(0.0014)	-0.0021***	(0.0008)
HHI	0.9550***	(0.3543)	-0.0930	(0.2109)	0.6720*	(0.3595)	-0.0997	(0.2169)
NPL	0.0092***	(0.0030)	-0.0061***	(0.0017)	0.0065**	(0.0029)	-0.0061***	(0.0017)
Perceived growth obstacles			-0.0055	(0.0253)			-0.0041	(0.0258)
Alternative funding use			0.0740**	(0.0298)			0.0711**	(0.0304)
Alternative financing demand			0.5522***	(0.0277)			0.5525***	(0.0284)
Intercept	0.1985	(0.1663)	-1.6103***	(0.0904)	0.2294	(0.1639)	-1.6088***	(0.0922)
Time dummies	Yes		Yes		Yes		Yes	
<i>Random effects</i>			0.8821***				0.8731***	
			(0.0300)				(0.0281)	
			0.7689***				0.7687***	
			(0.0137)				(0.0136)	
			-0.4228***				-0.2877***	
			(0.0362)				(0.0394)	
<i>Idiosyncratic errors</i>			-0.8279***				-0.7390***	
			(0.0173)				(0.0187)	
<i>Total correlation ()</i>			-0.6627***				-0.5567***	
			(0.0316)				(0.0269)	
Number of observations			46241				46241	
Log-likelihood			-29447.90				-30925.48	

Notes: the Table reports the estimated coefficients of the extended static model (Model *c*), using alternative definitions of credit rationing. Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S3 – The dynamics of firm’s access to credit using alternative credit rationing definitions

	<i>Model dyn_c)</i>				<i>Model dyn_c)</i>			
	Rationing 2		Loan demand		Rationing 3		Loan demand	
$R_{t,t}^*$	0.9092***	(0.1334)	-0.0059	(0.0707)	0.7322***	(0.1145)	0.0221	(0.0601)
$D_{t,t}$	-0.2927***	(0.0728)	0.4993***	(0.0382)	-0.2024***	(0.0684)	0.4941***	(0.0389)
Small	0.0122	(0.1052)	0.0913**	(0.0462)	0.0102	(0.0988)	0.0908**	(0.0463)
Medium	-0.0221	(0.1463)	0.1023*	(0.0604)	0.0318	(0.1307)	0.1019*	(0.0605)
Large	0.1155	(0.1915)	0.2371***	(0.0777)	0.1122	(0.1712)	0.2380***	(0.0779)
Autonomous firm	-0.2534	(0.4756)	0.1532	(0.2186)	-0.3359	(0.3952)	0.1559	(0.2183)
Individual owner	0.6415*	(0.3797)	0.2752*	(0.1673)	0.4741	(0.3401)	0.2699	(0.1673)
Family managed	0.6012*	(0.3172)	0.1306	(0.1452)	0.2593	(0.2948)	0.1302	(0.1460)
Young	0.0432	(0.5414)	0.2706	(0.2735)	-0.0914	(0.5935)	0.2641	(0.2742)
Exporter	0.1018	(0.1826)	0.0000	(0.0824)	0.3081*	(0.1701)	0.0005	(0.0826)
Low turnover	0.0478	(0.2807)	-0.0020	(0.1388)	0.0142	(0.2566)	-0.0059	(0.1388)
Turnover down	-0.0654	(0.1315)	0.0005	(0.0614)	-0.0499	(0.1231)	0.0007	(0.0615)
Turnover unchanged	0.0862	(0.1144)	-0.0423	(0.0515)	0.0744	(0.1065)	-0.0428	(0.0517)
Public support down	0.2374	(0.1471)	0.0471	(0.0703)	0.4097***	(0.1415)	0.0469	(0.0704)
Public support unchanged	0.0753	(0.1092)	-0.0412	(0.0491)	0.1394	(0.1014)	-0.0413	(0.0491)
Credit history down	0.3751**	(0.1568)	0.1109	(0.0856)	0.3305**	(0.1533)	0.1133	(0.0859)
Credit history unchanged	0.0338	(0.1099)	-0.0519	(0.0485)	0.0197	(0.0994)	-0.0517	(0.0486)
Fixed investment	-0.1610	(0.1069)	0.4510***	(0.0477)	-0.1981**	(0.0987)	0.4517***	(0.0478)
New products investment	-0.1094	(0.1283)	-0.1648***	(0.0593)	-0.0341	(0.1191)	-0.1650***	(0.0594)
Small loan	-0.1238	(0.2528)			0.0235	(0.2627)		
Medium loan	-0.0762	(0.2963)			0.2934	(0.2960)		
Medium-large loan	-0.1781	(0.3236)			0.1904	(0.3167)		
Large loan	-0.1348	(0.3860)			0.2024	(0.3644)		
Construction	0.1691	(0.1279)	0.0206	(0.0601)	0.2009	(0.1246)	0.0205	(0.0602)
Trade	0.0013	(0.1009)	0.0160	(0.0451)	0.0927	(0.0929)	0.0156	(0.0452)
Services	0.0010	(0.0916)	-0.0355	(0.0420)	0.0649	(0.0865)	-0.0360	(0.0421)
Continental	-0.2657***	(0.0989)	0.0515	(0.0444)	-0.2652***	(0.0914)	0.0515	(0.0444)
Mediterranean	-0.1749*	(0.0950)	0.4227***	(0.0415)	-0.0607	(0.0878)	0.4219***	(0.0416)
Cooperative	0.0006	(0.0022)	-0.0009	(0.0010)	-0.0031	(0.0021)	-0.0009	(0.0010)
HHI	0.8147	(0.5800)	-0.4579*	(0.2710)	0.4924	(0.5599)	-0.4639*	(0.2713)
NPL	-0.0016	(0.0047)	-0.0020	(0.0021)	-0.0006	(0.0043)	-0.0020	(0.0021)
Perceived growth obstacles			-0.0145	(0.0309)			-0.0158	(0.0310)
Alternative funding use			0.0576*	(0.0349)			0.0560	(0.0349)
Alternative financing demand			0.4825***	(0.0334)			0.4812***	(0.0335)
Intercept	-1.6322***	(0.3028)	-1.6083***	(0.1173)	-1.1532***	(0.2695)	-1.6071***	(0.1174)
Time dummies	Yes		Yes		Yes		Yes	
<i>Initial conditions</i>								
Rationing ₀	0.5638***	(0.1289)			0.6724***	(0.1072)		
Loan demand ₀			0.4274***	(0.0373)			0.4279***	(0.0374)
<i>Random effects</i>								
σ_α			0.6516***				0.7038***	
			(0.0562)				(0.0509)	
σ_η			0.4810***				0.4820***	
			(0.0227)				(0.0227)	
$\rho_{\alpha\eta}$			-0.0223				0.0261	
			(0.1442)				(0.1239)	
<i>Idiosyncratic errors</i>								
$\rho_{\varepsilon\mu}$			-0.2749***				-0.2969***	
			(0.0473)				(0.0440)	
<i>Total correlation (ρ_{tot})</i>			-0.2128***				-0.2122***	
			(0.0316)				(0.0269)	
Number of observations			15525				15525	
Log-likelihood			-9842.1				-10437.83	

Notes: the Table reports the estimated coefficients of the extended dynamic model (*Model dyn_c*), using alternative definitions of credit rationing (Rationing 2 and Rationing 3). Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S4 – Dynamic models on subsamples split by firm size (Rationing 1)

	Model d_c) SMEs		Model d_c) Micro and Small			Model d_c) Medium		
	Rationing	Loan demand	Rationing	Loan demand		Rationing	Loan demand	
$R_{i,t}^*$	1.3039*** (0.1820)	-0.0868 (0.0944)	1.2839*** (0.1801)	-0.0003 (0.1045)		1.6995*** (0.4232)	-0.3971** (0.1909)	
$D_{i,t}$	-0.3837*** (0.0870)	0.5201*** (0.0386)	-0.3589*** (0.0955)	0.4844*** (0.0469)		-0.2792* (0.1569)	0.6148*** (0.0645)	
Small	-0.1624 (0.1180)	0.0870* (0.0452)	-0.1552 (0.1119)	0.0766* (0.0454)				
Medium	-0.3910** (0.1679)	0.0981* (0.0591)						
Autonomous firm	-0.7043** (0.3382)	0.1546 (0.2389)	-0.2702 (0.4749)	0.0215 (0.3675)		-0.5784 (0.4231)	0.2090 (0.3031)	
Individual owner	0.4128 (0.4034)	0.2878* (0.1650)	0.7875 (0.5784)	0.3000 (0.2112)		0.6642 (0.4636)	0.2504 (0.2568)	
Family managed	0.8733** (0.3430)	0.1534 (0.1471)	1.4934*** (0.5307)	0.0923 (0.1937)		0.4523 (0.4565)	0.2149 (0.2173)	
Young	-1.0431** (0.5319)	0.1018 (0.2741)	-1.4892** (0.6213)	0.0030 (0.3189)		-0.3583 (0.8221)	0.4341 (0.4773)	
Exporter	0.0383 (0.2181)	0.0129 (0.0835)	-0.0095 (0.2185)	0.0273 (0.0937)		0.0395 (0.6122)	-0.0243 (0.1697)	
Low turnover	0.2093 (0.3272)	-0.0068 (0.1373)	0.2503 (0.3057)	0.0745 (0.1455)		-0.8730 (0.7944)	-0.5345 (0.3273)	
Turnover down	-0.1308 (0.1544)	0.0442 (0.0623)	-0.0804 (0.1641)	0.0381 (0.0733)		-0.1461 (0.2899)	0.0755 (0.1112)	
Turnover unchanged	0.0967 (0.1437)	-0.0342 (0.0533)	0.1809 (0.1592)	0.0091 (0.0633)		-0.2308 (0.2507)	-0.1262 (0.0920)	
Public support down	0.2800 (0.1724)	0.0094 (0.0706)	0.2258 (0.1835)	0.0029 (0.0817)		0.7347** (0.3379)	0.0201 (0.1318)	
Public support unchanged	0.1261 (0.1423)	-0.0759 (0.0501)	0.0070 (0.1514)	-0.0823 (0.0603)		0.7673** (0.3025)	-0.0538 (0.0853)	
Credit history down	-0.0811 (0.1764)	0.1104 (0.0871)	-0.1017 (0.1823)	0.0442 (0.0992)		-0.2345 (0.3425)	0.2722 (0.1732)	
Credit history unchanged	-0.1304 (0.1297)	-0.0469 (0.0501)	-0.0652 (0.1378)	-0.1137* (0.0612)		-0.4238* (0.2569)	0.0685 (0.0835)	
Fixed investment	-0.3683*** (0.1330)	0.4627*** (0.0484)	-0.3481** (0.1485)	0.4788*** (0.0571)		-0.4918* (0.2580)	0.4246*** (0.0858)	
New products investment	0.2499* (0.1499)	-0.1316** (0.0611)	0.1538 (0.1630)	-0.0912 (0.0742)		0.6444*** (0.2423)	-0.2105** (0.1010)	
Small loan	-0.0031 (0.2961)		0.0431 (0.2741)			-0.1407 (0.4967)		
Medium loan	0.0046 (0.3319)		0.0766 (0.3146)			-0.4353 (0.6560)		
Medium-large loan	0.0076 (0.3631)		0.1520 (0.3645)			-0.6097 (0.5766)		
Large loan	0.2400 (0.4161)		0.4055 (0.5437)			-0.2207 (0.6263)		
Construction	0.2352 (0.1459)	0.0304 (0.0594)	0.2248 (0.1644)	0.0157 (0.0707)		0.1665 (0.2644)	0.0472 (0.1062)	
Trade	0.0314 (0.1186)	0.0221 (0.0444)	0.1116 (0.1277)	0.0467 (0.0532)		-0.2635 (0.2668)	-0.0454 (0.0799)	
Services	0.1109 (0.1133)	-0.0295 (0.0421)	0.0967 (0.1257)	-0.0325 (0.0515)		0.1903 (0.2300)	-0.0254 (0.0741)	
Continental	-0.0705 (0.1158)	0.0677 (0.0454)	-0.2014 (0.1260)	0.0603 (0.0532)		0.2685 (0.2405)	0.1368 (0.0859)	
Mediterranean	-0.2992** (0.1206)	0.4247*** (0.0424)	-0.3297** (0.1286)	0.3899*** (0.0504)		-0.3486 (0.2552)	0.4903*** (0.0753)	
Cooperative	0.0074** (0.0029)	-0.0015 (0.0010)	0.0058* (0.0031)	-0.0013 (0.0012)		0.0139** (0.0067)	-0.0019 (0.0019)	
HHI	2.1238*** (0.6654)	-0.4859* (0.2781)	2.0640*** (0.7004)	-0.7562** (0.3268)		1.5882 (1.3833)	0.1494 (0.5231)	
NPL	0.0063 (0.0055)	-0.0022 (0.0021)	0.0021 (0.0059)	-0.0048* (0.0024)		0.0235* (0.0131)	0.0054 (0.0041)	
Perceived growth obstacles		-0.0168 (0.0316)		-0.0001 (0.0374)			-0.0520 (0.0565)	
Alternative funding use		0.0618* (0.0363)		0.0347 (0.0462)			0.1104* (0.0575)	
Alternative financing demand		0.4696*** (0.0344)		0.4451*** (0.0417)			0.5229*** (0.0589)	
Intercept	-2.4015*** (0.3637)	-1.6018*** (0.1206)	-2.4798*** (0.4068)	-1.5012*** (0.1494)		-3.2813*** (0.8246)	-1.6773*** (0.1862)	
Time dummies	Yes [0.0697]	Yes [0.0697]	Yes [0.1054]	Yes [0.1054]		Yes [0.8800]	Yes [0.8800]	
Initial conditions								
Rationing ₀	0.7119*** (0.1957)		0.6842*** (0.1938)			0.6626 (0.5381)		
Loan demand ₀		0.3865*** (0.0382)		0.3648*** (0.0463)			0.3938*** (0.0641)	
Random effects								
σ_α		0.5555*** (0.0757)		0.4303*** (0.1009)			0.5687*** (0.1766)	
σ_η		0.4567*** (0.0241)		0.4387*** (0.0298)			0.4569*** (0.0432)	
$\rho_{\alpha\eta}$		-0.0971 (0.2224)		0.1341 (0.3566)			-0.9999*** (0.0000)	
Idiosyncratic errors								
$\rho_{\varepsilon\mu}$		-0.3494*** (0.0605)		-0.2972*** (0.0649)			-0.3767*** (0.0782)	
Total correlation (ρ_{tot})		-0.2974		-0.2287			-0.5033	
Number of observations		13931		9596			4335	
Log-likelihood		-8237.51		-5641.02			-2543.24	

Notes: the Table reports the estimated coefficients of the dynamic models, estimated on subsamples split by firm size. Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively. ***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S5 – Dynamic models on subsamples split by firm size (Rationing 2)

	Model d_c) SMEs		Model d_c) Micro and Small		Model d_c) Medium	
	Rationing 2	Loan demand	Rationing 2	Loan demand	Rationing 2	Loan demand
$R_{i,t}^*$	0.8928*** (0.1447)	0.0148 (0.0708)	0.9211*** (0.1708)	0.0683 (0.0809)	1.0561*** (0.2165)	-0.0850 (0.1355)
$D_{i,t}$	-0.2987*** (0.0783)	0.5123*** (0.0392)	-0.3464*** (0.0952)	0.4745*** (0.0476)	-0.2379* (0.1223)	0.6111*** (0.0655)
Small	0.0081 (0.1082)	0.0876* (0.0453)	-0.0275 (0.1108)	0.0765* (0.0454)		
Medium	-0.0528 (0.1508)	0.0989* (0.0592)				
Autonomous firm	-0.1281 (0.5695)	0.1540 (0.2404)	-0.7165 (0.7637)	0.0178 (0.3684)	0.3045 (0.5426)	0.2285 (0.3052)
Individual owner	0.6881* (0.4062)	0.2880* (0.1654)	0.7934 (0.5461)	0.3004 (0.2104)	1.1657*** (0.4473)	0.2556 (0.2601)
Family managed	0.6717* (0.3542)	0.1528 (0.1472)	1.1197** (0.4827)	0.0881 (0.1929)	0.3912 (0.3919)	0.2221 (0.2190)
Young	0.2877 (0.5640)	0.1186 (0.2754)	0.0298 (0.6371)	0.0181 (0.3194)	0.8416 (1.0274)	0.4393 (0.4999)
Exporter	0.0933 (0.1906)	0.0123 (0.0833)	0.0608 (0.2136)	0.0268 (0.0934)	0.4574 (0.3433)	-0.0250 (0.1691)
Low turnover	0.0637 (0.2945)	-0.0101 (0.1375)	0.1119 (0.3117)	0.0703 (0.1454)	-0.2316 (0.5268)	-0.5147 (0.3218)
Turnover down	-0.0647 (0.1395)	0.0410 (0.0622)	-0.1218 (0.1694)	0.0357 (0.0731)	0.1532 (0.2046)	0.0651 (0.1114)
Turnover unchanged	0.0253 (0.1234)	-0.0341 (0.0531)	0.0939 (0.1490)	0.0088 (0.0631)	-0.1111 (0.1786)	-0.1293 (0.0920)
Public support down	0.2534 (0.1580)	0.0119 (0.0706)	0.2209 (0.1848)	0.0050 (0.0814)	0.3716 (0.2532)	0.0238 (0.1324)
Public support unchanged	0.0713 (0.1177)	-0.0741 (0.0500)	0.1231 (0.1404)	-0.0821 (0.0601)	-0.0524 (0.1789)	-0.0537 (0.0851)
Credit history down	0.2878* (0.1668)	0.1110 (0.0871)	0.2642 (0.1895)	0.0448 (0.0991)	0.2687 (0.2859)	0.2689 (0.1726)
Credit history unchanged	0.0087 (0.1183)	-0.0481 (0.0501)	0.0546 (0.1357)	-0.1150* (0.0610)	-0.0993 (0.1945)	0.0669 (0.0836)
Fixed investment	-0.1840 (0.1156)	0.4628*** (0.0484)	-0.2988** (0.1424)	0.4785*** (0.0569)	-0.0056 (0.1657)	0.4229*** (0.0857)
New products investment	-0.0692 (0.1404)	-0.1312** (0.0610)	-0.1711 (0.1665)	-0.0909 (0.0739)	0.1825 (0.2018)	-0.2100** (0.1012)
Small loan	-0.1727 (0.2565)		-0.1082 (0.2760)		-0.3891 (0.4820)	
Medium loan	-0.1361 (0.3015)		-0.0361 (0.3360)		-0.3257 (0.5015)	
Medium-large loan	-0.2957 (0.3299)		-0.2369 (0.3846)		-0.4146 (0.5041)	
Large loan	0.0285 (0.3949)		-0.1537 (0.5725)		0.0950 (0.5435)	
Construction	0.1442 (0.1331)	0.0292 (0.0594)	0.2231 (0.1674)	0.0146 (0.0706)	-0.1487 (0.1984)	0.0486 (0.1077)
Trade	-0.0127 (0.1055)	0.0225 (0.0444)	-0.0209 (0.1264)	0.0472 (0.0531)	0.0474 (0.1744)	-0.0416 (0.0797)
Services	-0.0045 (0.0991)	-0.0302 (0.0420)	-0.0059 (0.1227)	-0.0330 (0.0514)	-0.0798 (0.1571)	-0.0270 (0.0738)
Continental	-0.1883* (0.1057)	0.0697 (0.0454)	-0.2396* (0.1254)	0.0635 (0.0531)	-0.0484 (0.1720)	0.1410 (0.0859)
Mediterranean	-0.1490 (0.1033)	0.4266*** (0.0423)	-0.1463 (0.1234)	0.3904*** (0.0503)	-0.2329 (0.1648)	0.4967*** (0.0752)
Cooperative	0.0001 (0.0024)	-0.0015 (0.0010)	-0.0010 (0.0028)	-0.0013 (0.0012)	0.0032 (0.0039)	-0.0019 (0.0019)
HHI	1.0286 (0.6260)	-0.4847* (0.2782)	1.6409** (0.7410)	-0.7488** (0.3264)	-0.2743 (0.9946)	0.1637 (0.5230)
NPL	-0.0026 (0.0050)	-0.0022 (0.0021)	-0.0100* (0.0060)	-0.0047* (0.0024)	0.0136* (0.0078)	0.0051 (0.0041)
Perceived growth obstacles		-0.0173 (0.0316)		-0.0010 (0.0374)		-0.0500 (0.0564)
Alternative funding use		0.0639* (0.0363)		0.0343 (0.0460)		0.1223** (0.0575)
Alternative financing demand		0.4677*** (0.0344)		0.4424*** (0.0416)		0.5258*** (0.0592)
Intercept	-1.6328*** (0.3197)	-1.5980*** (0.1206)	-1.7709*** (0.4041)	-1.4969*** (0.1493)	-0.9284* (0.5060)	-1.6804*** (0.1866)
Time dummies	Yes [0.0140]	Yes [0.0140]	Yes [0.1361]	Yes [0.1361]	Yes [0.1041]	Yes [0.1041]
Initial conditions						
Rationing ₀	0.6211*** (0.1392)		0.6304*** (0.1625)		0.5481** (0.2308)	
Loan demand ₀		0.3837*** (0.0382)		0.3617*** (0.0463)		0.3860*** (0.0642)
<i>Random effects</i>						
σ_α		0.6911*** (0.0600)		0.6988*** (0.0725)		0.4661*** (0.1195)
σ_η		0.4558*** (0.0241)		0.4370*** (0.0298)		0.4580*** (0.0454)
$\rho_{\alpha\eta}$		-0.0897 (0.1500)		-0.0303 (0.1969)		-0.5875* (0.2587)
<i>Idiosyncratic errors</i>						
$\rho_{\varepsilon\mu}$		-0.2589*** (0.0513)		-0.2058*** (0.0654)		-0.4106*** (0.0823)
<i>Total correlation (ρ_{tot})</i>		-0.2150		-0.1615		-0.4417
Number of observations		13931		9596		4335
Log-likelihood		-8812.36		-6009.23		-2746.19

Notes: the Table reports the estimated coefficients of the dynamic models, estimated on subsamples split by firm size. Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively. ***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S6 – Dynamic models on subsamples split by firm size (Rationing 3)

	Model d_c) SMEs			Model d_c) Micro and Small			Model d_c) Medium					
	Rationing 3		Loan demand	Rationing 3		Loan demand	Rationing 3		Loan demand			
$R_{i,t}^*$	0.7198***	(0.1192)	0.0276	(0.0613)	0.7914***	(0.1330)	0.0750	(0.0720)	0.7236***	(0.2094)	-0.0890	(0.1115)
$D_{i,t}$	-0.1756**	(0.0709)	0.5077***	(0.0398)	-0.2309***	(0.0836)	0.4691***	(0.0485)	-0.1263	(0.1217)	0.6072***	(0.0668)
Small	0.0102	(0.0978)	0.0873*	(0.0454)	-0.0069	(0.0942)	0.0766*	(0.0454)				
Medium	0.0042	(0.1297)	0.0986*	(0.0593)								
Autonomous firm	0.0892	(0.4321)	0.1551	(0.2398)	-0.6358	(0.6502)	0.0154	(0.3678)	0.5465	(0.5051)	0.2361	(0.3056)
Individual owner	0.5485	(0.3456)	0.2835*	(0.1654)	0.6734	(0.4527)	0.2971	(0.2101)	0.6486	(0.5088)	0.2423	(0.2643)
Family managed	0.3336	(0.3076)	0.1524	(0.1479)	0.7704*	(0.4149)	0.0874	(0.1934)	-0.0743	(0.4127)	0.2189	(0.2219)
Young	0.2011	(0.6132)	0.1094	(0.2756)	-0.2333	(0.6774)	0.0152	(0.3197)	1.4641	(0.9698)	0.3896	(0.4931)
Exporter	0.3576**	(0.1702)	0.0120	(0.0834)	0.2634	(0.1822)	0.0266	(0.0936)	0.7136**	(0.3306)	-0.0229	(0.1692)
Low turnover	-0.0592	(0.2550)	-0.0108	(0.1375)	-0.0295	(0.2562)	0.0697	(0.1453)	-0.7153	(0.6588)	-0.5122	(0.3269)
Turnover down	-0.0150	(0.1261)	0.0408	(0.0623)	-0.0498	(0.1436)	0.0351	(0.0732)	0.1829	(0.2202)	0.0696	(0.1130)
Turnover unchanged	0.0449	(0.1129)	-0.0342	(0.0532)	0.1387	(0.1289)	0.0084	(0.0632)	-0.1259	(0.1983)	-0.1288	(0.0937)
Public support down	0.3857***	(0.1444)	0.0107	(0.0707)	0.4473***	(0.1601)	0.0040	(0.0814)	0.3465	(0.2580)	0.0236	(0.1346)
Public support unchanged	0.0768	(0.1038)	-0.0746	(0.0500)	0.1822	(0.1192)	-0.0823	(0.0601)	-0.1053	(0.1753)	-0.0561	(0.0858)
Credit history down	0.2943*	(0.1565)	0.1134	(0.0873)	0.1775	(0.1698)	0.0481	(0.0993)	0.6001**	(0.2966)	0.2737	(0.1759)
Credit history unchanged	0.0148	(0.1029)	-0.0476	(0.0501)	0.0115	(0.1169)	-0.1145*	(0.0611)	-0.0165	(0.1832)	0.0709	(0.0841)
Fixed investment	-0.1492	(0.1021)	0.4630***	(0.0484)	-0.2227*	(0.1202)	0.4785***	(0.0570)	-0.0238	(0.1769)	0.4242***	(0.0865)
New products investment	0.0169	(0.1233)	-0.1313**	(0.0611)	-0.1005	(0.1446)	-0.0903	(0.0740)	0.2508	(0.1995)	-0.2068**	(0.1024)
Small loan	0.0124	(0.2574)			0.0544	(0.2553)			-0.1754	(0.6517)		
Medium loan	0.2699	(0.2910)			0.3594	(0.2995)			0.0266	(0.6452)		
Medium-large loan	0.1309	(0.3135)			0.1671	(0.3431)			-0.0473	(0.6427)		
Large loan	0.2093	(0.3687)			0.3505	(0.5075)			0.1148	(0.6763)		
Construction	0.1910	(0.1248)	0.0294	(0.0595)	0.2759*	(0.1461)	0.0140	(0.0707)	-0.1003	(0.2295)	0.0532	(0.1085)
Trade	0.0863	(0.0933)	0.0224	(0.0444)	0.1107	(0.1070)	0.0465	(0.0532)	0.0199	(0.1739)	-0.0412	(0.0806)
Services	0.0621	(0.0889)	-0.0301	(0.0421)	-0.0231	(0.1062)	-0.0336	(0.0515)	0.2293	(0.1478)	-0.0232	(0.0745)
Continental	-0.2072**	(0.0946)	0.0694	(0.0454)	-0.2738**	(0.1085)	0.0646	(0.0532)	-0.0437	(0.1686)	0.1387	(0.0867)
Mediterranean	-0.0361	(0.0925)	0.4253***	(0.0424)	-0.0751	(0.1068)	0.3894***	(0.0504)	-0.0163	(0.1605)	0.4949***	(0.0755)
Cooperative	-0.0038*	(0.0021)	-0.0014	(0.0010)	-0.0036	(0.0024)	-0.0013	(0.0012)	-0.0035	(0.0038)	-0.0019	(0.0019)
HHI	0.6045	(0.5898)	-0.4900*	(0.2786)	1.0384	(0.6833)	-0.7484**	(0.3269)	-0.6913	(1.0142)	0.1667	(0.5273)
NPL	-0.0017	(0.0045)	-0.0022	(0.0021)	-0.0102**	(0.0052)	-0.0046*	(0.0024)	0.0138*	(0.0080)	0.0053	(0.0042)
Perceived growth obstacles			-0.0181	(0.0316)			-0.0010	(0.0374)			-0.0544	(0.0569)
Alternative funding use			0.0619*	(0.0363)			0.0333	(0.0461)			0.1179**	(0.0581)
Alternative financing demand			0.4672***	(0.0345)			0.4418***	(0.0417)			0.5222***	(0.0597)
Intercept	-1.1907***	(0.2792)	-1.5975***	(0.1206)	-1.5899***	(0.3446)	-1.4969***	(0.1493)	-0.5797	(0.5428)	-1.6854***	(0.1878)
Time dummies	Yes		Yes		Yes		Yes		Yes		Yes	
	[0.0097]		[0.0097]		[0.0588]		[0.0588]		[0.1792]		[0.1792]	
Initial conditions												
Rationing ₀ *	0.6289***	(0.1126)			0.5455***	(0.1252)			0.7207***	(0.2034)		
Loan demand ₀			0.3861***	(0.0383)			0.3626***	(0.0464)			0.4010***	(0.0649)
Random effects												
σ_α		0.6951***				0.6177***				0.6874***		
		(0.0545)				(0.0704)				(0.0864)		
σ_η		0.4566***				0.4372***				0.4643***		
		(0.0241)				(0.0298)				(0.0433)		
$\rho_{\alpha\eta}$		-0.0423				0.0440				-0.2252		
		(0.1351)				(0.1951)				(0.2030)		
Idiosyncratic errors												
$\rho_{\varepsilon t}$		-0.2639***				-0.1916***				-0.4957***		
		(0.1351)				(0.0571)				(0.0767)		
Total correlation (ρ_{tot})		-0.2071				-0.1401				-0.4242		
Number of observations		13931				9596				4335		
Log-likelihood		-9335.53				-6299.87				-2966.43		

Notes: the Table reports the estimated coefficients of the dynamic models, estimated on subsamples split by firm size. Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively. ***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S7 – The determinants of firms’ access to credit: estimates of the static model on the sub-sample used for the dynamic model

	Model a)				Model b)				Model c)			
	Rationing		Loan demand		Rationing		Loan demand		Rationing		Loan demand	
Small	-0.3035**	(0.1252)	0.1817***	(0.0592)	-0.2922**	(0.1259)	0.1821***	(0.0566)	-0.2655**	(0.1238)	0.1743***	(0.0566)
Medium	-0.5565***	(0.1787)	0.2427***	(0.0770)	-0.5550***	(0.1761)	0.2424***	(0.0739)	-0.5423***	(0.1751)	0.2377***	(0.0740)
Large	-0.9265***	(0.2388)	0.4491***	(0.1003)	-0.8732***	(0.2511)	0.4485***	(0.0967)	-0.8684***	(0.2453)	0.4448***	(0.0965)
Autonomous firm	-0.3222**	(0.1512)	0.2380***	(0.0681)	-0.3117**	(0.1513)	0.2378***	(0.0655)	-0.2999**	(0.1495)	0.2378***	(0.0655)
Individual owner	0.2671*	(0.1537)	0.0292	(0.0673)	0.3523**	(0.1470)	0.0292	(0.0644)	0.3312**	(0.1451)	0.0291	(0.0644)
Family managed	0.1263	(0.1348)	0.0167	(0.0599)	0.1988	(0.1321)	0.0169	(0.0575)	0.1872	(0.1305)	0.0201	(0.0576)
Young	0.0010	(0.4929)	-0.2400	(0.1860)	0.0214	(0.4783)	-0.2408	(0.1770)	0.0258	(0.4671)	-0.2401	(0.1771)
Exporter	0.0215	(0.1027)	0.0889**	(0.0438)	-0.0112	(0.0926)	0.0887**	(0.0418)	0.0020	(0.0914)	0.0934**	(0.0419)
Low turnover	0.4537***	(0.1401)	-0.2228***	(0.0621)	0.4631***	(0.1380)	-0.2230***	(0.0593)	0.4603***	(0.1368)	-0.2210***	(0.0595)
Turnover down	0.1624	(0.1164)	-0.0609	(0.0541)	0.1800	(0.1143)	-0.0611	(0.0517)	0.1580	(0.1130)	-0.0548	(0.0517)
Turnover unchanged	0.1282	(0.1038)	-0.0925**	(0.0465)	0.1297	(0.1035)	-0.0926**	(0.0447)	0.1304	(0.1027)	-0.0921**	(0.0448)
Public support down	0.6778***	(0.2387)	0.0644	(0.0611)	0.6842***	(0.1221)	0.0636	(0.0575)	0.6142***	(0.1221)	0.0836	(0.0583)
Public support unchanged	0.2228	(0.1379)	-0.0092	(0.0453)	0.2135*	(0.1124)	-0.0094	(0.0438)	0.2121*	(0.1101)	-0.0120	(0.0438)
Credit history down	0.4151**	(0.1993)	0.1281*	(0.0769)	0.4263***	(0.1353)	0.1273*	(0.0717)	0.4240***	(0.1326)	0.1302*	(0.0717)
Credit history unchanged	0.0255	(0.1053)	-0.0605	(0.0440)	0.0136	(0.1012)	-0.0604	(0.0425)	-0.0046	(0.1012)	-0.0572	(0.0425)
Fixed investment	-0.6872***	(0.0976)	0.5668***	(0.0418)	-0.7121***	(0.0918)	0.5673***	(0.0402)	-0.7085***	(0.0916)	0.5640***	(0.0403)
New products investment	0.2666**	(0.1096)	-0.1380***	(0.0514)	0.2998***	(0.1031)	-0.1380***	(0.0489)	0.2722***	(0.1017)	-0.1324***	(0.0489)
Small loan					-0.1766	(0.1357)			-0.1824	(0.1331)		
Medium loan					-0.0941	(0.1505)			-0.0912	(0.1471)		
Medium-large loan					0.1211	(0.1588)			0.0926	(0.1559)		
Large loan					-0.1299	(0.2014)			-0.1612	(0.1995)		
Construction	0.2189	(0.1666)	0.0064	(0.0787)	0.2267	(0.1509)	0.0055	(0.0746)	0.2442*	(0.1481)	0.0083	(0.0747)
Trade	0.0100	(0.1293)	-0.0129	(0.0592)	0.0093	(0.1277)	-0.0128	(0.0566)	0.0111	(0.1289)	-0.0053	(0.0571)
Services	0.0646	(0.1255)	-0.0726	(0.0553)	0.0901	(0.1258)	-0.0725	(0.0534)	0.0985	(0.1243)	-0.0740	(0.0535)
Continental	-0.1498	(0.0997)	0.1513***	(0.0427)	-0.2190**	(0.0983)	0.1513***	(0.0413)	-0.1219	(0.1247)	0.0900	(0.0557)
Mediterranean	-0.4952***	(0.1104)	0.6064***	(0.0418)	-0.5272***	(0.0947)	0.6063***	(0.0403)	-0.6483***	(0.1151)	0.6389***	(0.0519)
Cooperative									0.0093***	(0.0029)	-0.0012	(0.0013)
HHI									2.2023***	(0.6848)	-0.4484	(0.3358)
NPL									0.0143**	(0.0056)	-0.0061**	(0.0026)
Perceived growth obstacles			-0.0260	(0.0386)			-0.0263	(0.0386)			-0.0278	(0.0392)
Alternative funding use			0.0632	(0.0448)			0.0629	(0.0446)			0.0633	(0.0445)
Alternative financing demand			0.5747***	(0.0474)			0.5766***	(0.0430)			0.5731***	(0.0431)
Intercept	-0.4519	(0.7715)	-1.6241***	(0.1335)	-0.4219	(0.3392)	-1.6242***	(0.1288)	-0.8957***	(0.3462)	-1.4997***	(0.1396)
Time dummies		Yes		Yes		Yes		Yes		Yes		Yes
		[0.4868]		[0.4868]		[0.3577]		[0.3577]		[0.3180]		[0.3180]
<i>Random effects</i>												
σ_α		1.0687***				1.0853***				1.0568***		
		(0.1569)				(0.0681)				(0.0658)		
σ_η		0.8259***				0.8257***				0.8246***		
		(0.0274)				(0.0274)				(0.0274)		
$\rho_{\alpha\eta}$		-0.4962***				-0.4782***				-0.4752***		
		(0.2159)				(0.0598)				(0.0589)		
<i>Idiosyncratic errors</i>												
$\rho_{\varepsilon\mu}$		-0.9463***				-0.9616***				-0.9670***		
		(0.0668)				(0.0276)				(0.0245)		
<i>Total correlation (ρ_{tot})</i>												
		-0.7292				-0.7264				-0.7324		
Number of observations		15525				15525				15525		
Log-likelihood		-10007.98				-9963.17				-9944.34		

Notes: the Table reports the coefficients of the static random-effects Model *a*), *b*) and *c*) estimated on the same sample used for the estimation of the dynamic model (i.e., considering only those firms observed for at least two consecutive periods). Standard errors are reported in parentheses.

Micro firms, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S8 – The dynamics of firm’s access to credit focusing on firms needing external financing

	Model d_c)		Model d_c)		Model d_c)	
	Rationing	Loan demand	Rationing 2	Loan demand	Rationing 3	Loan demand
$R_{i,t}^*$	1.4560*** (0.1826)	-0.8411*** (0.1737)	1.0341*** (0.1278)	-0.7400*** (0.1444)	0.8119*** (0.1113)	-0.6098*** (0.1392)
$D_{i,t}$	-0.3731*** (0.0848)	0.5067*** (0.1019)	-0.2862*** (0.0702)	0.5852*** (0.1054)	-0.1653** (0.0660)	0.5757*** (0.1108)
Small	-0.2085* (0.1181)	0.1142 (0.1074)	-0.0163 (0.0993)	0.1245 (0.1073)	-0.0107 (0.0940)	0.1164 (0.1095)
Medium	-0.4598*** (0.1697)	0.1603 (0.1524)	-0.0709 (0.1404)	0.1557 (0.1518)	-0.0042 (0.1261)	0.1563 (0.1553)
Large	-0.5853** (0.2435)	0.2546 (0.2089)	0.0703 (0.1858)	0.2409 (0.2063)	0.0853 (0.1656)	0.2802 (0.2130)
Autonomous firm	-0.7600*** (0.2851)	0.6772 (0.6148)	-0.3297 (0.4608)	0.6342 (0.6162)	-0.3776 (0.3810)	0.6413 (0.6265)
Individual owner	0.3790 (0.3960)	0.2323 (0.4032)	0.6130* (0.3691)	0.2218 (0.3995)	0.4889 (0.3306)	0.1576 (0.4162)
Family managed	0.8767*** (0.3276)	-0.2275 (0.3609)	0.6397** (0.3111)	-0.2085 (0.3627)	0.3261 (0.2846)	-0.2515 (0.3735)
Young	-1.3521** (0.5394)	0.1794 (0.7057)	0.0593 (0.5391)	0.1697 (0.6937)	-0.0813 (0.5828)	0.2022 (0.7053)
Exporter	-0.0386 (0.2186)	0.1341 (0.2058)	0.0516 (0.1744)	0.1107 (0.2037)	0.2712* (0.1637)	0.1199 (0.2066)
Low turnover	0.1206 (0.3141)	0.3087 (0.3358)	-0.0376 (0.2706)	0.3402 (0.3303)	-0.0410 (0.2493)	0.3258 (0.3375)
Turnover down	-0.0897 (0.1509)	-0.1683 (0.1503)	-0.0312 (0.1241)	-0.1937 (0.1491)	-0.0212 (0.1177)	-0.1780 (0.1540)
Turnover unchanged	0.1099 (0.1395)	-0.0596 (0.1426)	0.0908 (0.1109)	-0.0581 (0.1420)	0.0710 (0.1036)	-0.0523 (0.1448)
Public support down	0.4089** (0.1716)	-0.2481 (0.1632)	0.2801** (0.1411)	-0.1860 (0.1632)	0.4392*** (0.1357)	-0.2077 (0.1674)
Public support unchanged	0.1690 (0.1391)	-0.0826 (0.1302)	0.0712 (0.1059)	-0.0425 (0.1305)	0.1399 (0.0983)	-0.0538 (0.1330)
Credit history down	0.0680 (0.1772)	-0.1765 (0.1878)	0.4133*** (0.1490)	-0.2004 (0.1880)	0.3694** (0.1465)	-0.1886 (0.1929)
Credit history unchanged	-0.1139 (0.1287)	-0.2383* (0.1362)	0.0648 (0.1066)	-0.2498* (0.1352)	0.0411 (0.0963)	-0.2416* (0.1374)
Fixed investment	-0.4043*** (0.1315)	0.4096*** (0.1239)	-0.1642 (0.1022)	0.3977*** (0.1231)	-0.1772* (0.0946)	0.4025*** (0.1266)
New products investment	0.1899 (0.1468)	-0.0641 (0.1476)	-0.1311 (0.1232)	-0.0390 (0.1461)	-0.0537 (0.1148)	-0.0570 (0.1516)
Small loan	-0.0526 (0.3031)		-0.1224 (0.2413)		0.0150 (0.2518)	
Medium loan	-0.0348 (0.3374)		-0.0559 (0.2825)		0.2934 (0.2828)	
Medium-large loan	0.0204 (0.3648)		-0.1811 (0.3099)		0.1770 (0.3038)	
Large loan	-0.0191 (0.4317)		-0.1233 (0.3762)		0.1830 (0.3553)	
Construction	0.2218 (0.1458)	0.0216 (0.1488)	0.1691 (0.1227)	0.0212 (0.1481)	0.1977 (0.1203)	0.0229 (0.1506)
Trade	-0.0054 (0.1195)	0.0713 (0.1141)	-0.0209 (0.0967)	0.0811 (0.1131)	0.0698 (0.0899)	0.0685 (0.1169)
Services	0.0576 (0.1133)	0.0051 (0.1060)	-0.0031 (0.0883)	0.0088 (0.1057)	0.0572 (0.0835)	-0.0072 (0.1085)
Continental	-0.0496 (0.1131)	-0.1538 (0.1053)	-0.2061** (0.0939)	-0.1697 (0.1055)	-0.2215** (0.0877)	-0.1767 (0.1082)
Mediterranean	-0.3024*** (0.1162)	0.4326*** (0.1136)	-0.1935** (0.0919)	0.4709*** (0.1130)	-0.0658 (0.0850)	0.4705*** (0.1151)
Cooperative	0.0068** (0.0028)	0.0000 (0.0026)	0.0000 (0.0021)	-0.0006 (0.0026)	-0.0034* (0.0020)	-0.0003 (0.0026)
HHI	2.8179*** (0.6497)	-1.8180*** (0.6272)	1.2789** (0.5510)	-1.7735*** (0.6293)	0.8796 (0.5362)	-1.7980*** (0.6468)
NPL	0.0136** (0.0053)	-0.0286*** (0.0051)	0.0056 (0.0044)	-0.0304*** (0.0051)	0.0049 (0.0041)	-0.0301*** (0.0052)
Perceived growth obstacles		-0.0278 (0.0786)		-0.0205 (0.0787)		-0.0338 (0.0806)
Alternative funding use		0.0291 (0.0921)		0.0404 (0.0912)		0.0324 (0.0941)
Alternative financing demand		0.3222*** (0.0829)		0.3415*** (0.0828)		0.3372*** (0.0854)
Intercept	-2.8168*** (0.3652)	1.6731*** (0.3029)	-1.8655*** (0.2908)	1.6847*** (0.3017)	-1.4112*** (0.2603)	1.7183*** (0.3112)
Time dummies	Yes [0.6137]	Yes [0.6137]	Yes [0.2115]	Yes [0.2115]	Yes [0.1488]	Yes [0.1488]
Initial conditions						
Rationing ₀	0.6117*** (0.1941)		0.4850*** (0.1237)		0.6306*** (0.1046)	
Loan demand ₀		0.2994*** (0.0966)		0.2847*** (0.0964)		0.3059*** (0.0996)
Random effects						
σ_α		0.7489*** (0.0597)		0.7437*** (0.0488)		0.7552*** (0.0459)
σ_η		1.0282*** (0.0440)		1.0354*** (0.0443)		1.0505*** (0.0444)
$\rho_{\alpha\eta}$		-0.7590*** (0.1065)		-0.7200*** (0.0925)		-0.6070*** (0.1023)
Idiosyncratic errors						
$\rho_{\varepsilon\mu}$		-0.5182*** (0.0913)		-0.5271*** (0.0815)		-0.5066*** (0.0879)
Total correlation (ρ_{tot})		-0.6153		-0.6029		-0.5437
Number of observations		6917		6917		6917
Log-likelihood		-2773.29		-3432.79		-4040.22

Notes: the Table reports the coefficients of the dynamic Models d_c) using, alternatively, Rationing, Rationing 2 and Rationing 3 as indicators of financing constraints. The models are estimated on the subsample of firms needing external financing. Standard errors are reported in parentheses. *Micro firms*, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S9 – The dynamics of firm’s access to credit focusing on firms with at least four observations

	Model d_c)		Model d_c)		Model d_c)	
	Rationing	Loan demand	Rationing 2	Loan demand	Rationing 3	Loan demand
$R_{i,t}^*$	1.3738*** (0.1978)	0.0535 (0.1251)	1.0111*** (0.1434)	0.0796 (0.0890)	0.8042*** (0.1226)	0.0946 (0.0757)
$D_{i,t}$	-0.4415*** (0.1003)	0.4991*** (0.0426)	-0.2758*** (0.0838)	0.4933*** (0.0432)	-0.2006** (0.0782)	0.4862*** (0.0439)
Small	-0.2670* (0.1476)	0.0590 (0.0582)	-0.0648 (0.1250)	0.0584 (0.0582)	-0.0035 (0.1179)	0.0580 (0.0582)
Medium	-0.5433** (0.2124)	0.0635 (0.0755)	-0.0888 (0.1706)	0.0634 (0.0754)	-0.0046 (0.1555)	0.0630 (0.0754)
Large	-0.7916*** (0.3027)	0.1503 (0.0968)	-0.0666 (0.2295)	0.1498 (0.0966)	0.1009 (0.2058)	0.1501 (0.0966)
Autonomous firm	-0.7185** (0.2919)	0.1934 (0.2364)	-0.0865 (0.4621)	0.1929 (0.2365)	-0.1694 (0.3967)	0.1949 (0.2360)
Individual owner	0.2432 (0.4131)	0.2966* (0.1796)	0.6435* (0.3795)	0.2990* (0.1796)	0.6016* (0.3489)	0.2937 (0.1793)
Family managed	0.5633* (0.3079)	0.0831 (0.1570)	0.4651 (0.3234)	0.0820 (0.1568)	0.1967 (0.3066)	0.0819 (0.1574)
Young	-1.2737** (0.5578)	0.2717 (0.2917)	0.0579 (0.6019)	0.2884 (0.2933)	-0.1251 (0.6404)	0.2802 (0.2940)
Exporter	-0.0500 (0.2371)	0.0179 (0.0922)	0.0543 (0.1983)	0.0183 (0.0922)	0.2410 (0.1852)	0.0189 (0.0922)
Low turnover	0.3617 (0.3463)	-0.0023 (0.1497)	0.1112 (0.2996)	-0.0015 (0.1500)	0.0460 (0.2702)	-0.0069 (0.1497)
Turnover down	-0.2035 (0.1654)	0.0055 (0.0665)	-0.0445 (0.1399)	0.0037 (0.0663)	-0.0051 (0.1288)	0.0036 (0.0664)
Turnover unchanged	0.0214 (0.1478)	-0.0317 (0.0562)	0.0593 (0.1226)	-0.0317 (0.0561)	0.0463 (0.1112)	-0.0324 (0.0561)
Public support down	0.3193* (0.1874)	0.0344 (0.0763)	0.1774 (0.1554)	0.0358 (0.0762)	0.3798*** (0.1473)	0.0370 (0.0762)
Public support unchanged	0.1677 (0.1500)	-0.0641 (0.0536)	0.0387 (0.1161)	-0.0632 (0.0535)	0.1590 (0.1072)	-0.0626 (0.0534)
Credit history down	-0.0450 (0.1905)	0.1126 (0.0932)	0.3414** (0.1657)	0.1120 (0.0932)	0.2842* (0.1585)	0.1147 (0.0933)
Credit history unchanged	-0.1143 (0.1358)	-0.0407 (0.0526)	-0.0051 (0.1172)	-0.0422 (0.0526)	-0.0209 (0.1034)	-0.0420 (0.0525)
Fixed investment	-0.4782*** (0.1448)	0.4530*** (0.0517)	-0.2094* (0.1140)	0.4527*** (0.0516)	-0.2518** (0.1043)	0.4530*** (0.0516)
New products investment	0.1931 (0.1577)	-0.1628** (0.0650)	-0.1400 (0.1369)	-0.1622** (0.0648)	-0.0266 (0.1238)	-0.1617** (0.0648)
Small loan	-0.1344 (0.3192)		-0.1829 (0.2640)		0.0020 (0.2712)	
Medium loan	-0.0267 (0.3561)		-0.1304 (0.3065)		0.2556 (0.3045)	
Medium-large loan	-0.0501 (0.3843)		-0.2797 (0.3270)		0.1598 (0.3225)	
Large loan	-0.0516 (0.4434)		-0.2761 (0.3819)		0.2084 (0.3685)	
Construction	0.2425 (0.1731)	-0.0381 (0.0749)	0.1246 (0.1493)	-0.0382 (0.0748)	0.1339 (0.1444)	-0.0401 (0.0748)
Trade	0.0953 (0.1366)	-0.0205 (0.0547)	0.0223 (0.1129)	-0.0202 (0.0546)	0.1095 (0.1036)	-0.0211 (0.0546)
Services	0.0647 (0.1317)	-0.0782 (0.0514)	-0.0390 (0.1054)	-0.0787 (0.0512)	0.0632 (0.0978)	-0.0789 (0.0512)
Continental	-0.1460 (0.1340)	0.0425 (0.0552)	-0.2777** (0.1149)	0.0447 (0.0551)	-0.3079*** (0.1062)	0.0447 (0.0551)
Mediterranean	-0.2720* (0.1427)	0.4286*** (0.0515)	-0.1493 (0.1119)	0.4280*** (0.0514)	-0.0282 (0.1020)	0.4251*** (0.0514)
Cooperative	0.0074** (0.0034)	-0.0006 (0.0013)	0.0021 (0.0026)	-0.0006 (0.0013)	-0.0005 (0.0024)	-0.0005 (0.0013)
HHI	2.4482*** (0.7781)	-0.3931 (0.3419)	0.9178 (0.6863)	-0.3857 (0.3414)	0.7220 (0.6567)	-0.3931 (0.3411)
NPL	0.0075 (0.0066)	-0.0016 (0.0026)	-0.0025 (0.0055)	-0.0016 (0.0026)	-0.0015 (0.0050)	-0.0015 (0.0026)
Perceived growth obstacles		0.0147 (0.0381)		0.0153 (0.0381)		0.0124 (0.0380)
Alternative funding use		0.0586 (0.0422)		0.0585 (0.0421)		0.0575 (0.0421)
Alternative financing demand		0.4892*** (0.0407)		0.4870*** (0.0406)		0.4861*** (0.0407)
Intercept	-2.2808*** (0.4513)	-1.6201*** (0.1541)	-1.7658*** (0.3698)	-1.6160*** (0.1539)	-1.2148*** (0.3304)	-1.6148*** (0.1537)
Time dummies	Yes [0.5711]	Yes [0.5711]	Yes [0.1151]	Yes [0.1151]	Yes [0.1130]	Yes [0.1130]
Initial conditions						
Rationing ₀ *	0.7208*** (0.2171)		0.5164*** (0.1405)		0.6482*** (0.1130)	
Loan demand ₀		0.4309*** (0.0420)		0.4290*** (0.0420)		0.4284*** (0.0420)
<i>Random effects</i>						
σ_α		0.5585*** (0.0765)		0.6143*** (0.0622)		0.6431*** (0.0542)
σ_η		0.4794*** (0.0240)		0.4774*** (0.0241)		0.4766*** (0.0241)
$\rho_{\alpha\eta}$		-0.0835 (0.2245)		-0.0689 (0.1575)		-0.0234 (0.1363)
<i>Idiosyncratic errors</i>						
$\rho_{\varepsilon\mu}$		-0.3234*** (0.0620)		-0.2497*** (0.0510)		-0.2800*** (0.0456)
<i>Total correlation (ρ_{tot})</i>		-0.2722		-0.2075		-0.2180
Number of observations		11393		11393		11393
Log-likelihood		-6746.76		-7252.04		-7696.34

Notes: the Table reports the coefficients of the dynamic Models d_c) using, alternatively, Rationing, Rationing 2 and Rationing 3 as indicators of financing constraints. The models are estimated on the subsample of firms with at least 4 observation over the waves 2014H1–2018H1. Standard errors are reported in parentheses.

Micro firms, Micro loan, Industry and Northern EU are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.

Table S10 – The dynamics of firm’s access to credit focusing on firms with at least three consecutive observations

	Model dyn_c)		Model dyn_c)		Model dyn_c)	
	Rationing	Credit demand	Rationing 2	Credit demand	Rationing 3	Credit demand
R_{t-1}^*	1.1907*** (0.2455)	-0.0882 (0.1349)	0.8291*** (0.1687)	-0.0357 (0.0952)	0.5855*** (0.1532)	0.0008 (0.0810)
D_{t-1}	-0.3984*** (0.1112)	0.4583*** (0.0458)	-0.2909*** (0.0924)	0.4575*** (0.0466)	-0.1331 (0.0914)	0.4527*** (0.0474)
Small	-0.3765** (0.1663)	0.0866 (0.0617)	-0.1252 (0.1401)	0.0865 (0.0618)	-0.0344 (0.1356)	0.0857 (0.0618)
Medium	-0.5961** (0.2372)	0.0871 (0.0802)	-0.0892 (0.1909)	0.0864 (0.0803)	-0.0036 (0.1791)	0.0855 (0.0803)
Large	-0.7094** (0.3259)	0.2046** (0.1026)	-0.0641 (0.2510)	0.2033** (0.1026)	0.0833 (0.2349)	0.2039** (0.1027)
Autonomous firm	-1.1008*** (0.3707)	0.2287 (0.2585)	-0.1979 (0.5625)	0.2328 (0.2592)	-0.1690 (0.4800)	0.2375 (0.2583)
Individual owner	0.1436 (0.5008)	0.3691* (0.1951)	0.5301 (0.4351)	0.3682* (0.1953)	0.4638 (0.4152)	0.3636* (0.1953)
Family managed	0.7649** (0.3793)	0.1258 (0.1681)	0.4725 (0.3596)	0.1257 (0.1681)	0.2450 (0.3530)	0.1264 (0.1687)
Young	-1.3880** (0.6813)	0.2309 (0.3408)	0.0194 (0.7157)	0.2472 (0.3430)	-0.0193 (0.7782)	0.2386 (0.3436)
Exporter	0.0257 (0.2559)	-0.0022 (0.0991)	0.1842 (0.2197)	-0.0026 (0.0993)	0.2466 (0.2121)	-0.0015 (0.0993)
Low turnover	0.2189 (0.4184)	-0.0158 (0.1678)	0.1273 (0.3500)	-0.0150 (0.1681)	0.0750 (0.3267)	-0.0201 (0.1681)
Turnover down	-0.0676 (0.1857)	-0.0065 (0.0724)	-0.0513 (0.1556)	-0.0100 (0.0724)	-0.0369 (0.1522)	-0.0092 (0.0725)
Turnover unchanged	0.1061 (0.1716)	-0.0609 (0.0614)	0.0724 (0.1356)	-0.0611 (0.0614)	0.0660 (0.1317)	-0.0610 (0.0614)
Public support down	0.3226 (0.2155)	0.0449 (0.0833)	0.1635 (0.1786)	0.0476 (0.0833)	0.4414** (0.1783)	0.0473 (0.0834)
Public support unchanged	0.0953 (0.1698)	-0.0281 (0.0579)	0.0124 (0.1304)	-0.0267 (0.0578)	0.1476 (0.1290)	-0.0270 (0.0578)
Credit history down	-0.0520 (0.2266)	0.1793* (0.1011)	0.4233** (0.1874)	0.1794* (0.1012)	0.4324** (0.1902)	0.1816* (0.1013)
Credit history unchanged	-0.1628 (0.1557)	-0.0182 (0.0572)	0.0190 (0.1301)	-0.0186 (0.0572)	0.0747 (0.1233)	-0.0190 (0.0572)
Fixed investment	-0.3774** (0.1651)	0.4401*** (0.0566)	-0.0588 (0.1303)	0.4398*** (0.0566)	-0.1753 (0.1236)	0.4405*** (0.0566)
New products investment	0.1777 (0.1789)	-0.1577** (0.0710)	-0.1446 (0.1535)	-0.1570** (0.0709)	-0.0228 (0.1477)	-0.1566** (0.0709)
Small loan	-0.2028 (0.3741)		-0.1271 (0.3045)		0.0668 (0.3247)	
Medium loan	-0.1230 (0.4119)		-0.0802 (0.3492)		0.3444 (0.3617)	
Medium-large loan	0.0450 (0.4511)		-0.1547 (0.3838)		0.2686 (0.3889)	
Large loan	0.0146 (0.5101)		-0.1123 (0.4511)		0.2581 (0.4436)	
Construction	0.2808 (0.1944)	-0.0401 (0.0805)	0.1502 (0.1658)	-0.0409 (0.0805)	0.1986 (0.1704)	-0.0421 (0.0805)
Trade	0.0495 (0.1530)	-0.0165 (0.0584)	0.0548 (0.1249)	-0.0171 (0.0584)	0.1426 (0.1221)	-0.0184 (0.0585)
Services	-0.0499 (0.1489)	-0.0804 (0.0546)	-0.0382 (0.1175)	-0.0807 (0.0545)	0.0678 (0.1149)	-0.0815 (0.0546)
Continental	-0.0891 (0.1537)	0.0438 (0.0589)	-0.2443* (0.1284)	0.0443 (0.0589)	-0.2606** (0.1250)	0.0442 (0.0589)
Mediterranean	-0.3150* (0.1608)	0.4162*** (0.0548)	-0.1194 (0.1250)	0.4175*** (0.0548)	-0.0167 (0.1192)	0.4168*** (0.0549)
Cooperative	0.0100** (0.0039)	-0.0003 (0.0014)	0.0013 (0.0028)	-0.0003 (0.0014)	-0.0012 (0.0028)	-0.0003 (0.0014)
HHI	2.0188** (0.8798)	-0.5860 (0.3594)	0.8884 (0.7552)	-0.5828 (0.3593)	0.7951 (0.7539)	-0.5893 (0.3593)
NPL	0.0103 (0.0077)	-0.0015 (0.0028)	-0.0039 (0.0063)	-0.0015 (0.0028)	-0.0001 (0.0061)	-0.0015 (0.0028)
Perceived growth obstacles		-0.0089 (0.0404)		-0.0090 (0.0404)		-0.0112 (0.0404)
Alternative funding use		0.0396 (0.0449)		0.0401 (0.0448)		0.0399 (0.0449)
Alternative financing demand		0.4620*** (0.0432)		0.4605*** (0.0432)		0.4591*** (0.0433)
Intercept	-2.8348*** (0.5244)	0.4867*** (0.1622)	-2.0230*** (0.4121)	-1.5321*** (0.1622)	-1.6241*** (0.3815)	-1.5296*** (0.1621)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes
Initial conditions						
Rationing ₀	0.9511*** (0.2470)		0.6984*** (0.1613)		0.7640*** (0.1407)	
Loan demand ₀		0.4867*** (0.0453)		0.4867*** (0.0453)		0.4871*** (0.0454)
<i>Random effects</i>						
σ_α		0.6843*** (0.0789)		0.7023*** (0.0634)		0.7906*** (0.0573)
σ_η		0.5054*** (0.0239)		0.5045*** (0.0239)		0.5048*** (0.0239)
$\rho_{\alpha\eta}$		0.0108 (0.1972)		0.0667 (0.1478)		0.0596 (0.1212)
<i>Idiosyncratic errors</i>						
$\rho_{\varepsilon\mu}$		-0.3470*** (0.0686)		-0.2434*** (0.0548)		-0.2767*** (0.0515)
<i>Total correlation (ρ_{tot})</i>		-0.4660		-0.3008		-0.3612
Number of observations		11041		11041		11041
Log-likelihood		-6544.12		-7033.24		-7464.85

Notes: the Table reports the coefficients of the dynamic Model *dyn_c*) using, alternatively, Rationing, Rationing 2 and Rationing 3 as indicators of financing constraints. The models are estimated on the subsample of firms with at least 3 consecutive observation over the waves 2014H1-2018H1. Standard errors are reported in parentheses.

Micro firms, *Micro loan*, *Industry* and *Northern EU* are used as base levels for the categorical variables of firm size, loan size, sector and geographic macro-area, respectively.

***, **, * denote significance at 1, 5 and 10% levels respectively.