

Article

# Financial Infrastructure and Access to Finance for European SMEs

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**Abstract:** In this article we assess credit rationing across European countries by analyzing the impact of banking competition on the access to finance of firms. The importance of the financial sector in promoting the sustainable economy is recognized by the European Union, that has taken the lead in efforts to build a financial system that supports sustainable growth. However, it should be acknowledged that in highly competitive business environments, it is not easy to challenge the existing paradigms, since companies need to be profitable in addition to improving their environmental performance. Using data from European firms Survey on the Access to Finance of small- and medium-sized enterprises (SMEs), our results, using Probit regression, support the Market Power Hypothesis, outlining that more concentrated banking markets are characterized by higher levels of credit rationing. Also, our results reveal that small firms are more credit rationed compared to large firms. The analysis shows that financial constraints are stronger in the countries more affected by the financial crisis.

**Keywords:** credit rationing; SMEs; firm financing; banking competition; Probit regression

## 1. Introduction

Access to bank credit is often indicated as one of the main constraints that affect small- and medium-sized enterprises (SMEs) and it is an important topic for policymakers and researchers alike, as the financial institutions are at the center of any transition to a sustainable economy. In the wake of the financial crisis of 2008–2009, much attention has turned to the relationship between the development of the financial sector and the health of the economy, because the core purpose of the financial system is to ensure that finance flows to support the long-term needs of what the G20 defines in its own mission statement as “balanced, sustained growth” [1]. The crisis had shown that excessive risk-taking combined with a low loss-absorbing capacity of the financial system could threaten the stability of the financial sector and have enormous costs for the economy as a whole [2]. With the purpose of addressing the 21st century key challenges by dealing with a range of global issues, such as environmental protection, health improvement and fight against poverty, the United Nations established the 2030 Agenda for Sustainable Development and proposed a set of 17 Sustainable Development Goals. These goals should be tackled to implement a balanced and comprehensive approach to achieve economic development, with respect to the environment and social equity. The European Union, with the Europe 2020 strategy, has also adopted a strategy for smart, sustainable and inclusive growth, agreeing on targets covering, amongst others, climate change

and energy sustainability. As in previous structural transformations, the financial system will play a major role in this process: the full potential of the financial system needs to be harnessed to serve as an engine in the global economy's transition toward sustainable development [3]. The access to capital is, therefore, an important enabler for the successful transition to economic systems that aims to reconcile economic and environmental performance, by adopting innovative approaches to address the relationship between business, the environment, and society [4]. The financial system is already transitioning to create, value, and transact financial assets in ways that shape real wealth to serve the long-term needs of an inclusive and more sustainable economy [5]. Interest in this subject intensified during the recent global financial crisis; prior literature has widely debated the relationship between banking competition and access to finance, from theoretical and empirical perspectives. From a theoretical point of view, access to bank credit is often indicated as one of the main constraints impairing firm growth, productivity, innovation, and export capacity, especially because it affects small- and medium-sized enterprises (SMEs) [6,7]. Multiple research papers were conducted on the financing of small businesses and they concentrate on testing the determinants and effects of bank lending constraints on firms since the onset of the crisis [8–10].

The availability and cost of bank loans are crucial for many small businesses because these businesses often lack other options for external funding [11]. Reliance on banking finance by SMEs is particularly increased during financial crises [12], therefore these suffer most from disruptions in financial markets and the slowdown in economic activity. Thus, the availability and cost of loans to small businesses can depend on the behavior of competing local banks [13].

There is a wide body of literature on the relationship between market structure or bank competition and access to credit [14–16]. Interest in this subject intensified during the recent global financial crisis, as many questioned whether high bank competition was, at least partially, involved in the casuistic processes. At the same time, the downfall of some institutions as a result of the crisis and the emergency measures taken by some governments to address this episode, such as mergers, bailouts, recapitalizations, and extension of guarantees, have led to concerns about the future of bank competition and its potential implications for access to bank finance [17].

Theoretically, higher competition has an ambiguous impact on firm financing. On the one hand, the market power hypothesis suggests that, by reducing interest rates, higher competition facilitates credit access or relaxes financial constraints [11]. On the other hand, the information hypothesis argues that, given the existence of information asymmetries and agency costs, higher competition increases financial constraints by reducing banks' incentives to build lending relationships [18]. Also, previous empirical evidence, which has mostly used concentration measures as proxies for competition, is also mixed [15,17,19].

In this context, we test the Information Hypothesis versus the Market Power Hypothesis with respect to the effect of banking competition on credit availability. We use data from the Survey on the Access to Finance of Small and Medium Enterprises survey conducted by the European Central Bank (ECB) and the European Commission (EC), aimed at quantifying the changes in terms of financing conditions of the SMEs. Our results support the Market Power Hypothesis, showing that in countries where banking market is less concentrated, the occurrence of credit rationing is less intense. Similar to Carbo-Valverde et al. [11], our results reveal that the probability of a small or medium size enterprise to access credit decreases in the case of a banking sector characterized by lower levels of competition and higher levels market power.

Following Chong et al. [14], we tested the market power hypothesis against the information hypothesis. The hypothesis can be stated as:

**Hypothesis 1 (H1).** *Credit rationing is diminished in a highly competitive banking sector.*

The impact of bank competition on financial markets and firms is an important topic for policymakers and researchers alike. Despite the policy relevance of this question, recent studies

were unsuccessful to provide a clear conclusion on the effect of banking competition on access to finance [15]. In line with the market power view, Beck et al. [20] show that bank concentration increases the probability that firms report finance as a major obstacle to growth. Similarly, Chong et al. [14] confirm the market power view documenting that credit availability is restrained in concentrated markets in China. Ryan et al. [21] shows strong support consistent with the market power hypothesis, that lower competition increases financial constraints for SME European firms. Two other recent studies also favor the market power hypothesis. Leon [15] examines firms from 69 developing and emerging countries and finds evidence that competition reduces credit constraints. Similarly, Love and Martinez-Peria [17] find evidence that competition augments access to finance in a sample of firms from 53 countries.

In contrast, the information hypothesis argues that in the presence of information asymmetries and agency costs, bank competition can reduce access to finance by making it more difficult for banks to internalize the costs of investing in building lending relationships, particularly with opaque clients [18,22–24]. González and González [25] also find results in line with the information hypothesis for firms from 39 countries. However, Mudd [26] obtains evidence of a non-linear relationship between bank competition and a firm's access to credit and show that competition has a positive but declining effect on a firm's use of bank financing, and the impact is changing into a negative one for very competitive markets.

These hypotheses were also addressed by Carbo-Valverde et al. [21], who raised attention about the use of Herfindahl-Hirschman Index (HHI) as a proxy for banking market power. Recently, a number of papers have called into question the use of concentration measures to capture competition [27–29], advocating for the use of non-structural measures such as the Lerner index and the Boone indicator instead.

Considering the existing literature on SMEs credit availability during financial crisis, there are some ways in which this paper brings additional insights to research on bank lending constraints during the recent financial crisis. First of all, as there are many debates in terms of the indices used as proxies for bank competition, we are considering in our analysis structural and non-structural measures of competition. Second, we examine how a firm's size moderates the connection between competition and access to finance. Third, we analyze not only the evolution of the relationship between bank competition and access to finance post crisis, but also the impact of the macroeconomic conditions (stressed economies versus the non-stressed economies) on the relationship between banking competition and access to finance for European SMEs.

The rest of the paper is organized as follows. Section 2 describes the data and econometric methodology, and Section 3 presents the results of the empirical analysis. Finally, Section 4 summarizes our findings.

## 2. Data and Methodology

### 2.1. Data

The data used in our investigation is collected from SAFE Survey [30], conducted by the European Central Bank (ECB) and the European Commission (EC), with the aim of quantifying the changes in terms of the financing conditions of the SMEs across European countries. The survey was conducted on a bi-annual basis, starting 2009. The period of analysis covers the survey rounds from January 2009 to September 2014. The sample size covers approximately 70,000 observations that include small and medium sized enterprises from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Spain and Portugal.

The dataset is unbalanced, due to the fact that for some countries the sample size was increased over time. Since the SAFE Survey also contains information on large enterprises, these were excluded from the further investigation, in order to obtain representative results strictly on small and medium sized enterprises. The main survey's aim was to identify the current state and the changes of the SMEs, in terms of their financial position, as well as the external sources of finance assessed by the firms for

their ongoing operations. The questions regard the credit conditions of the firm, with special interest on the amount of liabilities these firms have, also not omitting the frequency and their need of external sources of funding. The credit demand of the firms is quantified in several questions, the survey also collecting information on the different types of demanded loans, changes in the perceived availability of credit, as well as valuable accounting data of the firms. The database with the responses to the survey represents a relevant and important source of information about the European SMEs, as it assessed various facets of the financial situation and the difficulties encountered by the firms in terms of credit demand for the investigated period. Along with information about firms' characteristics, this dataset draws the ground for the investigation of the occurrence of credit rationing among European small and medium-size enterprises.

Considering the purpose of the study, SAFE Survey comprises accurate information regarding the financing of small businesses across euro area countries. Therefore, it is an invaluable source for determining the small firms' usage of external sources of financing, comparing to their needs and their outlook on the availability of credit, also pointing out their future needs of financing.

When it comes to quantifying credit rationing occurrence in the banking sector, there are no standard or exact rules for doing it. However, the literature provides several models that can be applied. For example, the presence of credit constraints can be measured by the measurement of loan applications and the corresponding refusals [31], by the accessibility to bank financing [32] or by the use of trade credit [18]. In this study, following Andries et al. [33], the degree of credit rationing is built on the firms' answers to the specific two questions from the SAFE: (1) *For each of the following ways of financing (bank overdraft, credit line or credit card overdraft, bank loan, trade credit, other external financing), could you please indicate whether you: applied for them over the past 6 months; did not apply because you thought you would be rejected; did not apply because you had sufficient internal funds or did not apply for other reasons?* and (2) *If you applied and tried to negotiate for this type of financing over the past 6 months, did you: receive all the financing you requested, receive only a part of the financing you requested, refuse to proceed because of unacceptable costs or terms, or have you not receive anything at all?*

In order to identify the firms' need for financing and the success of their bank loan applications, we construct a dummy variable *Credit Rationing* that has a value of 1 if the firm has applied for external financing and did not receive the entire requested amount, and a value of 0, otherwise.

For defining the competition in the banking sector, following Clerides et al. [34], Chong et al. [14] and Ryan et al. [21], we are using five measures for banking competition: two structural measures (HHI and 5-bank asset concentration) and three non-structural measures (Lerner index, H-Statistics and Boone indicator). The values of the variables corresponding to the investigated countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal and Spain) cover the period 2008–2013. Definitions and data sources for all variables used in our analysis are presented in Appendix A.

## 2.2. Empirical Model

Following Cenni et al. [35], Chong et al. [14], Drakos et al. [36] and Ryan et al. [21], we test the effect of banking competition on the access to finance of European small and medium-sized enterprises, using the following Probit model:

$$\Pr(\text{Credit rationing}_{i,j,t} = 1) = \varphi(\beta_0 + \beta_1 \times \text{Comp}_{j,t} + \beta_2 \times X_{i,j,t} + \beta_3 \times \text{BC}_{j,t} + \beta_4 \times \varphi_{s,t} + \beta_5 \times \eta_t + \varepsilon_{i,j,t}) \quad (1)$$

The dependent variable *Credit Rationing* is a dummy variable (binary) equal to 1 if the firm has applied for external financing and did not receive the entire requested amount and 0 if the firm did not apply for external financing or firm applied and received entire amount. The *Competition<sub>jt</sub>* represents one alternative measure of competition index in country *j* and year *t*; *X<sub>isjt</sub>* is a vector of time-varying firm-level control variables; *BC<sub>jt</sub>* is a vector of banking system and macroeconomic level

control variables;  $\varphi_{s,t}$  is an interaction of sector and country fixed effects;  $\eta_t$  is a time fixed effect which corresponds to each survey wave; and  $\varepsilon_{i,j,t}$  is an error term.

The vector of firm-specific variables  $X$  controls the credit demand considering the size and debt-to-assets ratio of the firms. The literature points out the firms' characteristics influence on the firms' demand for external financing [37]. Firms that are considered to be small or medium-sized have limited access to external financing [7,38]. Similarly, Affuso [39] shows that the debt-to-assets ratio is a powerful indicator for financial strength and it negatively affects the credit constraints. Also, we have analyzed banking system characteristics (Bank capital to assets ratio and Bank nonperforming loans to total gross loans) and macroeconomic conditions (GDP growth; Ease of Doing Business Index and Domestic credit to private sector by banks).

### 3. Data Analysis and Results

#### 3.1. Descriptive Statistics

In order to test the consequences of the recent financial crisis on the financing of European small businesses, we concentrate on 11 countries from the European area. The period of analysis covers the survey rounds from January 2009 to September 2014. The sample size covers approximately 69,324 observations and includes small and medium sized enterprises from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Spain and Portugal.

Table 1 presents the bank loan applications for the investigated period, with the respective values of the bank applications and the number of credits that were either accepted or rejected each year. Almost a quarter (24.8%) of the total number of firms applied for a bank loan. However, 17,892 out of these were applications for external financing and only 61.75% of them received the entire requested amount; the rest of 6843 firms represent the pool for the credit rationed cases. Thus, the mean value of "unsuccessful" shows that 38.24% of the firms that applied for a loan has faced credit constraints.

**Table 1.** Loan applications and credit approvals.

Application for a Loan	2009	2010	2011	2012	2013	2014	Total
Applied	2923	3033	3347	333	3464	1792	17,892
Did not apply because of possible rejection	523	724	949	907	920	512	4535
Did not apply because of sufficient internal funds	3705	5596	6691	6395	6557	2045	30,989
Did not apply for other reasons	2633	2370	2834	3155	2880	1360	15,232
DK/NA	131	124	116	129	102	74	676
Total	9915	11,847	13,937	13,919	13,923	5783	69,324
Bank loan application success	2009	2010	2011	2012	2013	2014	Total
Applied and got everything	1746	1952	2079	1995	2225	1052	11,049
Applied but only got part of it	269	285	340	347	311	197	1749
Applied but refused because cost was high	81	58	105	72	53	57	426
Applied but was rejected	385	303	374	427	415	205	2109
Applied and got most of it (75–99%)	263	285	261	277	289	132	1507
DK/NA	179	150	188	215	171	149	1052
Total	2923	3033	3347	3333	3464	1792	17,892

The descriptive statistics presented in Table 2 show that during 2009–2014, the *Credit Rationing* measure takes the value 1 if the firm did not receive the entire requested amount and 0 if the loan was fully granted. The value of this dummy variable counts the number of firms from the pool that applied for a loan but did not receive it entirely—in our case, 17,892 observations.

Regarding banking competition, the mean value of the 5-bank asset concentration variable is 71.84%, indicating that the investigated countries are characterized by large banks that hold a significant share of total commercial banking assets. In terms of competition and market power, the mean value of the Boone indicator, which is negative (−0.25), depicts a moderate to high level of competition of the banking sector of the investigated countries. This is enforced by the mean of the Lerner index

(0.1956) and H-statistic (0.744), which outline the fact that the banking systems from European Union are characterized by high level of competition and that the market is not a monopolistic one.

**Table 2.** Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
Credit rationing measure	17,892	0.3824	0.4860	0	1
Banking competition					
5-bank asset concentration	70,227	71.8485	22.9008	32.3004	100
HHI	71,656	62.6437	24.97	21.6954	100
Boone indicator	72,137	−0.02537	0.0493	−0.1574	0.1318
Lerner index	64,923	0.1956	0.0809	−0.0135	0.3288
H-statistic	41,250	0.7441	0.1960	0.505	1.257
Control variables					
Size	72,137	1.9006	0.7967	1	3
Debt-to-assets	63,541	2.6625	1.7762	1	9
Bank capital-to-assets	72,137	5.6892	1.1624	4.0984	12.6762
Bank NPL	72,137	7.4353	6.7171	0.5	33.7752
GDP growth	72,137	−0.4808	2.7755	−9.1	5.2
Ease of doing business	72,137	40.5213	24.2485	7	109
Domestic credit to private sector	72,137	157.9351	38.8826	95.2	245.4

### 3.2. Results

In this section we present the main findings of the research. Table 3 presents the results from the Probit regression, aiming to reveal the changes in the probability of a firm that applied for a credit to face credit rationing, controlling for variables at country level (GDP growth, Ease of doing business index, level of financial intermediation), banking sector level (bank capital to assets ratio, bank nonperforming loans to total loans ratio) and firm level (size, debt-to-assets ratio). We test the effects of banking competition on deteriorated access to external financing for firms in European countries.

In order to measure the level of competition across banking systems, we have used five alternative measures, the results of the estimates being presented in Models 1–5. Results presented in Table 3 shows that all coefficients are statistically significant but not all indicate the same direction in the relationship with credit rationing. It can be observed that the relationship between the probability of a firm to face credit constraints when applying for a loan and the type of indicator used for the banking sector characterization differs. The aim was to appraise the relative relevance of the five coefficients, corresponding to the banking sector, in clarifying the presence of financing constraints faced by SMEs.

The coefficients of the Models 1 and 2 indicate that there is a positive and significant relationship between bank concentration, which was measured using 5-bank asset concentration and HHI indicators, and credit rationing. This can be restated as: in markets characterized by a higher degree of bank concentration firms have higher probabilities of being denied credit approvals (or rationed). Lower levels of HHI decrease the probability of SMEs to be financially constrained and un-concentrated markets ease credit rationing, in line with the Market Power Hypothesis.

For use of the Boone Indicator, as an index for the degree of competition, the results of the estimation show that an increase with 1% of the Boone Indicator determines an increase in the probability of being credit rationed with 1.34%. At the same time, an increase of this index implies a deterioration of the competitive conduct of financial intermediaries. This reinforces the previous findings that showed that decreased competition is associated with higher levels of credit rationing among SMEs (Market Power theory). Higher levels of competition imply more effort from the banks to increase their assets (i.e., loans), thus reducing the rationalization of credit and facilitating the access to finance of their clients [40].

**Table 3.** Main empirical results—Probit estimations.

Credit Rationing	Model 1	Model 2	Model 3	Model 4	Model 5
5-bank Asset Concentration	0.0074 *** (0.0007)				
HHI		0.0073 *** (0.0006)			
Boone Indicator			1.3438 *** (0.2386)		
Lerner Index				−0.6350 *** (0.1663)	
H-statistic					0.3822 *** (0.0818)
Size	−0.2282 *** (0.0129)	−0.2214 *** (0.0129)	−0.2284 *** (0.0130)	−0.2395 *** (0.0132)	−0.1856 *** (0.0180)
Debt-to-assets	−0.0551 *** (0.0087)	−0.0528 *** (0.0086)	−0.0466 *** (0.0086)	−0.0581 *** (0.0089)	−0.0477 *** (0.0121)
Bank capital-to-assets	−0.1627 *** (0.0119)	−0.1441 *** (0.0110)	−0.0770 *** (0.0112)	−0.1118 *** (0.0109)	−0.1349 *** (0.0147)
Bank NPL	0.0353 *** (0.0026)	0.0349 *** (0.0023)	0.0353 *** (0.0023)	0.0204 *** (0.0041)	0.0298 *** (0.0051)
GDP Growth	−0.0149 ** (0.0075)	−0.0008 (0.0078)	−0.0519 *** (0.0067)	−0.0569 *** (0.0071)	−0.1084 *** (0.0088)
Ease of Doing Business	0.0051 *** (0.0007)	0.0049 *** (0.0007)	0.0011 * (0.0006)	0.0035 *** (0.0008)	−0.0030 *** (0.0011)
Domestic credit to private sector	0.0023 *** (0.0003)	0.0025 *** (0.0003)	0.0027 *** (0.0003)	0.0044 *** (0.0003)	0.0039 *** (0.0004)
Chi square p-value	0.0000	0.0000	0.0000	0.0000	0.0000
N. of cases	15,872	16,100	16,100	15,081	8799

Note: Significance at \* 10%, \*\* 5%, \*\*\* 1% level.

The Model 5 also reveals a positive relationship between credit rationing and the H-statistic. An indicator of degree of competition, this appears to be significant for our model at 1% level. High values of H-statistic are connected with more competitive banking systems. A percentage of 0.3822 increases in credit rationing would be determined by an increase of 1% in the value of the H-statistic. Restating, as H-statistic weights the intensity of competition in the bank market by indicating the elasticity of bank revenues in regard to their input prices, an increase in the value of this indicator relates an increase in the revenues of the bank. Thus, having more capacity of producing higher quality products and services implies an increase in the demand of credit from clients, which, at the same time, invariably increases the probability of facing credit rationing. Furthermore, a decreased level of competition (i.e., lower value of H-statistic) increases the interest rates applied by the banks, thus reducing the availability of SMEs to financial resources allocation. These results are in line with [6].

Model 4 indicates that there is a negative relationship between the Lerner Index and the probability of credit rationing. The sign shows that 1% increase in the Lerner index (i.e., decrease in competition) determines a decrease in the probability of credit rationing by 0.63%. In other words, as this indicator measures the market power in the banking market, we can affirm that in countries that are characterized by a high Lerner index (i.e., low levels of competition), credit rationing decreases in intensity. Having a greater market power implies larger portfolio, larger capital and capacity, but also more information and potential of having and choosing to borrow the low risk clients. In the case of SMEs, which are characterized by considerably increased probability of default, credit rationing occurs at increased

levels. This is in line with [21,41] and enforces the idea that more powerful banking markets imply more restrictions regarding loans supply (Market Power Hypothesis).

The sign of the variable Size is negative, consistent with many other studies that outlined the idea that banks limit the credit allocation to relatively small firms, which are characterized as being “opaque” firms, that do not have continuous and stable flow of operations. At the banking sector level, the variable Bank nonperforming loans to total loans ratio is in a positive relationship with credit rationing. This ratio indicates the amount of granted loans that defaulted, depicting the assumption that, in the lending process, banks assign an important value to the “hard and soft” information they have about their clients. In other words, in order to prevent the possible losses that may occur in the event of a borrower not repaying the principal and making the interest payments, banks constrain the granting of credit to those firms that are associated with higher risk of default (i.e., SMEs). This supports the idea that small firms do not have very secure and long relationships with the banks [27]. Additionally, Darvas [42] outlined that SMEs are characterized by a low level of transparency, which translates into higher levels of information asymmetry in the lender–borrower relationship. Consequently, many of the credits granted to SMEs defaulted and, thus, we are able to affirm that the ratio of bank nonperforming loans is an important indicator for the supply side in the application of credit rationing to firms.

The estimates show that the GDP growth ratio of the investigated countries is a significant variable for the model. The next indicator, “Ease of Doing Business Index”, appears to positively influence the occurrence of credit rationing. This index is representative for the economic overview of a country with respect to the enhancement of business activities and the effectiveness of policy regulations. As it comes to the relationship with credit rationing, the positive sign of the coefficient depicts that as the index increases, so does the probability of a firm to face credit constraints. This comes naturally, as an increase in the value of the index indicates a decrease of the degree of business-friendly regulatory environment, thus more space for credit allocation and less access to external financing for business entities.

The last variable of the model is a measure of financial intermediation. Significant for our model, this indicator depicts the following idea: an increase in the proportion of domestic credit provided by the financial institutions to the private sector (as % of GDP) increases the probability of credit rationing. An explanation for this could be related to the ex post behavior of the borrower. In the case of a client (who has more “soft” information related to its business overall level of risk) characterized by a higher level of credit default probability and thus willing to pay a higher interest rate, banks may face the adverse selection problem and may opt for lending to the riskier borrower, in the detriment of the less risky one, who may not be able to pay the interest rate. In this sense, the amount of credit allocated to the private sector is increased, but so is the probability of credit rationing for the less risky borrowers.

So far, the estimates support the market power hypothesis. However, there is the possibility for the presence of heterogeneity across several characteristics. In line with this, the empirical model was extended in order to allow the heterogeneous effects across firm size and effects of the latest financial crisis.

### 3.3. Robustness Tests

In order to test the robustness of our results, we provide a number of alternative specifications of the base results. We study whether Credit rationing measure reacts differently to the banking competition depending on some firm and country characteristics. The following equations are used:

$$\Pr(\text{Credit rationing}_{i,j,t} = 1) = \varphi(\beta_0 + \beta_1 \times \text{Comp}_{j,t} + \zeta \times \text{Com}_{j,t} * \text{Size}_{ij,t} + \beta_2 \times X_{i,j,t} + \beta_3 \times \text{BC}_{j,t} + \beta_4 \times \varphi_{s,t} + \beta_5 \times \eta_t + \varepsilon_{ij,t}) \quad (2)$$

$$\Pr(\text{Credit rationing}_{i,j,t} = 1) = \varphi(\beta_0 + \beta_1 \times \text{Comp}_{j,t} + \zeta \times \text{Com}_{j,t} * \text{Stressed}_{ij,t} + \beta_2 \times X_{i,j,t} + \beta_3 \times \text{BC}_{j,t} + \beta_4 \times \varphi_{s,t} + \beta_5 \times \eta_t + \varepsilon_{ij,t}) \quad (3)$$

We used the Difference-in-Difference approach to assess the impact of the recent European sovereign debt crisis on financing of European SMEs. The reasoning behind the categorization and grouping of countries is that the behavior of firms from stressed economies is different from the behavior of firms from non-stressed economies. Also, using a Difference-in-Difference approach, we test the existence of heterogeneity in the probability of small or medium enterprise to face financial constraints based on the size of a firms. We add to our baseline equation an interaction term between the banking competition and the following dummy variables: (1) Large firms; and (2) Stressed countries.

### 3.3.1. Firm Heterogeneity

Firm characteristics are very important in the process of credit allocation by banks, as these factors provide to the borrower valuable information about the overall business and its growth prospects. In order to capture the heterogeneous effect, we used the interaction between banking competition indicator and a new dummy created variable Large firms following European Commission definition of Small and medium-sized enterprises (EU recommendation 2003/361). Large firms are equal to 0 if the firm has staff headcount less than 50 and is equal to 1 if the firm has more than 50 staff-headcount. Beck et al. [32] outlined that the size of the firm is an important determinant of credit rationing in the lending process and small-sized business entities face less access to external sources of financing due to their increased probability of default, higher associated risk and discontinuity in terms of investment opportunities.

Table 4 reveals several changes in terms of the effect on the probability of a firm to face credit rationing. For example, the sign of the coefficient corresponding to the Large variable shows that there is a negative relationship between the Credit rationing and the size of the firm. In other words, as the firms have many employees, its probability to be credit rationed is diminished. This result is consistent with other researches [21,43] that outlined that small firms experience less availability to external financing, especially due to their increased level of risk and relative opacity.

**Table 4.** Difference in difference by firm size.

	Small	Large	Diff.
Credit rationed	0.409274	0.3322088	0.0771 ***

Note: Significance at \*\*\* 1% level.

Applying the Difference in Difference method, the results depicted in Table 5 show that the probability of a firm to face credit constraints decreases with 0.07% by a decrease in terms of size (i.e., number of employees). Thus, financial constraints are lower as the firm is bigger.

**Table 5.** Heterogeneity of the firm size effect.

Credit Rationing	Model 1	Model 2	Model 3	Model 4	Model 5
	5-Bank Asset Concentration	HHI	Boone Indicator	Lerner Index	H-Statistic
Banking Competition measure	0.0055 *** (0.0008)	0.0063 *** (0.0007)	1.6689 *** (0.2738)	−1.2601 *** (0.1834)	0.2184 ** (0.0945)
Large firm x Banking competition	0.0077 *** (0.0009)	0.0053 *** (0.0008)	1.0009 ** (0.4010)	1.6929 *** (0.2737)	0.4233 ** (0.1754)
Large firms	−0.7529 *** (0.0651)	−0.5378 *** (0.0544)	−0.2218 *** (0.0233)	−0.5908 *** (0.0600)	−0.4769 *** (0.1262)
Size	−0.0603 *** (0.0087)	−0.0591 *** (0.0086)	−0.0534 *** (0.0086)	−0.0663 *** (0.0088)	−0.0517 *** (0.0121)

Table 5. Cont.

Credit Rationing	Model 1	Model 2	Model 3	Model 4	Model 5
	5-Bank Asset Concentration	HHI	Boone Indicator	Lerner Index	H-Statistic
Bank capital-to-asset	−0.1930 *** (0.0117)	−0.1805 *** (0.0106)	−0.1101 *** (0.0110)	−0.1463 *** (0.0107)	−0.1597 *** (0.0146)
Bank NPL	0.0370 *** (0.0026)	0.0364 *** (0.0023)	0.0375 *** (0.0023)	0.0202 *** (0.0041)	0.0304 *** (0.0051)
GDP Growth	−0.0102 (0.0075)	0.0046 (0.0078)	−0.0527 *** (0.0067)	−0.0581 *** (0.0071)	−0.1146 *** (0.0088)
Ease of Doing Business	0.0052 *** (0.0007)	0.0049 *** (0.0007)	0.0004 (0.0006)	0.0032 *** (0.0008)	−0.0037 *** (0.0011)
Domestic credit to private sector	0.0017 *** (0.0003)	0.0019 *** (0.0003)	0.0017 *** (0.0003)	0.0039 *** (0.0003)	0.0036 *** (0.0004)
Chi square p-value	0.0000	0.0000	0.0000	0.0000	0.0000
N. of cases	15,872	16,100	16,100	15,081	8799

Note: Significance at \*\* 5%, \*\*\* 1% level.

Regarding the interaction with the other indicators, the results show an opposite direction in the heterogeneity of the relationship between the probability of facing credit constraints and the Lerner index. The negative sign of the coefficient outlines that an increase with 1% in the market power of the banks is associated with 1.26% decrease in the probability of a firm to be denied credit (/or receive less than demanded), as that firm has many employees, other variables remaining constant. This can be interpreted as, banks strive to supply a higher amount of clients' demand when having more competitors on the market, thus increasing the assets in their balances and decreasing the application of credit rationing for the firms that have a higher number of employees.

### 3.3.2. Heterogeneity across Countries

Starting in 2000, the European banking sectors experienced an extraordinary credit boom, which ended abruptly with the financial crisis of 2008 [44]. We test for the heterogeneity across countries, grouping the investigated countries based on the post-crisis economic environment. We have created a dummy variable *Stressed* that takes the value of 1 for firms from PIIGS countries (Portugal, Italy, Ireland, Greece and Spain) that are characterized by a lower degree of financial and economic recovery caused by the global financial crisis; and value 0 for firms from Austria, Belgium, Finland, France, Germany and The Netherlands.

The univariate analysis results presented in Table 6 show that the probability of a firm to face credit constraints is higher with 2.85% in average, in case of firms from PIIGS countries than in case of firms from other European countries.

Table 6. Difference in difference by country.

	Not Stressed	Stressed	Diff.
Credit rationed	0.8334	0.8619	−0.0285 ***

Note: Significance at \*\*\* 1% level.

The results presented in Table 7 (Models 1 and 2) show that the impact of bank concentration is augmented in case of firms from stressed countries. Similar results are for market power, results of Model 4 shows that the impact of market power measured using Lerner index on Credit rationing is amplified in case of firms from PIIGS countries. When measuring the degree of competition with the H-statistic, firms from the stressed countries are associated with higher levels of credit rationing. In the case of the firms from the countries that suffered more after the late financial crisis, the model shows a

negative sign for the H-statistic, result that enforces the idea that less competitive banking markets display more credit rationing.

**Table 7.** Heterogeneity across countries.

Credit Rationing	Model 1	Model 2	Model 3	Model 4	Model 5
	5-Bank Asset Concentration	HHI	Boone Indicator	Lerner Index	H-Statistic
Banking competition	0.0039 *** (0.0008)	0.0042 *** (0.0008)	3.9580 *** (0.7209)	−0.7008 *** (0.2361)	0.8152 *** (0.1184)
Stressed x Banking competition	0.0086 *** (0.0009)	0.0055 *** (0.0008)	−3.5527 *** (0.7571)	−0.0740 (0.3162)	−1.1461 *** (0.2894)
Stressed	0.3965 *** (0.0919)	0.0358 (0.0729)	0.1665 *** (0.0508)	0.4896 *** (0.0779)	1.1848 *** (0.2429)
Size	−0.1854 *** (0.0135)	−0.1854 *** (0.0134)	−0.2078 *** (0.0132)	−0.1989 *** (0.0138)	−0.1654 *** (0.0184)
Debt-to-assets	−0.0356 *** (0.0088)	−0.0354 *** (0.0087)	−0.0366 *** (0.0087)	−0.0395 *** (0.0090)	−0.0397 *** (0.0122)
Bank capital-to-assets	−0.1468 *** (0.0122)	−0.1254 *** (0.0111)	−0.0545 *** (0.0119)	−0.0957 *** (0.0121)	−0.1459 *** (0.0150)
Bank NPL	0.0247 *** (0.0034)	0.0218 *** (0.0028)	0.0224 *** (0.0029)	−0.0078 (0.0049)	0.0152 ** (0.0074)
GDP Growth	0.0008 (0.0078)	0.0095 (0.0080)	−0.0516 *** (0.0067)	−0.0566 *** (0.0071)	−0.0807 *** (0.0102)
Ease of Doing Business	0.0066 *** (0.0009)	0.0041 *** (0.0008)	−0.0013 * (0.0007)	0.0006 (0.0008)	−0.0040 *** (0.0011)
Domestic credit to private sector	0.0013 *** (0.0004)	0.0016 *** (0.0004)	0.0019 *** (0.0003)	0.0025 *** (0.0003)	0.0014 ** (0.0006)
Chi square p-value	0.0000	0.0000	0.0000	0.0000	0.0000
N. of cases	15,872	16,100	16,100	15,081	8799

Note: Significance at \*\* 5%, \*\*\* 1% level.

#### 4. Conclusions

The present paper examines the effects of banking competition on the European SMEs' access to finance, testing the Market Power Hypothesis against the Information Hypothesis, with special focus on the level of competition and concentration in the European banking sector.

The results of the study confirm the Market Power Hypothesis, outlining that the probability of a small or medium size enterprise to be credit rationed is increased in the case of a banking sector characterized by lower levels of competition and higher levels market power. This means that increased competition in the banking market is associated with more credit availability. The results of our research indicate that there is a positive and significant relationship between bank concentration and credit rationing and the decreased competition is associated with higher levels of credit rationing among SMEs.

The relevance of a financial infrastructure that supports European SMEs access to finance is therefore critical for the successful adoption the United Nations Sustainable Development Goals, namely the promotion of promoting sustainable industrialization and fostering innovation (Goal 9). Policymakers need to promote adequate support for that aim by supporting competitive banking markets and credit availability for SMEs, which is particularly relevant in countries affected by the global financial crisis. From the companies' side, particular attention is needed for risk management and increased transparency to easy the access to credit.

Also, our results show that the probability of being credit constrained is increased for small firms and for firms from countries that have been significantly affected by the global financial crisis.

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## Appendix A

**Table A1.** Variable definitions.

Variable Name	Definition	Source
Credit rationing	A dummy variable that takes the value 1 if the firm applied for a loan and received a smaller or no amount at all and 0 if the firm applied for a loan and received the entire requested amount.	SAFE Survey
Boone Indicator	A measure of degree of competition based on profit-efficiency in the banking market. It is calculated as the elasticity of profits to marginal costs. An increase in the Boone indicator implies a deterioration of the competitive conduct of financial intermediaries.	World Bank
H-statistic	A measure of the degree of competition in the banking market. It measures the elasticity of banks revenues relative to input prices. Under perfect competition, an increase in input prices raises both marginal costs and total revenues by the same amount, and hence the H-statistic equals 1. Under a monopoly, an increase in input prices results in a rise in marginal costs, a fall in output, and a decline in revenues, leading to an H-statistic less than or equal to 0. When H-statistic is between 0 and 1, the system operates under monopolistic competition. However, it is possible for H-stat to be greater than 1 in some oligopolistic markets.	World Bank
5-bank asset concentration	Assets of five largest banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax, discontinued operations and other assets.	World Bank
HHI	A country-level indicator of bank concentration, measured by the Herfindahl Hirschman Index, with higher values indicating greater market concentration.	World Bank
Lerner Index	A measure of market power in the banking market. It compares output pricing and marginal costs (that is, markup). An increase in the Lerner index indicates a deterioration of the competitive conduct of financial intermediaries.	World Bank
GDP growth (%)	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.	World Bank
Ease of Doing Business Index	Ease of doing business is an index published by the World Bank. It is an aggregate figure that includes different parameters which define the ease of doing business in a country.	World Bank

Table A1. Cont.

Variable Name	Definition	Source
Domestic credit to private sector by banks (% of GDP)	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.	World Bank
Bank capital to assets ratio (%)	Ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. Capital includes tier 1 capital (paid-up shares and common stock), which is a common feature in all countries' banking systems, and total regulatory capital, which includes several specified types of subordinated debt instruments that need not be repaid if the funds are required to maintain minimum capital levels (these comprise tier 2 and tier 3 capital). Total assets include all nonfinancial and financial assets.	World Bank
Bank nonperforming loans to total gross loans (%)	Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as nonperforming includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue.	World Bank
Size	Micro-firm (1–9 employees); Small (10–49 employees); Medium-sized (50–249 employees)	SAFE Survey
Debt-to-assets ratio	Indicates the proportion of a company's assets that are being financed with debt, rather than equity.	SAFE Survey
Industry	Mining, Wholesale, Manufacturing, Construction, Transport, Real Estate.	SAFE Survey

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