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Credit rationing prevalence for Eurozone firms

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ABSTRACT

Using a comprehensive survey micro dataset compiled by the European Central Bank, we shed light on the anatomy of two crucial credit market outcomes, namely discouragement and credit rationing. In particular, we assess the empirical prevalence of these two phenomena over a decade and across Eurozone countries. Prevalence was measured by projecting discouragement and rejection rates on firm size and age, traits known to be correlated with these market outcomes, also allowing for country heterogeneity. Country heterogeneity is emphatic both for discouragement and rejection rates, while discouragement and rejection rates drop monotonically with firm size. Age exerts a more complicated effect, where it takes the form of an inverse U for rejection rates, while it takes a partially monotonic drop for discouragement and the combined credit rationing metric.

1. Introduction

Small and medium-sized enterprises (SMEs hereafter) exhibit a high reliance on bank credit when internal funds are scarce and/or due to a lack of alternatives as their overall traits prevents them from accessing external financing (e.g., Berger and Udell, 1998; Beck and Demirguc-Kunt, 2006; Berger and Frame 2007; Banerjee and Duflo, 2014; Moro et al., 2015 etc.). SMEs face difficulties obtaining external finance mainly due to their inherent informational opacity (e.g., Petersen and Rajan 1994; Berger et al., 2001; Berger and Udell, 2006; Guiso and Minetti, 2010 etc.). Within this context, the reduced ability to access credit may affect SMEs' investment opportunities (e.g., Cowling et al., 2012).

However, the limited use of external finance by SMEs might also be the result of firm behaviour as well. Actually, a sizeable portion of SMEs chooses not to apply for a bank loan, even if they need one. The relevant literature calls this group of firms discouraged borrowers,[1] formally defined as the firms who need bank credit but do not apply for it due to fear of rejection (Piga and Atzeni, 2007).[2] In particular, discouraged firms are self-rationed, which means that not accessing credit is not the decision of another party (supply) but a result of their choice (demand). The central argument is that the demand-side factors of discouraged borrowers make their financing behaviour considerably interesting in their own right, as it goes beyond the traditional rationing problem.

This strand of literature has received a disproportionately low attention, and only recent studies have explored the discouraged borrowers in credit dynamics (see, for example, among others, Chakravarty and Yilmazer, 2009; Popov and Udell, 2010; Popov and Ongena, 2011; Ferrando, and Mulier 2015). Nevertheless, the existing literature has documented that discouragement is at least twice as prevalent as loan rejection, making it at least equally important for SMEs (e.g., Levenson and Willard 2000; Freel et al., 2012). Hence, discouraged borrowers cannot be excluded from a generalised analysis of the determinants of availability of credit.[3]

The present analysis utilizes data from the Survey of Access to Finance of Enterprises, covering SMEs from Eurozone countries for the post-2009 period up until 2018 and for 19 waves. The SAFE database provides the largest available dataset in terms of country and time

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[1] "Discouraged Borrower", defined as a good firm, requiring finance, that chooses not to apply to the bank because it feels its application will be rejected. (Cavalluzzo *et.al.*, 2002; Kon and Storey, 2003).

[2] The term 'discouraged' has originally been used in the context of labor economics to describe agents who do not apply for jobs because they fear rejection (see Finegan, 1981), and later employed by the consumer credit literature (see Jappelli, 1990).

[3] This according to Jappelli (1990) could lead to biased estimates of the probability of borrowers being credit constrained. Indeed, discouraged borrowers are mainly unobservable, as they do not officially apply for a loan, they do not face a direct loan refusal, thus they should not be counted as rejected applicants.

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coverage. Thus, it offers the opportunity to empirically document, based on a large and quality dataset, the prevalence of credit rationing. This is exactly the aim of the present study, to assess the prevalence of credit rationing by paying particular attention to its constituents, rejected loan applicants and discouraged potential borrowers. In other words, whereas traditional studies of credit rationing only distinguish between the characteristics of rejected and non-rejected borrowers, we distinguish even further between rejected and discouraged borrowers. This allows us to draw an anatomy of SMEs predicting the probability of being discouraged, extending the knowledge on discouraged borrowers in loan dynamics (e.g., Hashi and Toci, 2010; Gama et al., 2017; Anastasiou et al., 2022, etc.).

Note that we are not interested in investigating the credit rationing determinants since the extant empirical literature has adequately identified them almost beyond any doubt. In addition, instead of simply calculating the empirical probabilities of rationing based on raw data, we will extract these probabilities by mapping them on the two most prominent firm characteristics, age and size. Among the several firm characteristics which may act as credit rationing predictors or even just correlates, firm age and size emerge as the strongest and most reliable ones across all previous studies. In this line, the use of these tow fundamental firm characteristics allows us to explore how rationing prevalence is distributed across selected sample sub-groups justifying the term anatomy of SMEs.

Our main findings suggest that the frequency of discouraged firms cannot be ignored in the credit market outcomes literature, since smaller and younger firms are found to be systematically discouraged from applying for a loan. We also explore country effects and find that there are systematic differences among countries reflecting the special macroeconomic conditions of individual countries.

This paper contributes to the literature in the following ways. First, to the best of our knowledge, this paper provides a holistic view of directly observed frictions in the credit market by studying at the same time the credit rationing effect via loan applications and borrower discouragement. Indeed, by using such a rich sample in terms of country and time coverage of a unique confidential survey-based dataset of the European Central Bank, firms are classified as financially constrained when their loan application is either rejected or when they are discouraged (Bircan and De Haas, 2020). In this line, we show that Kon and Storey's (2003) approach can indeed explain the prevalence of discouragement. Secondly, this paper provides an eagle's view of the distribution of SMEs by exploring the differences in credit rationing patterns making the distinction of rejected/ discouraged borrowers relative to their characteristics (age, size) more concrete. Finally, following Ferrando, and Mulier (2015), the substantial cross-country differences in rejected/discouraged borrowers and the varying approval standards might signal a weak coherence of the banking sector in the euro area.

The rest of the paper is organized as follows. Section 2 summarizes the data and variables. Section 3 discusses the empirical strategy along with the empirical evidence. Finally, Section 4 concludes.

2. Brief literature review

The traditional research on SMEs finance has concentrated much of its attention on firms that apply for funding and, specifically, on the problem of credit rationing (e.g., Stiglitz and Weiss, 1981; Greenwald et al., 1984; Chan and Kanatas, 1985; Rajan, 1992; Kiyotaki and Moore, 1997; Bloom et al., 2007; etc.). Indeed, the modern analysis of credit markets from the perspective of imperfect information theory dates from Jaffee and Russell (1976), which explains how unobserved differences in borrower quality can induce credit rationing. Empirical research has shown that a significant portion of firms cannot access bank loans for reasons unrelated to their quality. This is central to the original work of Stiglitz and Weiss (1981) who exploited informational asymmetries to motivate a form of credit rationing where the market denies funds to borrowers with characteristics identical to those receiving loans as a protective mechanism against asymmetric information. In particular, they show that banks are seriously concerned about the interest rate they receive when they grant a loan, and of course, the riskiness of the loan. However, the interest rate a bank charges may itself affect the riskiness of the pool of loans by either adversely sorting potential borrowers (adverse selection effect) or by affecting the actions of borrowers (incentive effect or moral hazard). Both effects are derived directly from the residual imperfect information, which is present in loan markets after banks have evaluated loan applications. As a result of such a credit rationing situation, some positive NPV projects are not undertaken in the resulting bank loan market 'equilibrium'. According to Calabrese et. al., (2021), such rationing usually takes the following possible forms, either firms are partially satisfied, either they are entirely denied a loan, or the cost is too high, and they fail to get a loan. This is a supply-side measure of credit constraints. Although banks have introduced stricter screening processes and techniques to evaluate loan applicants, several SMEs continue to face financial constraints (Artola and Genre, 2011).

However, this type of rationing stemming from imperfect information only applies to potential borrowers who are actually loan applicants. In order to obtain unbiased estimates of the borrower-lender relationship, it is necessary to model not only those who place an application, but also those who decide not to submit a loan application, even when they need external bank lending. This group of firms corresponds to the discouraged potential bank borrowers. Indeed, there is an emerging literature on demand-side constraints on access to finance among SMEs that goes beyond the *a la* Stiglitz and Weiss (1981) credit rationing definition. By discouraged borrowers, we mean firms who would have applied for credit but did not because they thought their applications would be rejected (Cavalluzzo et al., 2002; Kon and Storey, 2003). This is, in principle, a demand-side measure of credit constraints (Calabrese et.al., 2021). Building on the general credit rationing theories, Kon and Storey (2003) argue that the level of discouragement is based on three main factors; the application costs, the bank's screening error, and the interest rate difference between banks and other money lenders. Prior empirical evidence suggests that discouragement is quite common among potential borrowers[4] (Freel et al., 2012; Ferrando et al., 2015, 2017; Popov, 2016; Macan Bhaird et al., 2016; Rostamkalaei et al., 2020; Qi and Nguyen, 2021 etc.). Hence, discouraged borrowers should not be omitted when one attempts to measure credit rationing, since their omission would underestimate the credit rationing phenomenon (Freel et al., 2012). Another strand of the literature has attempted to shed light on whether discouraged borrowers correctly or erroneously perceive the likelihood of their rejection (Diagne, 1999; Vermoesen et al., 2013).

However, hesitancy to apply for bank debt by firms with good credit history and prospects leads to sub-optimal investment strategy. This widespread phenomenon has attracted the interest of academics and policymakers as the reported discouraged borrowers have already outnumbered the typical Type I rationed ones (e.g., Levenson and Willard, 2000; Freel et al., 2012; Cole and Sokolyk, 2016 etc.). On top of that, though, the self-rationed approach establishes an actual market imperfection that creates economic implications that might undermine SMEs' viability leading to a market failure.

3. Data description

This study employs data from the **Survey of Access to Finance of Enterprises** (SAFE), a firm-level confidential survey launched in the second half of 2009 and conducted by the European Commission and the

[4] According to Brown et al., 2022, in most developed economies, borrower discouragement affects between 10 and 20% of SMEs in most developed economies, while Calabrese et al., (2021) find that 6.5% of SMEs from a number of EU countries are discouraged borrowers.

European Central Bank twice a year. The SAFE survey[5] contains information on the characteristics (size, sector, turnover, age, and ownership) of the respondent firm and on the firm's assessment of recent short-term developments associated with its financing, including its funding needs and access to finance. The SAFE survey allows the sample to be stratified by firm-size class, economic activity, and country. In particular, we use nineteen (19) waves that correspond to the period 2009H2-2018H2, covering the Eurozone countries. The pooled data give us a sample with a total of 122,134 firm-wave observations within the Eurozone that are considered relatively homogeneous.[6] Financial market integration, common monetary policy and the risk premium merely stemming from currency risk are all well considered when dealing with a homogeneous sample that avoids unnecessary noise coming from non-fully comparable countries.

Two survey questions provide crucial information for our analysis. Our starting point is the following survey question, which in the SAFE questionnaire is posed as follows (Q7A in survey questionnaire):

Participants are given a choice between five possible answers: "1, Applied", "2, Did not apply because of possible rejection", "3, Did not apply because of sufficient internal funds", "4, Did not apply for other reasons", and "5, Do not know/Not answered".

We also use answers to the following survey question (Q7B in the SAFE questionnaire):

Participants are given a choice between seven possible answers: "1, Received everything", "2, Received most of it [Between 75 % and 99 %]", "3, Only received a limited part of it [Between 1 % and 74 %]", "4, Refused because the cost was too high", "5, was rejected", "6, Application is still pending", and "7, Do not know/ Not answered".

In order to observe the salient feature of discouragement, we need to set as a condition the firm's hesitance to place an application due to fear of the possible negative outcome. This will determine the estimation technique to be deployed. From Q7A and Q7B we can classify a firm as needing or not needing a loan.

Let N_i be an indicator showing whether the i-th firm needs or not a bank loan attaining the following values (excluding those firms who answered DK/NA):

$$N_i = \begin{cases} 1 \textit{Iffirmirepliedthatdidn}' \textit{tapplyduetosufficientfunds} \\ 0 \textit{otherwise} \end{cases} \quad (1)$$

By combining the answers from the above questions of the SAFE survey, we are in a position to empirically match the three nodes of the credit application sequence by classifying firms according to the following rules:

- **Discouraged** (based on Q7A of the questionnaire): Firm needs a bank loan but did not apply due to fear of possible rejection[7]
- **Rejected** (based on Q7A and Q7B of the questionnaire): Firm needs a bank loan and is not self-rationed, but bank rejected firm's loan application

Based on these definitions, we construct the following dichotomous indicators, where the first one indicates whether the *i-th firm was granted a loan* attaining the following values (excluding those firms who answered DK/NA):

$$R_i = \begin{cases} 1 \text{ if firm needs credit and applied, but the application was rejected by the bank} \\ 0 \textit{otherwise} \end{cases} \quad (2)$$

Then we define D_i as a dichotomous indicator that classifies the *i-th* firm as discouraged or not as follows:

$$D_i = \begin{cases} 1 \text{ if firm needs credit, but did not apply because of fear of rejection} \\ 0 \textit{otherwise} \end{cases} \quad (3)$$

The summary statistics per country and wave are reported in Tables A1 and A2 in the appendix involving both the discouraged and rejected loan applications. We observe that across the Eurozone countries, several countries have a high rate of decline in loan acceptance and a high rate of self-rationing behaviour. Surprisingly the Netherlands[8] presents the highest rate of loan refusals followed by Estonia and Lithuania. Luxembourg is the country with the lowest rate of loan refusals.

We also find that the percentage of discouraged SMEs closely follows rejected applicants. This is evidence that a significant portion of self-rated firms cannot be omitted from the analysis of firms' financing. In particular, in the case of Greece, there is a higher fraction of discouraged SMEs compared to the rejected ones. The same pattern is revealed during the Eurozone's sovereign debt crisis, especially between waves 6 to 12. This is reasonable given that high uncertainty surrounded the economic environment during this period, thus making the lending market and borrowers' prospects for acceptance even weaker.

The absence of significant information on the level of indebtedness of respondents, which would reflect their past borrowing history, means that the interpretation of responses should be treated very cautiously. The profile of the borrowers or balance sheet information is not available in the SAFE survey, so any attempt to distinguish between applicants becomes impossible. In addition, detailed information regarding the terms of the loan (supply side) is not accessible. However, the survey provides qualitative data of the SMEs that can be used as proxy variables

[5] For a methodological guidance please see the latest user guide by ECB: https://www.ecb.europa.eu/stats/pdf/surveys/sme/methodological_information_survey_and_user_guide.pdf.

[6] Having the luxury of a rather big sample of firm-wave observations, we decided to exclude the non-Eurozone member states from our sample in order to assure a more homogeneous group of countries, in terms of institutional factors and economic status. For more detailed arguments see Bris et al. (2009).

[7] We do acknowledge the somehow narrow definition of borrower discouragement in the SAFE survey relative to other databases allowing for a broader measure of borrower discouragement (e.g., Brown et al., 2022). However, the way the SAFE survey is constructed does not permit us further flexibility in this.

[8] "Dutch SMEs are applying for relatively few bank loans, and that those applications are relatively often rejected by the banks. This applies to all businesses but more so to SMEs. The 2009–2018 period shows a steady trend, although in recent years the difference with the eurozone average number of applications has grown, while for the number of rejections the difference has decreased. The relatively high interest rates at Dutch banks may be an indication of market power, and the banks are also providing comparatively large numbers of loans for the housing market. It is a rather attractive market, because of the fiscal subsidies on homeownership in combination with the strong level of protection for banks in cases of defaults on loans." (Dutch SME bank financing, from a European perspective, CPB Policy Brief, Karen van der Wiel, Andrei Dubovik and Fien van Solinge, July 2019).

addressing risk characteristics for both the supply and demand side, controlling for variations in the investment opportunity set (Hubbard, 1998). This opportunity set is highly correlated to appropriate proxies that capture aspects of information flows and transparency, which can affect the cost of capital. In an attempt then to compensate for the absence of user cost of capital, we control for age and size, which are thought to be aspects of a firm's profile expected to be related to the user cost of capital (e.g., Oliner and Rudebusch, 1992; Schaller, 1993; Carpenter and Rondi, 2000; Degryse and Ongena, 2005; Hadlock and Pierce 2010, Chakravarty and Xiang, 2013; Öztürk and Mrkaic, 2014; Liberti and Petersen, 2018; Ferrando and Ruggieri, 2018; Kallandranis et.al., 2020, Bongini et al., 2021 etc.). Indeed, according to the models of Jaffee and Russell (1976) and Petersen and Rajan (1995) smaller and younger firms are expected to be more credit rationed. Overall, in this study firm size and age are treated as proxies for risk (on the supply side) and need (on the demand side). This is considered a standardized approach in the relevant literature to analyze firms' anatomy.

In particular, longevity may imply an intrinsic survival ability of the firm, which would indicate quality and therefore reduce asymmetric information. Also, the ability to assess the credit quality of relatively young firms is diminished given the lack of sufficiently long record, that would inevitably lead potential lenders to require a premium or even refuse credit (e.g., Carpenter and Rondi, 2000; Berger et al., 2001; Hyytinen and Pajarinen, 2007; Serrasqueiro and Nunes, 2011; Xiang et al., 2015; Bongini et al., 2021 etc.). Hence, older firms are more likely to be successful when applying for a loan (e.g., Berger and Udell, 1995; Petersen and Rajan, 1994). For the same reason they are also less likely to be discouraged borrowers. Indeed, the results for firm characteristic variables are generally consistent in direction and significance across the studies, including the parameter of age as a determinant of discouragement. In particular, the literature (e.g., Freel et al., 2012; Artola and Genre, 2011; Chakravarty and Xiang, 2013; Mac an Bhaird et al., 2016; Cowling et al., 2012; Moro *et. al.,* 2020; Anastasiou et al., 2022 etc.) finds that discouraged borrowers are generally younger, something that is compatible with informational theories of credit rationing.

On the other hand, several theoretical and empirical studies have used size as an alternative attribute that may have a potentially significant impact on investment decisions in the presence of asymmetric information. Usually, larger firms are considered lower-risk borrowers since they have more credible mechanisms to convey creditworthy information to lenders relative to smaller firms. The importance of size was firstly reported by Gertler (1988), who argued that information-based financial constraints are more likely to have a more significant impact on small firms than large firms, partly because large firms tend to be more "mature" and have more established relations with providers of finance. The mainstream of the credit rationing literature supports the hypothesis that smaller firms tend to be disadvantaged relative to the larger ones, in terms of access to capital, with smaller-sized firms being also more likely to be discouraged from applying for a loan (e.g., Carpenter and Rondi, 2000; Audretsch and Elston, 2002; Drakos and Kallandranis, 2005; Garcia-Teruel and Martinez-Solano, 2007; Psillaki and Daskalakis, 2009; Hashi and Toci, 2010; Drakos and Giannakopoulos, 2011; Freel et al., 2012; Chakravarty and Xiang, 2013; Farinha and Felix, 2015; Rostamkalaei et al., 2020; Bongini et al., 2021; Ferrando and Mulier, 2022, etc.).

Based on the SAFE classification system, we capture age and size by appropriate sets of dummy variables whose detailed definitions are provided in Tab. A3.

4. Methodology and results

4.1. Methodology

The key dependent variables used in the analysis are binary and measure whether SMEs in the sample needed finance in the last six months but did not apply due to fear of their application is turned down (discouraged borrower) or applied and got rejected. Hence, we estimate a Probit model, which assumes that the observed Bernoulli "success" or "failure" results from an underlying but not directly observable, normally distributed random variable. Denote the underlying, unobservable or latent random variable by L and suppose that L is associated with a vector of predictor variables $\times$ according to the linear specification as follows:

Table 1
Credit Outcomes per age and size class.

	Rejected	Discouraged	Both
MICRO	15.29 %	9.70 %	13.04 %
SMALL	9.06 %	6.08 %	8.80 %
MEDIUM	5.90 %	3.68 %	5.78 %
LARGE	3.02 %	2.47 %	3.71 %
<2 years of age	14.70 %	6.10 %	10.35 %
Between 2 and 5 years of age	17.80 %	9.26 %	13.68 %
Between 5 and 10 years of age	12.90 %	7.97 %	11.44 %
>10 years of age	7.80 %	5.97 %	8.35 %

$$L_{i,t}^{*} = \boldsymbol{x}_{i,t}^{'}\beta + c_i + e_{i,t} \tag{4}$$

where c_i is the unobserved heterogeneity and $e_{i,t}|\boldsymbol{x}\ N(0,1)$. The vector of covariates $\mathbf{x}_{i,t}$ is assumed for the time being to include firm-specific characteristics, while β denotes a vector of constant parameters.

We start by examining only the role of the time trend in the explanation of self-rationed and rejected firms by estimating the following econometric specification, accounting also for country and year fixed effects:

$$Pr\left(Y_{i,t}^{j}=1\right) = \boldsymbol{\theta}_0 + \boldsymbol{\theta}_1 TREND_t + \varepsilon_{i,t} \tag{5}$$

where j = D, R or both.

The linear time trend will offer information regarding the time trajectory of the phenomena under scrutiny.[9]

Then, we proceed with the estimation of our full model specification, in which we also include additional determinants. In particular, the vector of covariates is based on independent variables which are expected to contribute to explaining the intensity of rejection and/or discouragement as follows:

(i) **Size** which consists of Micro, Small, Medium and Large companies *(SIZE)*,
(ii) **Age** which varies from less than two years of age to>10 years *(AGE)*
(iii) **Trend** which is a linear time trend increasing with the sequence of waves

The following model[10] is thus employed, accounting also for country and year fixed effects:

$$Pr\left(Y_{i,t}^{j}=1\right) = \boldsymbol{\gamma}_0 + \boldsymbol{\gamma}_1 AGE_{i,t} + \boldsymbol{\gamma}_2 SIZE_{i,t} + \boldsymbol{\gamma}_3 TREND_t + \varepsilon_{i,t} \tag{6}$$

where j = D, R or both.

The variables introduced in the estimation reflect the individual influences on credit approval as well as the potential arguments of the credit constraints. The SAFE survey allows us to partition our sample by classifying firms ranging between firms facing a higher likelihood of

[9] In particular, the significance and sign of the trend's coefficient reveals whether there is any discernible pattern (upward or downward or flat) with respect to the time trajectory of the dependent variable.

[10] The model presented in equation (6) is our main model. However, we also provide estimation results for nested variations that capture either individual characteristics (country, or age, or size), or a pair of characteristics (country and age, country and size). These nested models are provided in order to show the effects of these characteristics.

Table 2
Probit Model only with Time trend[a, b, c].

	Rejected	Discouraged	Combined Sample
trend	−0.030***(0.001)	−0.001(0.001)	−0.008***(0.000)
Diagnostics			
R-squared	0.013	0.000	0.001
Observations	36,283	122,134	122,134
LR	298.650(0.000)	1.640(0.200)	79.250(0.000)

Notes: (a) numbers denote estimated Marginal Effects, (b) numbers in parentheses denote robust standard errors, (c) ***, **, * denote statistical significance at the 1, 5 and 10 percent level respectively.

being financially constrained and firms with a lower probability of being financially constrained who would, in essence, act as a control group (see Tab. A3). This fully justifies our approach to analyzing the anatomy of SMEs relative to the prevalence of rationing. Besides, country-specific effects may influence borrowing and lending beyond the characteristics of firms. Following previous literature (e.g., Rajan and Zingales 1995, Beattie et al., 2006) we aim to provide evidence that there are also significant country effects that can be responsible for the main differences in the determinants of finance seeking. Our main priors are that the probability of being rationed or discouraged is a decreasing function of both the categorical variables of age and size.

4.2. Credit market outcomes prevalence

In Table 1, we assess the prevalence of the possible outcomes by distinguishing rejected and discouraged borrowers from the full sample categorizing SMEs according to size and age, which are crucial firm characteristics for credit market outcomes. Discouragement rate exhibits a clear inverse relationship with SMEs size, calculated at 9.70 % for Micro firms, dropping to 6.08 % for Small firms, and being as low as 3.68 % and 2.47 % for Medium and Large firms, respectively. An analogous pattern is documented for rejection rates, which is 15.29 % for Micro firms, 9.06 % for Small firms, falling to 5.9 % and 3.03 % for Medium and Large firms. The same pattern is revealed when both outcomes are combined. Looking at age classes, we encounter an inverse-U pattern. In particular, discouragement for the youngest firms (age<2 years) is 6.10 %, reaching its maximum level at 9.26 % for firms in the 2 to 5 years age class, and then falling to 7.97 % and 5.97 % for firms in the 5 to 10 years of age and>10 years of age respectively. The humped relationship is also present in rejection rates, being at 14.7 % for firms<2 years old, increasing to 17.8 % for firms between 2 and 5 years of age, and then dropping to 12.9 % and 7.8 % for firms between 5 and 10 years of age and>10 years of age respectively. The all-in-one relationship when both outcomes are encountered follows the same route.

Table 3
Probit Model for rejected SMEs[a, b, c].

	Country	Size	Age	Size & Country	Age & Country	Size & Age & Country
Micro	–	0.168***(0.010)	–	0.157***(0.009)	–	0.146***(0.009)
Small	–	0.089***(0.007)	–	0.083***(0.007)	–	0.080***(0.007)
Medium	–	0.048***(0.007)	–	0.045***(0.007)	–	0.044***(0.009)
Large	–	–	–	–	–	–
<2 years	–	–	0.056***(0.015)	–	0.069***(0.015)	0.030**(0.012)
Between 2 and 5 years	–	–	0.086***(0.009)	–	0.085***(0.009)	0.052***(0.008)
Between 5 and 10 years	–	–	0.046***(0.005)	–	0.043***(0.005)	0.022***(0.004)
>10 years	–	–	–	–	–	–
Austria	−0.059***(0.003)	–	–	−0.055***(0.003)	−0.059***(0.003)	−0.055***(0.003)
Belgium	−0.032***(0.004)	–	–	−0.037***(0.004)	−0.033***(0.004)	−0.038***(0.004)
Cyprus	0.036(0.025)	–	–	0.030(0.024)	0.034(0.025)	0.029 (0.024)
Estonia	0.039(0.034)	–	–	0.039(0.033)	0.037(0.034)	0.039(0.033)
Finland	−0.033***(0.006)	–	–	−0.032***(0.005)	−0.033***(0.005)	−0.032***(0.005)
France	−0.023***(0.004)	–	–	−0.021***(0.003)	−0.025***(0.003)	−0.023***(0.003)
Germany	−0.052***(0.003)	–	–	−0.045***(0.003)	−0.052***(0.003)	−0.045***(0.003)
Greece	0.076***(0.009)	–	–	0.063***(0.008)	0.076***(0.009)	0.063***(0.008)
Ireland	0.045***(0.010)	–	–	0.036***(0.009)	0.045***(0.010)	0.036***(0.009)
Italy	−0.012**(0.004)	–	–	−0.014***(0.003)	−0.013**(0.004)	−0.015***(0.003)
Latvia	0.001(0.034)	–	–	0.008(0.022)	−0.003(0.020)	0.004(0.021)
Lithuania	0.056**(0.018)	–	–	0.068***(0.019)	0.045**(0.017)	0.059**(0.018)
Luxembourg	−0.062***(0.010)	–	–	−0.058***(0.009)	−0.063***(0.009)	−0.059***(0.008)
Malta	−0.047**(0.014)	–	–	−0.045**(0.013)	−0.046**(0.014)	−0.044**(0.013)
Netherlands	0.088***(0.011)	–	–	0.008***(0.011)	0.083***(0.011)	0.080***(0.011)
Portugal	−0.008(0.006)	–	–	−0.007(0.006)	−0,008(0.006)	−0.008(0.006)
Slovak Rep	−0.012(0.010)	–	–	−0.007(0.010)	−0.016(0.009)	−0.010(0.009)
Slovenia	0.0003(0.014)	–	–	0.006(0.014)	−0.0007(0.014)	0.005(0.014)
Spain	–	–	–	–	–	–
trend	−0.004***(0.000)	−0.004***(0.000)	−0.004***(0.000)	−0.004***(0.000)	−0.004***(0.000)	−0.004***(0.000)
Diagnostics						
R-squared	0.047	0.049	0.022	0.079	0.056	0.082
Observations	36,283	36,283	36,283	36,283	36,283	36,283
Predicted Probability	0.079	0.078	0.096	0.079	0.077	0.072
Wald p-value	0.000	0.000	0.000	0.000	0.000	0.000
Hypotheses Testing [p-value]						
Zero size effects◆	–	724.700(0.000)	–	669.990(0.000)	–	554.160(0.000)
Zero age effects◆	–	–	199.980(0.000)	–	207.970(0.000)	79.410(0.000)
Zero country effects◆	707.070(0.000)	–	–	651.040(0.000)	714.470(0.000)	656.800(0.000)
Micro = Small	–	0.323***(0.023)	–	0.316***(0.023)	–	0.288***(0.023)
Small = Medium	–	0.224***(0.025)	–	0.222***(0.025)	–	0.208***(0.025)
Start-up = Relatively new	–	–	−0.133*(0.084)	–	−0.076(0.078)	−0.117(0.078)
Relatively new = Middle age	–	–	0.169***(0.000)	–	0.186***(0.048)	0.162***(0.047)

Notes: (a) numbers denote estimated Marginal Effects, (b) numbers in parentheses denote robust standard errors, (c) ***, **, * denote statistical significance at the 1, 5 and 10 percent level respectively. ◆ $\mathbf{x^2}$**-** statistic. The tests of attribute pairs are linear combinations of estimators.

Table 4
Probit Model for discouraged SMEs[a, b, c.]

	Country	Size	Age	Size & Country	Age & Country	Size & Age & Country
Micro	–	0.094*** (0.004)	–	0.079*** (0.004)	–	0.076*** (0.004)
Small	–	0.055*** (0.004)	–	0.047*** (0.003)	–	0.046*** (0.003)
Medium	–	0.022*** (0.003)	–	0.018*** (0.003)	–	0.018*** (0.003)
Large	–	–	–	–	–	–
<2 years	–	–	0.001(0.005)	–	0.008(0.006)	−0.006(0.004)
Between 2 and 5 years	–	–	0.034*** (0.003)	–	0.036*** (0.003)	0.019*** (0.003)
Between 5 and 10 years	–	–	0.020*** (0.002)	–	0.020*** (0.002)	0.009*** (0.002)
>10 years	–	–	–	–	–	–
Austria	−0.027*** (0.002)	–	–	−0.025*** (0.002)	−0.027*** (0.002)	−0.025*** (0.002)
Belgium	−0.012*** (0.002)	–	–	−0.015*** (0.002)	−0.013*** (0.002)	−0.015*** (0.002)
Cyprus	0.059*** (0.013)	–	–	0.057*** (0.012)	0.060*** (0.013)	0.057*** (0.012)
Estonia	−0.002(0.010)	–	–	−0.001(0.010)	0.004(0.010)	−0.002 (0.010)
Finland	−0.041*** (0.002)	–	–	−0.039*** (0.001)	−0.041*** (0.002)	−0.039*** (0.001)
France	−0.009*** (0.002)	–	–	−0.007*** (0.002)	−0.010*** (0.002)	−0.007*** (0.002)
Germany	−0.016*** (0.002)	–	–	−0.011*** (0.002)	−0.016*** (0.002)	−0.011*** (0.002)
Greece	0.133*** (0.005)	–	–	0.115*** (0.005)	0.132*** (0.005)	0.115*** (0.005)
Ireland	0.055*** (0.004)	–	–	0.052*** (0.004)	0.056*** (0.004)	0.053*** (0.004)
Italy	−0.004* (0.002)	–	–	−0.006** (0.002)	−0.005** (0.002)	−0.006** (0.002)
Latvia	0.004 (0.008)	–	–	0.008 (0.009)	0.001 (0.008)	0.006 (0.008)
Lithuania	0.0009 (0.007)	–	–	0.007 (0.007)	−0.002 (0.006)	0.005 (0.007)
Luxembourg	−0.034*** (0.006)	–	–	−0.032*** (0.006)	−0.034*** (0.006)	−0.032** (0.006)
Malta	−0.033*** (0.006)	–	–	−0.031*** (0.006)	−0.033** (0.006)	−0.031*** (0.006)
Netherlands	0.029*** (0.004)	–	–	0.029*** (0.004)	0.027*** (0.004)	0.028*** (0.004)
Portugal	0.004 (0.003)	–	–	0.003 (0.003)	0.004 (0.003)	0.002 (0.003)
Slovak Rep	−0.014*** (0.004)	–	–	−0.012** (0.004)	−0.016*** (0.004)	−0.012** (0.004)
Slovenia	0.005 (0.007)	–	–	0.008 (0.007)	0.004 (0.007)	0.008 (0.007)
Spain	–	–	–	–	–	–
trend	−0.0004** (0.0001)	−0.0002* (0.0001)	−0.0002 (0.0001)	−0.0004*** (0.0001)	−0.0002* (0.0001)	−0.0003** (0.0001)
Diagnostics						
R-squared	0.043	0.025	0.0029	0.063	0.046	0.064
Observations	122,134	122,134	122,134	122,134	122,134	122,134
Predicted Probability	0.057	0.058	0.063	0.053	0.056	0.143
Wald p-value	0.000	0.000	0.000	0.000	0.000	0.000
Hypotheses Testing [p-value]						
Zero size effects◆	–	1387.840 (0.000)	–	1114.680 (0.000)	–	999.010 (0.000)
Zero age effects◆	–	–	169.970 (0.000)	–	197.05 (0.000)	66.660 (0.000)
Zero country effects◆	2564.060 (0.000)	–	–	2240.200 (0.000)	2591.69 (0.000)	2257.750 (0.000)
Micro = Small	–	0.249*** (0.013)	–	0.227*** (0.013)	–	0.217*** (0.013)
Small = Medium	–	0.241*** (0.016)	–	0.225*** (0.016)	–	0.218*** (0.016)
Start-up = Relatively new	–	–	−0.221*** (0.051)	–	−0.196*** (0.052)	−0.223*** (0.052)
Relatively new = Middle age	–	–	0.082** (0.026)	–	0.098*** (0.027)	0.076** (0.027)

Notes: (a) numbers denote estimated Marginal Effects, (b) numbers in parentheses denote robust standard errors, (c) ***, **, * denote statistical significance at the 1, 5 and 10 percent level respectively. ◆ **x^2-** statistic. The tests of attribute pairs are linear combinations of estimators.

4.3. Discussion of Results: Estimating Trend, size and age effects

Estimated coefficients and marginal probabilities from the logistic regressions are presented in this section. Starting with the results reported in Table 2, we observe that the time trend exerts a negative impact on each type of credit outcome, thus, are both declining over time. However, a significant impact is encountered only for the rejected applicants and the combined sample, while the effect is insignificant for discouragement. Hence, these findings suggest that rejection rates on average follow a negative trend and therefore are becoming lower. In contrast, the discouragement rate does not show any discernible pattern across time.

Next, we turn our attention to the discussion of the estimation results regarding size and age. A vector of firm characteristic variables is included in all regressions, along with country dummies and a linear time trend. We employ-six different Probit specifications, belonging to two groups. The first group of models considers country, size and age effects in isolation in order to explore their stand-alone abilities to explain observed discouragement and rejection prevalence. The second group, which is the focus of our main analysis, considers two pairs of joint effects (i.e. country and size; country and age) and an extended model where all three effects are allowed.

Table 3 reports the estimated Marginal Effects for each of the specifications mentioned above for SMEs who are in need, applied and rejected. In particular, Table 3 presents the results of the effects of SMEs' characteristics on the main reported reasons for borrower rejection, where the base category is the upper bound categorical variable of firm factors.

We see that the model, including country effects only is able to explain about 4.7 % of the observed variation, the model including only size effects explains about 4.9 %, while the model with age effects has negligible explanatory power. The hypotheses tests show strong evidence against the zero effect on the probability of rejecting individual attributes and country. Moreover, the data strongly reject the hypothesis that there is no country effect on the credit outcome, and country effects remain significant even in the presence of firm-specific characteristics.

Allowing both for country and size effects, the explanatory power increases to almost 8 %, which is roughly the sum of their individual explanatory powers, suggesting that size effects are orthogonal to country effects, while for the pair age-country increases to 5.6 %.

We now turn our attention to our main model that includes all three sources of variation (country, size, age), a specification that has 8.2 % explanatory power. The firm characteristics which were significant in the previous regressions remain significant in this specification. For example, micro firms are associated with a higher probability of being denied credit, potentially because they are more opaque and/or because of lower collateral availability (e.g., Audretsch and Elston 2002; Berger and Udell, 1998, 2006 etc.). In particular, using large firms as the reference group, the rejection likelihood is 14.6 percentage points (pp. hereafter) higher for Micro firms, while for Small firms it is 8.0 pp.

Table 5
Probit model for SMEs rejected or discouraged[a, b, c].

	Country	Size	Age	Size & Country	Age & Country	Size & Age & Country
Micro	–	0.119*** (0.004)	–	0.103*** (0.004)	–	0.098*** (0.004)
Small	–	0.074*** (0.004)	–	0.065*** (0.004)	–	0.063*** (0.004)
Medium	–	0.034*** (0.004)	–	0.030*** (0.004)	–	0.030*** (0.004)
Large	–	–	–	–	–	–
<2 years	–	–	0.018** (0.007)	–	0.027*** (0.007)	0.007 (0.006)
Between 2 and 5 years	–	–	0.051*** (0.004)	–	0.053*** (0.004)	0.033*** (0.004)
Between 5 and 10 years	–	–	0.030*** (0.002)	–	0.030*** (0.002)	0.016*** (0.002)
>10 years	–	–	–	–	–	–
Austria	−0.050*** (0.002)	–	–	−0.048*** (0.002)	−0.050*** (0.002)	−0.048*** (0.002)
Belgium	−0.025*** (0.003)	–	–	−0.028*** (0.002)	−0.026*** (0.003)	−0.028*** (0.002)
Cyprus	0.054*** (0.013)	–	–	0.052*** (0.013)	0.055*** (0.013)	0.052*** (0.013)
Estonia	−0.010 (0.011)	–	–	−0.009 (0.011)	−0.013 (0.011)	−0.011 (0.011)
Finland	−0.058*** (0.002)	–	–	−0.056*** (0.002)	−0.057*** (0.002)	−0.056*** (0.002)
France	−0.017*** (0.002)	–	–	−0.015*** (0.002)	−0.019*** (0.002)	−0.016*** (0.002)
Germany	−0.038*** (0.002)	–	–	−0.032*** (0.002)	−0.038*** (0.002)	−0.033*** (0.002)
Greece	0.143*** (0.006)	–	–	0.125*** (0.005)	0.142*** (0.006)	0.125*** (0.005)
Ireland	0.047*** (0.005)	–	–	0.044*** (0.004)	0.048*** (0.005)	0.045*** (0.004)
Italy	−0.007** (0.002)	–	–	−0.009*** (0.002)	−0.008** (0.002)	−0.010*** (0.002)
Latvia	−0.010 (0.009)	–	–	−0.006 (0.009)	−0.014* (0.008)	−0.009 (0.009)
Lithuania	0.013 (0.008)	–	–	0.021** (0.009)	0.007 (0.008)	0.017* (0.008)
Luxembourg	−0.058*** (0.006)	–	–	−0.055*** (0.006)	−0.058*** (0.006)	−0.056*** (0.006)
Malta	−0.053*** (0.007)	–	–	−0.051*** (0.006)	−0.052*** (0.007)	−0.051*** (0.006)
Netherlands	0.028*** (0.004)	–	–	0.028*** (0.004)	0.025*** (0.004)	0.027*** (0.004)
Portugal	−0.007** (0.003)	–	–	−0.009** (0.003)	−0.008** (0.010)	−0.009** (0.003)
Slovak Rep	−0.027*** (0.004)	–	–	−0.023*** (0.004)	−0.028*** (0.004)	−0.025*** (0.004)
Slovenia	0.004 (0.008)	–	–	0.008 (0.009)	0.003 (0.008)	0.008 (0.008)
Spain	–	–	–	–	–	–
trend	−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)
Diagnostics						
R-squared	0.041	0.023	0.048	0.059	0.045	0.060
Observations	122,134	122,134	122,134	122,134	122,134	122,134
Predicted probability	0.082	0.084	0.088	0.078	0.081	0.078
Wald p-value	0.000	0.000	0.000	0.000	0.000	0.000
Hypotheses Testing [p-value]						
Zero size effects◆	–	1572.820 (0.000)	–	1256.070 (0.000)	–	1082.42 (0.000)
Zero age effects◆	–	–	279.860 (0.000)	–	314.050 (0.000)	122.820 (0.000)
Zero country effects◆	2969.360 (0.000)	–	–	2617.38 (0.000)	3004.890 (0.000)	2648.080 (0.000)
Micro = Small	–	0.233*** (0.011)	–	0.208*** (0.012)	–	0.192*** (0.012)
Small = Medium	–	0.218*** (0.014)	–	0.204*** (0.014)	–	0.196*** (0.014)
Start-up = Relatively new	–	–	−0.168** (0.044)	–	−0.134** (0.044)	−0.155** (0.045)
Relatively new = Middle age	–	–	0.098*** (0.024)	–	0.113*** (0.024)	0.093*** (0.024)

Notes: (a) numbers denote estimated Marginal Effects, (b) numbers in parentheses denote robust standard errors, (c) ***, **, * denote statistical significance at the 1, 5 and 10 percent level respectively. ◆ **x^2-** statistic. The tests of attribute pairs are linear combinations of estimators.

higher and for Medium firms is 4.4 pp. higher. Hence, the probability of being credit rationed within a Stiglitz and Weiss (1981) notion is a decreasing function of firm size. To further establish the differential impact of size on rejection rates, we perform equality tests on each consecutive pair of size parameters, which all of them turn out to be significant, providing statistical evidence for the monotonic drop.

Using the oldest age class as a benchmark, we find that the youngest firms (<2 years old) have 3.0 pp. higher probability of being rejected, while firms between 2 and 5 are more likely to get rejected by 5.2 pp. Older firms of 5 to 10 years are less likely to be denied credit revealing a probability of 2.2 pp, potentially because of their lower informational opaqueness (Beck and Levine, 2003). This pattern implies an inverse U-shaped relationship between the probability of rejection and age classes. The equality tests further support this result on each consecutive pair of age parameters.

Looking at countries' marginal effects, we find that there is substantial variation in loan rejection across Eurozone countries, confirming the differences in the macroeconomic conditions and possibly structural characteristics. Finally, the coefficient of the linear time trend was found as being negative across all specifications, indicating that the phenomena of credit rationing is on a decreasing path over time. Overall, the results provide evidence for a monotonic drop of rejection rates with firm size.

Table 4 reports the estimation results in the sample of discouraged firms. We find that we cannot reject the equality hypotheses or the zero effects for country and both firm characteristics. Turning to the model of interest that allows all three sources of variation, it has an explanatory power of about 6.4 %. Similarly, as with credit denial, a common refrain in small-firm research is that size matters. The likelihood of discouragement diminishes with firm size. This finding is consistent with the relevant literature (e.g., Levenson and Willard, 2000; Xiang et al., 2015; Ferrando, and Mulier 2015; Rostamkalaei et al., 2020 etc.), which argues that small businesses despite their desire for credit are more discouraged from applying rather than rejected.

On the other hand, increasing firm size indicates diminishing risk, information fullness, higher collateral and greater resources. Thus, it is not surprising that larger firms are less likely to be discouraged. In particular, following a monotonic drop, the likelihood of being discouraged is 7.6 pp. higher for Micro firms, also 4.6 pp. for small firms and by 1.8 pp. for Medium firms.

Regarding firm age, the estimated impacts are mixed, result that is in line with the existing literature. No impact is reported by some researchers (Chakravarty and Xiang, 2013; Freel et al., 2012; Moro et al., 2020 etc.) while others report a negative effect (Cole and Sokolyk, 2016; Cowling et al., 2012;) or positive (Han et al., 2009) correlations of firm age with the likelihood of being discouraged. We find that the probability of discouragement is non-uniform across firms' age (e.g., Cole and Sokolyk, 2016; Cowling et al., 2012). In particular, the coefficient of start-ups (<2 years age) was found insignificant, while for relatively new and middle-aged firms their marginal effects are significantly positive

Table 6
Predicted probability of rationing across sample subgroups.

	Rejected	Discouraged	Combined
Scenarios based on a single trait	Mean Value		
Micro	0.152	0.096	0.129
Small	0.090	0.060	0.088
Medium	0.059	0.037	0.058
Large	0.030	0.025	0.037
Age < 2 years	0.150	0.060	0.104
2 years < Age < 5 years	0.178	0.093	0.137
5 years < Age < 10 years	0.129	0.080	0.114
Age > 10 years	0.078	0.059	0.083
Predicted Probability Ratio			
Micro vs Large	5.06	3.84	3.48
Small vs Large	3.00	2.40	2.37
Medium vs Large	1.96	1.48	1.56
Relatively New vs Old	2.28	1.57	1.65
Middle Age vs Old	1.65	1.35	1.37
Scenarios based on two traits			
Small & Relatively New	0.153	0.078	0.119
Medium & Middle age	0.079	0.044	0.071
Large & Old	0.028	0.024	0.036
Predicted Probability Ratio			
Small & Relatively New vs Large & Old	5.46	3.25	3.30
Medium & Middle Age vs Large & Old	2.82	1.83	1.97
Scenarios based on three traits[a]			
Micro & Age < 2 years & located in Greece	0.315	0.221	0.300
Micro & Age < 2 years & located in Germany	0.120	0.061	0.089
Small & 2 years < Age < 5 years & located in Greece	0.289	0.226	0.302
Small & 2 years < Age < 5 years & located in Germany	0.090	0.061	0.084
Medium & 5 years < Age < 10 years & located in Greece	0.165	0.148	0.209
Medium & 5 years < Age < 10 years & located in Germany	0.039	0.033	0.046
Large & Age > 10 years & located in Greece	0.077	0.098	0.130
Large & Age > 10 years & located in Germany	0.013	0.018	0.023
Predicted Probability Ratio			
Micro & Age < 2 years vs Large & Age > 10 years in Greece	4.09	2.25	2.30
Micro & Age < 2 years vs Large & Age > 10 years in Germany	9.23	3.38	3.86
Small & 2 years < Age < 5 years vs Large & Age > 10 years in Greece	3.75	2.30	2.32
Small & 2 years < Age < 5 years vs Large & Age > 10 years in Germany	6.92	3.38	3.65
Medium & 5 years < Age < 10 years vs Large & Age > 10 years in Greece	2.14	1.51	1.60
Medium & 5 years < Age < 10 years vs Large & Age > 10 years in Germany	3.00	1.83	2.00

Note: Greece and Germany are two representative countries whose predicted probabilities belong to the highest and lowest quartile of the estimated predicted probability.

and decreasing. Thus, we find a monotonic drop in discouragement rates when the start-up segment is not considered. Hence, older firms are less likely to be discouraged borrowers relative to younger firms (Mac an Bhaird et al., 2016; Calabrese et al., 2021; Brown et al., 2022 etc.). The non-significance of start-ups might come from the assumption that due to their limited financing opportunities, start-ups still apply even if they will not get a loan application approved.

Country heterogeneity is emphatically evident in discouragement rates. In particular, Greece (13.3 pp.), Ireland (5.5 pp.) and Cyprus (5.9 pp) are the countries with the highest marginal effects, while the countries with the lowest are Finland (-4.1 pp.), Luxembourg (-3.4 pp.), and Austria (-2.7 pp.). Finally, we find once again that discouragement decreases over time.

In Table 5 we present the results for the combined group of firms that includes both rejected and discouraged applicants. In particular, we estimate the marginal effects of being credit rationed across waves as a function of both predictors of the varying degrees to which financing constraints may exist. We find that we cannot reject the equality hypotheses or the zero effects for country and SMEs characteristics. The monotonically decreasing curve of the SMEs' rationing function is in line with the previous findings when firms were separated into discouraged and rejected. In particular, our results show that rationing probability eases for large firms confirming the above predictions along with market imperfections. We, therefore, find that small firms are more likely to be rationed. In particular, the probability that a medium-firm is credit constraint is 3.0 %, but, as size descents, the probability of rationing begins to rise reaching a level of 9.8 % for start-ups.

Regarding age, the credit rationing probability does not follow a clear monotonic pattern. The results show that the coefficient of the start-ups is insignificant. Regarding the two remaining groups, it is evident that the Probability of older SMEs being credit rationed is 1.6 %, relatively lower than the middle-aged firms for which the probability doubles to 3.3 %. Table 5 confirms once again, via the country dummies, the heterogeneous impact of the macroeconomic conditions on individual Eurozone member states.

4.4. *Mapping credit outcomes across different sample subgroups*

Based on appropriately selected sub-groups of firms that highlight different combinations of their characteristics, we explore and quantify the differences in credit rationing patterns. In particular, we calculate the probability of rejection, discouragement and their combination under the following scenarios:

Scenarios based on a single characteristic:

- Firms by size class.
- Firms by age class.

Scenarios based on two characteristics:

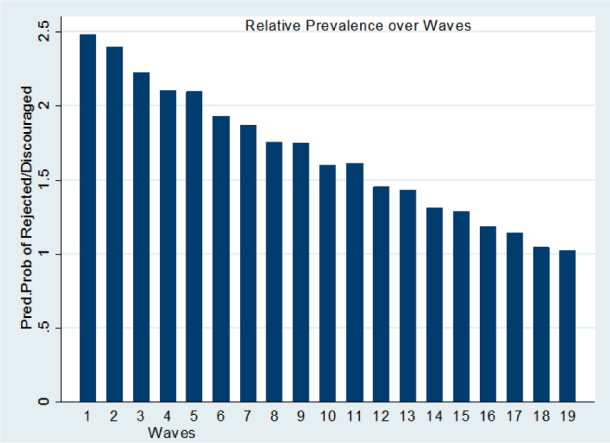
- Micro and start-up firms up to 2 years of age.
- A small firm between 2 and 5 years of age.
- A medium firm between 5 and 10 years of age.
- A large firm above 10 years of age.

Scenarios based on three characteristics:

- Micro and start-up firms up to 2 years of age / falling below the 25th and above the 75th percentile of the distribution.
- A small firm between 2 and 5 years of age / falling below the 25th and above the 75th percentile of the distribution.
- A medium firm between 5 and 10 years of age / falling below the 25th and above the 75th percentile of the distribution.
- A large firm above 10 years of age / falling below the 25th and above the 75th percentile of the distribution.

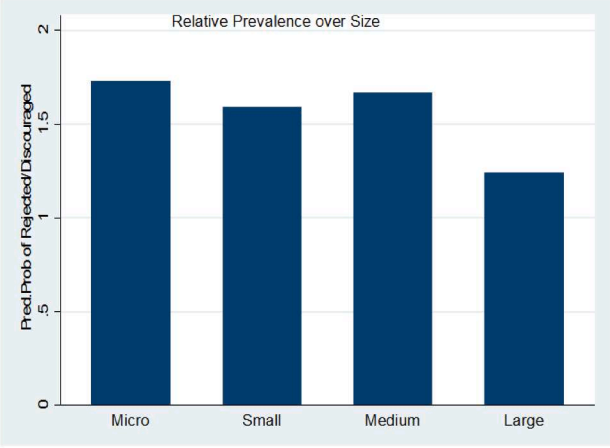
The relevant results for the mean predicted probabilities are reported in Table 6. We firstly compare firms across size classes. As previously found, across the three possible credit rationing outcomes, size exerts a monotonic downward drop (from large to micro firms). The probability of a micro firm getting rejected is 15.2 % higher than the large firms and 9.6 % and 12.9 % for discouraged and combined sample, respectively. This produces a Predicted Probability Ratio (PPR hereafter) ranging from 5.06 to 3.48. Hence, it is suggested that a micro firm is 5.06 times more likely to get a rejection compared to its large counterpart, while 3.84 more likely to be discouraged and 3.48 is to be credit rationed. In this line, when considering the age effect, relatively new SMEs reveal a higher PPR compared to older counterparts across all facets of outcomes. In particular, the PPR ranges from 2.28 for rejected applicants to 1.65 for the combined sample, indicating that younger companies are always

Graph 1



Graph 1.

Graph 2



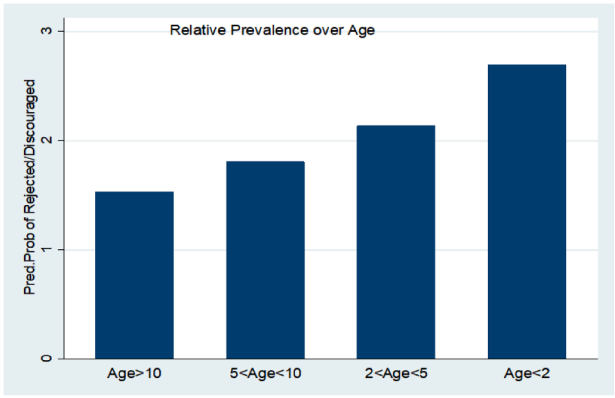
Graph 2.

more likely to get rejected, discouraged or rationed.

Moving on to the comparison of bivariate scenarios across credit outcomes, we provide the combination of both attributes starting from the two high ends of the classification when start-ups are not considered, namely the small and relatively new firms and of large and oldest ones. The PPRs for all combinations are higher than the unity implying that the probability of getting rejected/discouraged or both is higher for small and relatively new firms compared to the large and old firms. Furthermore, the predicted probabilities exert a clear monotonic drop as size and age increase (e.g., Cowling et al., 2012; Xiang et al., 2015 etc.), confirming that both parameters of knowing to be material for credit outcomes are indeed significant.

The final scenario confirms the above when additionally, the lowest and highest percentile of the distribution is included to allow for an even deeper classification within the distribution. Both low and high quartile of the estimated predicted probability correspond to two extreme country cases, that of Greece and German respectively. The average probability of getting rejected for SMEs located in Greece is significantly higher; 31.5 % for start-ups and micro firms relative to the large and old firms, which is 7.7 %. The same monotonic pattern holds across all possible credit outcomes for firms in Greece or Germany. However, the

Graph 3



Graph 3.

probability of rejection, discouragement, or rationing is, on average, always higher for firms operating in Greece when both characteristics associated with firms' capital structure are examined. Contrary, the PPR shows that small and young firms in Germany compared to large and old, are more likely to be credit rationed relative to Greek firms. This possibly stems from the fact that for the Large and Old Greek SMEs the probability of being rationed is unusually high relative to the German firms due to the special economic conditions that took place during the period under investigation.

4.5. Relative prevalence of credit rationing outcomes

To get a deeper insight of the phenomena, we compare the relative prevalence of the two credit market outcomes throughout the period under investigation. Essentially, in Graph 1 we plot overtime the relative prevalence of rejection rate versus discouragement rate, based on the mean predicted probabilities.

The graph is very informative and provides a very clear picture of the relative trajectories of the two underlying phenomena. At the beginning of the sample, the rejection rate was approximately 2.5 times higher than the discouragement rate. However, there is a clear change in the mix of the credit market outcomes, with the discouragement rate rapidly gaining ground, leading to tan approximately 1-to1 ratio of the two phenomena at the end of the sample. This result is clearly something that policy makers should consider when designing policies aiming at increasing the access of enterprises to credit.

In Graph 2 and Graph 3 we show the same ratio across size and age groups. In Graph 2, regarding size the data suggest that the relative prevalence of rejection rate vs discouragement rate does not exhibit any striking differences across size classes. In contrast, when we focus on age classes, it becomes apparent that the relative prevalence behaves very differently. In particular, the prevalence of rejection vs discouragement increases monotonically as firm age decreases. In fact, the relative prevalence for the oldest firms (above 10 years of age) stands at approximately 1.5, while for start-ups (<2 years of age) is almost double. Again, this finding is quite informative for policy makers with respect to the relative prevalence of the phenomena across firms at different points of their life cycle.

5. Conclusions

Using the SAFE survey and probit models, we attempt to shed light on the prevalence of credit rationing in relation to SMEs. The study shifts attention from identifying the traditional determinants of credit

Table A1
Descriptive Statistics.

Proportion of SMEs being rationed/discouraged or both per country			
Country	Rejected	Discouraged	Both
Austria	3.15 %	3.19 %	4.02 %
Belgium	5.95 %	4.65 %	6.6 %
Germany	4.43 %	4.29 %	5.48 %
Spain	10.58 %	5.99 %	9.62 %
Finland	5.75 %	1.85 %	3.13 %
France	7.34 %	5.00 %	7.65 %
Greece	19.40 %	20.24 %	25.41 %
Ireland	15.18 %	11.80 %	14.75 %
Italy	8.74 %	5.49 %	8.69 %
Luxembourg	2.40 %	2.37 %	2.96 %
Netherlands	19.86 %	9.01 %	12.56 %
Portugal	8.99 %	6.44 %	8.59 %
Cyprus	14.18 %	12.10 %	15.42 %
Estonia	15.00 %	5.75 %	8.40 %
Lithuania	15.60 %	6.04 %	10.85 %
Latvia	9.58 %	6.40 %	8.26 %
Malta	4.00 %	2.50 %	3.43 %
Slovenia	9.62 %	6.43 %	9.74 %
Slovak Republic	7.36 %	4.35 %	6.16 %

Table A2
Descriptive Statistics.

Proportion of SMEs being rationed/discouraged or both per wave			
Wave	Rejected	Discouraged	Both
Wave 1	14.8 %	5.00 %	8.38 %
Wave 2	17.8 %	5.47 %	9.90 %
Wave 3	9.28 %	5.40 %	8.29 %
Wave 4	8.46 %	6.51 %	9.14 %
Wave 5	8.06 %	6.06 %	8.31 %
Wave 6	11.27 %	7.19 %	10.64 %
Wave 7	13.43 %	6.63 %	10.45 %
Wave 8	10.42 %	6.66 %	9.78 %
Wave 9	11.04 %	6.66 %	9.93 %
Wave 10	10.26 %	6.35 %	9.48 %
Wave 11	11.15 %	8.47 %	11.97 %
Wave 12	8.03 %	7.92 %	10.42 %
Wave 13	8.07 %	6.96 %	9.47 %
Wave 14	6.68 %	6.71 %	8.79 %
Wave 15	6.58 %	6.54 %	8.56 %
Wave 16	6.01 %	6.30 %	8.21 %
Wave 17	5.47 %	5.41 %	7.05 %
Wave 18	4.55 %	4.84 %	6.21 %
Wave 19	4.74 %	4.68 %	6.09 %

rationing, to exploring the anatomy of loan applicants with a special focus on those who did not apply due to fear of rejection. We actually map the probabilities of rationing on two commonly used non-financial attributes: age and size, both expected to be related to the probability of credit rationing.

Several findings emerge from our analysis. Overall, credit rationed firms are generally smaller and younger, which is consistent with informational theories of credit rationing as both characteristics affect the symmetric information and the perceived risk. In particular, discouragement and rejection rates follow a monotonic drop with firm size. At the same time, the age characteristic takes the form of a partial monotonic drop for discouragement and for the combined sample as well. Regarding the rejected applicants, age follows an inverse U-shaped pattern. All in all, the results are in line with the long-evidenced difficulty in accessing the external debt of small and young firms.

Notably, confirming previous results (e.g., Freel et al., 2012; Chakravarty and Xiang, 2013 etc.), we provide evidence that discouraged SMEs is high and therefore its importance cannot be underestimated. Moreover, we show that the prevalence of the discouragement rate rapidly gains ground overtime relative to the rejection rate. Additionally, when one focuses on age classes the prevalence of rejection over discouragement is almost twice as high.

Table A3
Notation and definition of variables.

Panel A: Dependent Variables	
DISCOURAGED	1, if firm needs a bank loan but did apply due to fear of possible rejection;****0 if firm needs a bank loan and applied, or needs a bank loan but did not apply for other reasons
REJECTED	1, if bank rejected firm's loan application;****0 if bank fully or partially granted loan request
Panel B: Firm-specific control variables	
SIZE- The number of employees measured by categorical variable:	
MICRO	1, if # of employees $\leq$ 9; 0, otherwise
SMALL	1, if 10 $\leq$ # of employees $\leq$ 49; 0, otherwise
MEDIUM	1, if 50 $\leq$ # of employees $\leq$ 249; 0, otherwise
LARGE	1, if 250 $\leq$ # of employees; 0, otherwise
AGE- Years from establishment measured by categorical variable:	
<2 years of age	1, if firm age<2 years; 0, otherwise
Between 2 and 5 years of age	1, if firm age between 2 and 5 years; 0, otherwise
Between 5 and 10 years of age	1, if firm age between 5 and 10 years; 0 otherwise
>10 years of age	1, if firm age above 10 years; 0 otherwise

The implications of the findings are even more interesting as they highlight the information imperfections between firms and banks, which turns to become a precondition not only for the rejected firms to exist but also for the discouraged ones. This situation could suggest that (a) self-rationed firms prevent themselves from undertaking profitable projects (e.g., Vermoesen et al., 2013), (b) a misallocation of funds, and consequently (c) generating detrimental effects on (long-term) economic growth. Therefore, policymakers should deploy various tools in order to minimize these problems, such as (a) greater information sharing among participants in the credit market and (b) extending loan guarantee schemes. In general, policymakers need to design supportive policies for enterprises concerning access to credit (e.g., Moro et al., 2020).

As it regards future research, there are several paths to follow. In our view, what remains a black box is which are the causal determinants of discouragement, rather than simply which are its correlates. In other words, what desperately calls for investigation is modelling the process that firms follow, which eventually leads them to discouragement or self-rationing, based on a formal economic model. Perhaps, such a model should, apart from the standard (marginal) cost-benefit analysis regarding the application and each possible outcomes, might need to include behavioural aspects in order to capture the firms' perception of potential rejection.

CRediT authorship contribution statement

Christos Kallandranis: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Dimitrios Anastasiou:** Writing – review & editing, Validation, Project administration. **Konstantinos Drakos:** Writing – review & editing, Supervision, Investigation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

Appendix

See Table A1-A3.

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