A Disequilibrium Model for Estimating Credit Rationing in Private Small and Medium Enterprises: The Role of Size and Ownership Concentration

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Abstract

Using a large panel data set of Italian private SMEs, this paper estimates a disequilibrium model of demand and supply of credit in the period 2007-2011. We find that private SMEs were credit rationed during the crisis. On the demand side, firms which requested more bank credit were smaller firms, showing higher short and long term financing needs, fewer available internal sources, fewer substitutes for bank finance and lower cost of bank credit. Economic sentiment exerts a positive effect on the demand for loans. On the supply side, loans were reduced more to smaller and riskier firms. Banks preferred to allocate new credit to SMEs which could offer collateral and showed higher increase in sales. Willingness to lend and credit deterioration have respectively a positive and a negative impact on the bank supply of credit. Finally, banks appear to consider a strong ownership concentration a negative element in willingness to lend.

Keywords: Credit demand, credit supply, credit rationing, SMEs, financial constraints.

JEL Classification: E51, G01

1. Introduction

The financial crisis which erupted in September 2008 with the collapse of Lehman Brothers turned quickly into an economic crisis. Given that banks are an important source of funding for small and medium enterprises (SMEs), the financial sector is in fact closely linked to the real sector. This is especially true in the Euro zone, where capital markets are relatively undeveloped compared to the USA and there are many SMEs. Most European financial systems are in fact intermediary-oriented rather than market-oriented.

Since 2008 there has been a wide-ranging debate on whether European banks have reduced lending to SMEs. The discussion centers not on whether SMEs have received less credit from banks during the crisis than in the past, but on why this happened. In other words, have European banks reduced lending to firms or have SMEs reduced their demand for credit? This paper tries to answer these questions focusing on the Italian market in the period 2007-2011.

From a theoretical point of view, the sudden dry up in bank liquidity could have affected the availability of credit for firms. Dropin liquidity for banks may have impacted on the supply of credit for enterprises, especially for those unable to access external sources of funds other than banks, such as trade credit or financial markets. This is particularly relevant for private Italian SMEs, as their opacity makes it difficult to access funds from other sources.

On the other hand, firms might alsohave reduced their demand for credit. Since 2008, Italian companies have experienced progressive reductions in sales, profitability and cash flows. The companies most affected by the declines in profits are the smaller ones. The financial difficulties related to the reduction of income are associated with marked lengthening of payment terms for customers. This has led many enterprises in turn to delay payments to suppliers. Shock, which was large and persistent, has come to represent one of the main channels of transmission of liquidity strains within the production system. The weak accumulation of capital could in fact decisively contribute to limiting the financing needs of companies. Existing literature has investigated whether reductions in credit lending during the recent crisis were caused by demand-side or supply-side factors.Previous empirical results conflict, and do not point to conclusive evidence of a capital-related contraction of credit supply in Europe during the recent crisis. The identification of changes in credit supply is particularly difficult because of the need to take into account changes in the demand for credit (Udell 2009; Albertazzi and Marchetti 2010).

Our paper tries to overcome this gap and empirically investigate the existence of credit rationing in the Italian corporate bank loan market by estimating the demand-supply disequilibrium model for bank credit. From this model, we derive the proportion of credit rationed companies using a panel data set of private Italian SMEs for the period 2007-2011.

This study contributes to previous literature on different counts. First, our paper is the first to investigate the Italian credit market during the recent crisis by applying a disequilibrium model. Second, this study is one of the few using a large sample of private SMEs. Third, to our knowledge, this is the first paper to study the relationship between ownership concentration and credit rationing. The remainder of the paper is organized as follows: the literature on credit rationing is summarized in Section 2 and the methodology and the sample are described in Sections 3 and 4.The results are discussed in Section 5. Lastly, the conclusions of the study are presented in Section 6.

2. Literature review

The literature on credit rationing is mainly based on the assumption of the existence of asymmetric information between borrowers (firms) and lenders (banks). In equilibrium with credit rationing, demand exceeds supply at the current interest rate, and the result is a situation of under-investment by firms. Credit rationing is often a problem for SMEs, for which the banking system plays a crucial role in the provision of external finance. Since SMEs are often unable to access other markets for funds, banks are their main external source of funds (Berger and Udell 1998; Robb and Robinson 2009), helping them to substitute expensive trade credit (Fisman and Love 2003).

With the recent international financial crisis, the issue of credit rationing to SMEs has become urgent.Several authors have investigated whether reductions in lending were caused by demand-side or supply-side factors in the European context.On the one hand, credit supply is affected by the banks' balance-sheet strength, the *bank lending channel*(Adrian and Shin 2010). On the other hand, demand is affected by the firm balance-sheet strength, the firm *balance-sheet channel* (Bernanke et al. 1996).

Different strategies have been used in the literature in order to identify supply shocks.

One strategy consists of using credit registry data on firms that have multiple lenders (Albertazzi and Marchetti 2010; Puri et al. 2011; Jimenez et al. 2012; Iyer et al. 2014).Using this strategy, Jimenez et al. (2012), focussing on the effect of firm balance-sheet strength on loan granting, show that Spanish firm heterogeneity in balance-sheet strength determines the probability a loan is granted to the firm applying in both good and crisis times. The authors therefore suggest that reductions in business lending in Spain during the financial crisis were predominantly caused by supply effects. Uri et al. (2011) and Iyer et al. (2014) reach the same results studying the effects of the crisis in Germany in 2006-2008 and in Portugal in 2007-2009. Moreover, Albertazzi and Marchetti (2010) show evidence of a contraction of credit supply in the Italian credit market in the period September 2008-March 2009. Quite strikingly, they find that larger less-capitalized banks reallocated their credit away from riskier firms (the "*flight to quality effect*"), but smaller less-capitalized banks did not.

A second approach to identifying supply shock is to use survey data that contains information on loan applications (Popov and Udell 2010, 2012; Rottmann and Wollmershauser 2013; Presbitero et al. 2014).In this context, Popov and Udell (2010) find that both demand and supply factors led to lower SME lending in 14 European countries in the early stage of the 2007-2008 financial crisis.

They find that European banks experiencing stress to their assets and equity values extended less credit: the decline in credit was greater among high-risk firms and companies with fewer tangible assets. These results were confirmed by a subsequent analysis on 16 emerging European countries (Popov and Udell 2012).Presbitero et al. (2014) come to the same conclusions with reference to the Italian market. They find evidence that in Italy there was a significant contraction in both demand and supply of credit in the period 2008-2009.Moreover, Rottmann and Wollmershauser (2013) find that in the period 2008-2009 only large German firms reportedless willingness by banks to grant credit. They therefore argue that in Germany reductions in SME lending were caused only by demand-side factors.

A third alternative approachto identifying supply shock is to apply a disequilibrium model to identify credit constrained firms (Kremp and Sevestre 2013; Farinha and Felix 2015). Kremp and Sevestre (2013),focusing on the French credit market in the period 2000-2010, show that since 2008 most of the observed reduction in outstanding loans is explained by the decrease in French SMEs' demand for credit, following a big decline in their business and investment projects. Moreover, Farinha and Felix (2015) demonstrate that a considerable fraction of Portuguese SMEs were credit constrained between 2010 and 2012. The studies described above show different results and do not yield conclusive evidence of a capital-related contraction of credit supply in Europe during the recent crisis. The identification of changes in credit supply is particularly difficult because of the need to take into account variation in the demand for credit (Udell 2009; Albertazzi and Marchetti 2010).

Our paper tries to overcome this gap and empirically investigate the existence of credit rationing in the Italian corporate bank loan market by estimating the demand-supply disequilibrium model for bank credit. From this model, we derive the proportion of credit rationed companies using a panel data set of private Italian SMEs for the period 2007-2011.

In the study of the restrictions to credit supply, Italy is an excellent laboratory for three main reasons. First, although Italian banks have been affected by the financial crisis, their systemic stability has not been endangered (Panetta et. al. 2009; De Mitri et al. 2010). Second, among European countries, the Italian market has the largest percentage of private SMEs in its economic system. Third, and most importantly, Italy is a bank-oriented economy and, for this reason, changes in credit supply can make a big impact. Lastly, thanks to common economic and banking features, the analysis of the Italian credit market during the crisis can help us to understand the changes in continental intermediary-oriented in general. In order to investigate the demand and supply dynamics in the credit market during the crisis, this paper aims to verify the following hypothesis:

H_1: Reduction in bank lending for Italian private SMEs during the recent crisis was caused by both demand-side and supply-side factors.

A number of studies have tried to identify what kind of firms are more exposed to credit tightening (Bagella et al. 2001; Becchetti and Trovato 2002; Presbitero et al. 2014).Pre-crisis literature shows that SME financial constraints are inversely related to firm size (Bagella et al. 2001; Becchetti and Trovato 2002). Is this relationship confirmed during the recent crisis? To answer this question, we verify the following hypothesis:

H_2: Reduction in bank lending for Italian private SMEs during the recent crisis was greater for smaller companies.

Finally, we investigate if ownership concentration in Italian private firms can impact their financial constraints. We test the following hypothesis:

H_3: Reduction in bank lending for Italian private SMEs during the recent crisis was greater for concentrated ownership companies.

The first contribution to the literature is that this is the first paper to investigate the Italian credit market during the recent crisis by applying a disequilibrium model. Second, our paper is one of the few using a large sample of private SMEs. Specifically, we focus on 113,503observations of 33,066non-listed Italian companies between 2007 and 2011. Third, to our knowledge, this is the first paper in this field studying the relationship between ownership concentration and credit rationing.

3. Methodology

We empirically investigate the existence of credit rationing in the Italian corporate bank loan market by estimating a demand-supply disequilibrium model for bank credit. We suppose that credit demand and supply curves (where the supply curve is intended at the firm level and its location is related to the market interest rate and to the firm risk)can be represented according to the Bank of Italy diagram (Panetta and Signoretti 2010): when demand is low, the amount of loans is *demand-driven*; but when demand is high, demand does not intersect with supply and the maximum supply determines the amount of loans lent to firms. In order to investigate the existence of credit rationing (i.e. disequilibrium in the credit market), we estimate the following simultaneous equations (Kremp and Sevestre 2013; Farinha and Felix 2015): (i) a demand equation L_t^d; (ii) a supply equation L_t^s; (iii) and a transaction equation L_t.

$$L_t^d = \beta_1 x_{1t} + \varepsilon_{1t} \quad (1)$$

$$L_t^s = \beta_2 x_{2t} + \varepsilon_{2t} \quad (2)$$

$$L_t = \min (L_t^d, L_t^s) \quad (3)$$

Wherex1t and x_{2t} are exogenous and independent vectors, β_1 andβ_2 are their coefficients and ε_{1t} andε_{2t} are disturbance terms. In our model, only the amount of bank credit received (L_t) is observed, while L_t^d and L_t^s are the results of estimations. Equation (3) links the observed amount of bank loans received by firms to the unobserved demand and supply. Specifically, our model assumes that the observed amount of bank credit is the minimum of supply and demand. This system of equations is estimated through the maximum likelihood method.The demand equation L_t^d (1) depends on the following variables:

1) Firm size: we expect that smaller companies request more bank credit than larger firms, given that they are unable to access external sources of funds other than banks, such as trade credit or financial markets (Kremp and Sevestre 2013; Farinha and Felix 2015).

2) Short-term financing needs: we assume that firms showing the highest increases in working capital in the year *t* compared to year *t-1* will exhibit the greatest need for short-term credit (Kremp and Sevestre 2013; Farinha and Felix 2015). We proxy short-term financing needs with the increase in working capital over total assets, although most previous papers use sales to account.

3) Long-term financing needs: we hypothesize that firms with greater long-term financing needs show a higher demand for bank credit (Kremp and Sevestre 2013; Farinha and Felix 2015).

4) Internal available resources: according to the "*pecking order theory*" (Fama and French 2002), firms choose their financial resources following a precise order. Companies prefer internal available sources and, when these are not sufficient, they look for external sources such as bank credit. For this reason, we assume that the demand for bank credit increases if a firm has fewer available internal sources (Kremp and Sevestre 2013; Farinha and Felix 2015).

5) Substitutes for bank finance: we assume that firms with more substitutes for bank finance show a lower demand for bank credit (Kremp and Sevestre 2013; Farinha and Felix 2015). Other sources of external available finance are taken into account through non-bank financial debt over total assets and commercial debt over total assets. Commercial debt allows for the role of trade credit as a cheaper and alternative source of short-term finance.

6) Cost of bank debt: we expect that the demand for bank credit decreases if the cost of bank credit is high (Kremp and Sevestre 2013; Farinha and Felix 2015).

7) Economic Sentiment Indicator (ESI): we assume that the demand for bank credit, in general, increases if the Economic Sentiment Indicator Increases. The ESI index is a proxy of economic optimism; it is a composite indicator calculated by Eurostat comprising five sectorial confidence indicators (Industrial, Services, Consumer, Construction and Retail trade). Each confidence indicator is an arithmetical average of seasonally adjusted balances of answers to a selection of questions related to the reference variable.

8) Real Gross Domestic Product growth (GDP): we expect that the demand for bank credit increases if the real gross domestic product growth increases. The roles of GDP and ESIaresimilar, except that ESI is mainly influenced by expectations and GDP is related to past macroeconomic data.

The supply equation L_t^S (2) depends on the following variables:

1) Firm size: we expect that banks have reduced lending more to smaller firms than to larger ones, as smaller firms have higher failure rates than larger ones (Hall 1992; Kremp and Sevestre 2013; Farinha and Felix 2015).

2) Firm default risk: *ceteris paribus*, banks prefer to offer credit to companies characterized by a low level of default risk, for which the repayment of the loans is more certain (Kremp and Sevestre 2013). Following Albertazzi and Marchetti (2010), we proxy the firm default risk by Altman Z-score estimated for private companies (Altman 1968, 1977). This measure predicts the probability that a firm will go into bankruptcy within two years, and is proven to be suitable for Italian companies (Altman et al. 2013). The Z-score estimated for private companies is a linear combination of five business ratios, weighted by coefficients, according to the following formula:

$$Z = 0.717x_1 + 0.847x_2 + 3.107x_3 + 0.420x_4 + 0.998x_5 \quad (4)$$

Where x_1 = (current assets – current liabilities) / total assets; x_2 = retained earnings / total assets; x_3 = earnings before interest and taxes / total assets; x_4 = book value of equity / total liabilities; x_5 = sales/ total assets.

3) Ability to provide collateral: as suggested by Kremp and Sevestre (2013) and Farinha and Felix (2015), we assume that banks prefer to allocate new credit to firms which can offer collateral, given that this can have a signalling value (Bester 1987), and this reduces the information asymmetry between SMEs and financial companies (Chan and Kanatas 1985). In the case of firm default, banks can sell the collateral obtained, thus recovering their loans totally or partially.

4) Change in sales: we expect firms with bigger decrease in sales to be more financially constrained.

5) Ownership concentration: we assume that banks prefer to allocate new credit to firms with lower concentrated ownership. Concentrated ownership in fact has negative consequences for firms, including higher cost of capital due to fewer diversification opportunities for investors (Fama and Jensen 1983a, 1983b) and the possibility that large shareholders deprive small owners of their part of residual income. We measure ownership concentration by the BVD Independence Ratio. This ratio, available from the AIDA database, classifies firms into four groups: (i) no shareholder holding more than 25% of equity capital (independent companies); (ii) one or more shareholder holding more than 25% of equity capital, but not over 50%; (iii) more than one shareholder jointly holding more than 50% of equity capital (indirectly majority owned companies); (iv) at least one shareholder holding more than 50% of equity capital (directly majority owned companies). We proxy ownership concentration by a scale from 1 (independent companies) to 4 (directly majority owned companies).

6) Willingness to lend: we expect that credit supply is high when willingness to lend is high.

7) Credit deterioration: we assume that banks prefer to allocate new credit when credit deterioration is low.

Table 1 shows the definition of the variables used in the paper.

Table 1: Definition of variables

Variables	Symbol	Definition and calculation model
Firm size[a]	Size	Calculated as the natural logarithm of firm's total assets
Short-term financing needs[a]	ST_Fin	Estimated through the increase in working capital over total assets. Working capital is calculated as the sum of trade credit and inventories, net of commercial debt
Estimated short-term financing needs[a]	$E[ST\_Fin_t]$	Measured by an auxiliary regression, including only exogenous variables (instruments) in order to avoid endogeneity estimation problems
Long-term financing needs[a]	LT_Fin	Calculated as the amount of firm investment over total assets
Estimated long-term financing needs[a]	$E[LT\_Fin_t]$	Measured by an auxiliary regression including only exogenous variables (instruments)in order to avoid endogeneity estimation problems
Internal available resources[a]	Cash	Calculated asthe company cash flow over total assets
Financial substitute for bank finance[a]	Sub_f	Calculated asthe firm non-bank financial debt over total assets
Commercial substitute for bank finance[a]	Sub_c	Calculated asthe firm commercial debt over total assets
Cost of bank debt[a]	Int	Calculated asthe ratio of firm interest expenses over total debt
Economic Sentiment Indicator[b]	ESI	Composite indicator calculated by Eurostat and made up of five sectorial confidence indicators (Industrial, Services, Consumer, Construction and Retail trade).Confidence indicators are arithmetic means of seasonally averages of answers to a selection of questions closely related to the reference variable they are supposed to track. ESI is calculated as an index with mean value of 100 and standard deviation of 10 over a fixed standardised sample period
Real gross domestic product growth[c]	GDP	Measured by the growth of the total market value of all final goods and services produced in a country in a given year, equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports
Firm default risk[a]	Z_score	Proxied by Altman Z-score estimated for private companies
Ability to provide collateral[a]	Coll	Calculated by tangible assets over total assets
Change in sales[a]	ΔSales	Measured by the change of natural logarithm of sales between *t* and *t-1*
Ownership concentration[a]	Own	Measured by a scale coming from 1 (independent companies) to 4 (directly majority owned companies)
Willingness to lend[d]	Will	Calculated as the ratio of total net loans and total customer deposits considering all the Italian banking system
Credit deterioration[e]	C_Det	Calculated as the ratio of new non-performing loans on total loans considering all Italian banks
Change in total amount of bank loans[a]	L_t^d , L_t^s, $\Delta\log(Bank_{tot})$	Measured by the change in natural logarithm of total amount of bank loans between *t* and *t-1*

[a]Denotes that data source is AIDA.[b] Denotes that data source is Eurostat.[c] Denotes that data source is ISTAT (Italian National Institute of Statistics).[d] Denotes that data source is Bankscope.[e] Denotes that data source is Bankit.

Since there might be significant biases in the parameters of "short-term financing needs" (ST_Fin) and "long-term financing needs" (LT_Fin) caused by their probable endogenity, we also substitute these variables by their estimations (E[ST_Fin] and E[LT_Fin]). These estimations come from two auxiliary regressions. The estimations however are not available for some firms, and this procedure caused a reduction in the sample size from 113,503 observations of 33,066 companies to 96,215 observations of 29,152 companies. The disequilibrium model we consider is the following:

$$L_t^d = \alpha + \beta_1 Size_{t-1} + \beta_2 ST\_Fin_t + \beta_3 LT\_Fin_t + \beta_4 Cash_t + \beta_5 Sub\_f_t + \beta_6 Sub\_c_t + \beta_7 Int_{t-1} + \beta_8 Esi_t + \beta_9 GDP_{t-1} + \varepsilon_d \quad (5a)$$

$$L_t^d = \alpha + \beta_1 Size_{t-1} + \beta_2 E[ST\_Fin_t] + \beta_3 E[LT\_Fin_t] + \beta_4 Cash_t + \beta_5 Sub\_f_t + \beta_6 Sub\_c_t + \beta_7 Int_{t-1} + \beta_8 Esi_t + \beta_9 GDP_{t-1} + \varepsilon_d \quad (5b)$$

$$L_t^s = \alpha + \gamma_1 Size_t + \gamma_2 Z\_score_{t-1} + \gamma_3 Coll_t + \gamma_4 \Delta Sales_t + \gamma_5 Own_t + \gamma_6 Will_t + \gamma_7 C\_Det_t + \varepsilon_s \quad (6)$$

$$L_t = \min (L_t^d, L_t^s) \quad (3)$$

where L_t^d and L_t^s are the change in total amount of bank loans. Moreover, we measure credit rationing according to two different models. Model 1 (Kremp and Sevestre 2013) consists of computing the unconditional probability of a partial credit rationing as follows:

$$\Pr(\text{Partial rationing}) = \Pr(X_d b_d + u_d > X_s b_s + u_s) = \Pr(X_d b_d - X_s b_s > u_s - u_d) =$$

$$= \Pr(((X_d b_d - X_s b_s) / \sigma) > ((u_s - u_d) / \sigma))) = \Phi((X_d b_d - X_s b_s) / \sigma) \quad (7)$$

where X_d and X_s represent respectively the explanatory factors of the demand for loans and supply of loans, b_d and b_s their coefficients, u_d and u_s the unobserved factors that may respectively affect the demand and supply of loans, which may be correlated with each other, and $\sigma^2 = var(u_s - u_d)$.Finally, Model 2 estimates the conditional probability, i.e. the probability of partial rationing, conditional on the observed amount of loans (Kremp and Sevestre 2013). Conditional probability, which differs from unconditional probability when variances of the disturbances of the supply and demand equations significantly differ from each other, is calculated as follows:

$$\Pr(\text{Partial rationing} / NL_t) = \frac{f_s(NL_t)(1 - F_d(NL_t))}{f_d(NL_t)(1 - F_s(NL_t)) + f_s(NL_t)(1 - F_d(NL_t))} \quad (8)$$

Where NL_t are new loans at time *t*;$f_d(NL_t) = (1/\sigma_d\sqrt{2\pi})\exp((-1/2\sigma^2_d (NL_t - X_{d,t}b_d)^2)$ is the density function of loans if demand is observed; $F_d = \phi(((NL_t - X_{d,t}b_d) - \rho(\sigma_d / \sigma_s)(NL_t - X_{s,t}b_s))/(\sigma^2_d\sqrt{1-\rho^2}))$ is the corresponding cumulative function, accounting for a possible correlation with the supply equation; $f_s(NL_t) = (1/\sigma_s\sqrt{2\pi})\exp((-1/2\sigma^2_s (NL_t - X_{s,t}b_s)^2)$ is the density function of loans if supply is observed; $F_s = \phi(((NL_t - X_{s,t}b_s) - \rho(\sigma_s/\sigma_d)(NL_t - X_{d,t}b_d))/(\sigma^2_s\sqrt{1-\rho^2}))$ is the corresponding cumulative function. We compute this probability and consider that a firm was credit rationed whenever it is greater than 0.5.

Sample

Following Atanasova and Wilson (2004), we use a panel data set to estimate the disequilibrium model of Italian SME corporate bank lending. From the Bureau Van Dijk AIDA database, we initially take all Italian unlisted companies which provide detailed financial statements in every year in the 2006-2011 period. We eliminate those firms whose turnover was below 2 million euros (micro firms in the EU definition) and over 50 million euros (large firms in the EU definition).Like Opler et al. (1999), we exclude financial and public service companies. We then eliminate those firm-year observations reporting negative and null sales and a negative cost of debt. We also exclude those firms with non-positive amount of loans, as zero loans usually means loans are not available, firms with negative or null liquidity index (Bigelli and Sánchez-Vidal 2012) and bankrupt firms. Finally, we eliminate those firm-year observations giving outliers in estimations and reporting a negative firm equity. The final sample comprises 33,066 Italian SMEs, yielding an aggregate sample of 113,503observations.Table 2 reports the distribution of observations over different years for our sample.

Table 2: Distribution of observations over years

Year	Number of firms per year	Number of firms - percentage	Number of firms (cumulative)	Number of firms - percentage (cumulative)
2007	21,900	19.29	21,900	19.29
2008	22,163	19.53	44,063	38.82
2009	22,847	20.13	66,910	58.95
2010	23,275	20.51	90,185	79.46
2011	23,318	20.54	113,503	100.00
Total	113,503	100.00	113,503	100.00

Table 2 shows the number of observations of 33,066 non-listed Italian companies in the period 2007-2011. The data source is AIDA.

Table 2shows that the number of observations is well distributed among the period, with between 21,900 and 23,318 observations for each year. Looking at the distribution of observations across industries, (Table 3),"Wholesale", "Construction" and “Wood and paper paste” industries contribute most with over 44% of the total observations.

Table 3: Distribution of observations over industry

	2007	2008	2009	2010	2011	Total
Agriculture	188	183	186	187	182	926
Mining	120	103	114	114	110	561
Manufacturing	1,097	1,098	1,105	1,164	1,157	5,621
Textiles and clothes	1,320	1,301	1,268	1,254	1,230	6,373
Wood and paper paste	2,593	2,534	2,561	2,518	2,536	12,742
Metallurgy	1,917	1,941	2,018	2,000	2,007	9,883
Electronics	2,015	2,028	2,123	2,133	2,122	10,421
Automotive	292	300	314	329	329	1,564
Furniture	454	433	437	438	420	2,182
Other manufacturing	375	365	380	383	382	1,885
Energy	499	527	568	612	641	2,847
Construction	2,446	2,507	2,603	2,731	2,768	13,055
Wholesale	4,736	4,825	4,962	4,902	4,880	24,305
Retail commerce	788	830	861	924	917	4,320
Transport	869	885	897	942	920	4,513
Service	268	278	297	298	301	1,442
Communication	179	188	177	205	187	936
Informatics	262	295	300	322	343	1,522
Advisory	619	652	728	828	838	3,665
Tourism	357	373	415	453	465	2,063
Education	24	27	25	22	25	123
Health	308	306	302	311	336	1,563
Entertainment	87	88	102	95	100	472
Other services	87	96	104	110	122	519
Total	21,900	22,163	22,847	23,275	23,318	113,503

Table 3 shows the number of observations of 33,066 non-listed Italian companies in the period 2007-2011 over different industries. The data source is AIDA.

The sample is in general representative of the Italian economy as a whole, both geographically and in terms of industry breakdown. The data refer only to Italy, but give an insight into the whole Eurozone. Italian credit growth as well as many other quantitative aspects of the Italian loan market is, in fact, very similar to corresponding aspects in the whole area. For example, the correlation between Italian and European series of credit growth, bank interest rates, and the various European Central Bank (ECB) survey indices, is very high.

Table 4 reports some descriptive statistics for the variables used, while Table 5 shows the correlations between the independent variables. The results appear to support the theory that every independent variable has its own informative value in explaining the dependent variable.

Table 4: Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
$Size_t$	16.258	16.223	23.276	11.187	0.953	0.269	4.408
$Size_{t-1}$	16.212	16.173	23.028	10.792	0.952	0.241	4.520
ST_Fin_t	0.009	0.010	5.783	-5.053	0.131	-1.494	81.286
LT_Fin_t	0.019	0.000	0.986	-0.995	0.093	1.048	18.493
$Cash_t$	0.042	0.034	0.860	-0.961	0.062	-0.39	22.963
Sub_f_t	0.026	0.000	0.952	-0.137	0.070	4.512	29.968
Sub_c_t	0.253	0.227	1.211	-0.642	0.162	0.862	3.726
Int_{t-1}	5.974	5.450	20.000	0.000	3.917	0.907	4.077
Z_score_{t-1}	1.561	1.447	13.744	-1.381	0.908	2.041	15.578
$Coll_t$	0.231	0.173	0.998	-0.042	0.214	1.073	3.637
$\Delta Sales_t$	0.000	0.021	14.691	-12.655	0.468	-0.475	77.825
Own_t	3.048	4.000	4.000	1.000	1.123	-0.484	1.558

Table 4 shows descriptive statistics of the sample.The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2011. Variables are defined in Table 1.

Table 5: Correlation matrix

	$Size_{t-1}$	$Size_t$	ST_Fin_t	LT_Fin_t	$Cash_t$	Sub_f_t	Sub_c_t	Int_{t-1}	Z_score_{t-1}	$Coll_t$	$\Delta Sales_t$	Own_t
$Size_{t-1}$	1	0.976	-0.061	-0.012	-0.052	0.005	-0.361	-0.076	-0.439	0.204	-0.051	0.056
$Size_t$	0.976	1	0.027	0.095	-0.027	0.002	-0.347	-0.078	-0.426	0.206	0.003	0.056
ST_Fin_t	-0.061	0.027	1	-0.052	0.102	0.002	-0.028	0.000	0.038	-0.063	0.046	-0.007
LT_Fin_t	-0.012	0.095	-0.052	1	0.009	-0.003	-0.065	0.012	0.023	0.191	0.041	-0.019
$Cash_t$	-0.052	-0.027	0.102	0.009	1	-0.078	-0.032	-0.061	0.179	0.062	0.131	-0.005
Sub_f_t	0.005	0.002	0.002	-0.003	-0.078	1	-0.118	0.047	-0.093	0.044	-0.015	0.018
Sub_c_t	-0.361	-0.347	-0.028	-0.065	-0.032	-0.118	1	0.063	0.396	-0.369	0.096	-0.028
Int_{t-1}	-0.076	-0.078	0.000	0.012	-0.061	0.047	0.063	1	0.041	-0.021	-0.060	-0.000
Z_score_{t-1}	-0.439	-0.426	0.038	0.023	0.179	-0.093	0.396	0.041	1	-0.343	-0.097	-0.030
$Coll_t$	0.204	0.206	-0.063	0.191	0.062	0.044	-0.369	-0.021	-0.343	1	-0.023	-0.048
$\Delta Sales_t$	-0.051	0.003	0.046	0.041	0.131	-0.015	0.096	-0.060	-0.097	-0.023	1	0.004
Own_t	0.056	0.056	-0.007	-0.019	-0.005	0.018	-0.028	-0.000	-0.030	-0.048	0.004	1

Table 5 shows the correlation matrix of the independent variables. The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2011.Variables are defined in Table 1.

4. Results

4.1 Estimation results

Results of the disequilibrium model for corporate bank lending 2007-2011are reported in Table 6. We hypothesize that residual distribution is a Student's t with three degrees of freedom, as we found this distribution to be the best representative of the residual kurtosis.

Table 6: Demand and supply of credit

	Equation	(a)			(b)		
		L_t^d calculated following equation (5a)			L_t^d calculated following equation (5b)		
	Variables	Coefficient	Std. Error	Probability	Coefficient	Std. Error	Probability
L_t^d	const	0.1470***	0.0249	0.0000	-0.0129	0.0352	0.7140
	$Size_{t-1}$	-0.0144***	0.0012	0.0000	-0.0191***	0.0017	0.0000
	ST_Fin_t	1.7345***	0.0078	0.0000	-	-	-
	LT_Fin_t	1.5718***	0.0124	0.0000	-	-	-
	$E[ST\_Fin_t]$	-	-	-	4.1951***	0.0686	0.0000
	$E[LT\_Fin_t]$	-	-	-	5.1127***	0.0885	0.0000
	$Cash_t$	-1.2310***	0.0158	0.0000	-1.2542***	0.0254	0.0000
	Sub_f_t	-0.2179***	0.0142	0.0000	-0.1996***	0.0169	0.0000
	Sub_c_t	-0.0032	0.0066	0.6234	-0.6759***	0.0129	0.0000
	Int_{t-1}	-0.0006***	0.0002	0.0079	-0.0014***	0.0003	0.0000
	ESIF	0.0016***	0.0001	0.0000	0.0053***	0.0002	0.0000
	$gGDP_{t-1}$	0.0048***	0.0004	0.0000	0.0004	0.0006	0.5268
L_t^s	const	-0.6212***	0.1068	0.0000	-1.5363***	0.1074	0.0000
	$Size_t$	0.0674***	0.0063	0.0000	0.1128***	0.0068	0.0000
	Z_score_{t-1}	0.1157***	0.0080	0.0000	0.0469***	0.0061	0.0000
	$Coll_t$	0.0000	0.0229	0.9990	0.1301***	0.0306	0.0000
	$\Delta Sales_t$	0.1389***	0.0067	0.0000	0.1815***	0.0070	0.0000
	Own_t	-0.0369***	0.0057	0.0000	-0.0213***	0.0048	0.0000
	Will	0.1163***	0.0076	0.0000	0.0408***	0.0068	0.0000
	C_Det	-0.1566***	0.0077	0.0000	-0.0326***	0.0057	0.0000
	σ_d	0.2324***	0.0009	0.0000	0.2388***	0.0012	0.0000
	ρ	0.6697***	0.0158	0.0000	0.6792***	0.0186	0.0000
	σ_s	0.3986***	0.0057	0.0000	0.3733***	0.0061	0.0000
	Log likelihood	-52,043			-42,833		
	Avg. log likelihood	-0.4585			-0.4452		
	Number of Coefs.	21			21		
	N. of observations	113,503			96,215		

Table 6 reports the results of the disequilibrium model. The estimation is performed by means of the LLM (log-likelihood method) statistical package E-views 8.1. Variables are defined in Table 1. Column (a) shows the results of the disequilibrium model applied to Equations (3), (5a) and (6), where the dependent variable is the change in natural logarithm of total amount of bank loans between *t* and *t*-1. The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2011.Column (b) shows the results of the disequilibrium model applied to Equations (3), (5b) and (6), where the dependent variable is the change in natural logarithm of total amount of bank loans between *t* and *t*-1. The sample consists of 96,215 observations of 29,152 non-listed Italian companies between 2007 and 2011.

All parameters shown in Table 6 have the expected signs. In particular, the macro-variables Economic Sentiment Indicator and real Gross Domestic Product growth exert a positive effect on the demand for loans. Moreover, propensities to lend and credit deterioration have a positive and a negative impact on the bank supply of credit, respectively.

The coefficients of E[ST_Fin] and E[LT_Fin]in Equation (b) Table 6are much higher than the corresponding coefficients in Equation (a) Table 6, but comparing Column (a) and Column (b) in Table 6 all the other parameters are almost the same. This means that when the increase in bank loans is lower than demand, the amount of short and long term financing needs is lower than desired. Ignoring this effect could cause a bias, which is confirmed by the test reported by Hurn and Muscatelli (1992) and Engle and Hendry (1993). This test consists of estimating Equation (a) after adding the residuals (ST_Fint-E[ST_Fint]) and (LT_Fint-E[LT_Fint]) to its repressors. The high significance of their coefficients confirms the strong bias caused by endogeneity. For this reason, we consider Equation (b) as our main result, and the discussion below is based on this Equation.

As regards the demand equation, all economic independent variables are significant at 1% level. More specifically, the dependent variable is inversely related to firm size: this means that smaller firms requested more bank credit than larger ones, as shown by Atanasova and Wilson (2004), Carbo-Valverde et al. (2009), Iyeret al. (2014) and Farinha and Felix(2015).Second, companies registering higher increase in working capital as well in investments exhibit higher demand for credit. This confirms the findings of Kremp and Sevestre (2013) and Farinha and Felix (2015).Third, the demand for loans increases if a firm has fewer available internal sources. This evidence supports the "*pecking order theory*" (Fama and French 2002) according to which companies prefer internal resources to bank credit, as suggested by Atanasova and Wilson (2004), Carbo-Valverde et al. (2009), Kremp and Sevestre (2013) and Farinha and Felix (2015). As predicted, SMEs with more available substitutes for bank finance (i.e. non-bank financial debts and commercial debts) show a lower demand for loans. Moreover, the coefficient of the cost of bank debt is significantly negative. This means that a higher interest rate applied by financial companies reduces the desire for bank credit, as shown by Carbo-Valverde et al. (2009), Kremp and Sevestre (2013) and Farinha and Felix (2015).

As regards the supply equation, the results are consistent with our expectations, as all explanatory economic variables are found significant at 1% level. Firm size shows a significant positive effect on the amount of bank credit supplied to the company. This means that in the credit rationing process, banks reduced lending more to smaller companies than to larger firms, as predicted by Hypothesis 2. These results are consistent with the findings of Carbo-Valverde et al. (2009) and Farinha and Felix (2015). The Altman Z-score shows a positive relationship with credit supply. This means that, as predicted, banks prefer to offer credit to firms characterized by a low level of default risk, for which the repayment of the loans is more certain. This confirms that the "*flight to quality effect*", which Albertazzi and Domenico (2010) identify in Italy in the period 2008-2009, persisted in the years 2010 and 2011.

The ability to provide collateral, which in the literature shows an ambiguous link with credit supply, is found to exert a positive effect on company ability to borrow loans from banks. In other words, banks prefer to allocate new credit to firms which can offer collateral, because in the case of default, financial companies can sell the collateral and recover the loans totally or partially. As predicted, the amount of tangible assets available to offer as collateral seems indeed to be considered a risk mitigant by banks, as shown by Carbo-Valverde et al. (2009), Kremp and Sevestre (2013) and Farinha and Felix (2015). The coefficient of the change in sales is significantly positive, thus suggesting that firms with bigger decreases in sales are more financially constrained. Ownership structure shows a negative relationship with the dependent variable. This means that banks consider a strong ownership concentration to be a negative element in deciding for lending. This result is consistent with Hypothesis 3. Private companies where the ownership is concentrated in fact show a high cost of capital and are often characterized by the presence of a large shareholder trying to deprive small owners of their part of residual income. On the contrary, in widespread ownership firms, shareholders exert control over one another and, moreover, all of them can offer personal collateral to banks.

The impact of the explanatory variables used in Table 6, Column (b) on demand and supply of bank credit is shown in Figure 1, where the absolute value of every coefficient is multiplied by the 0.05-0.95 inter-quantile range of its correspondent variable.

Figure 1: Relevance of explanatory variables to demand and supply of bank credit

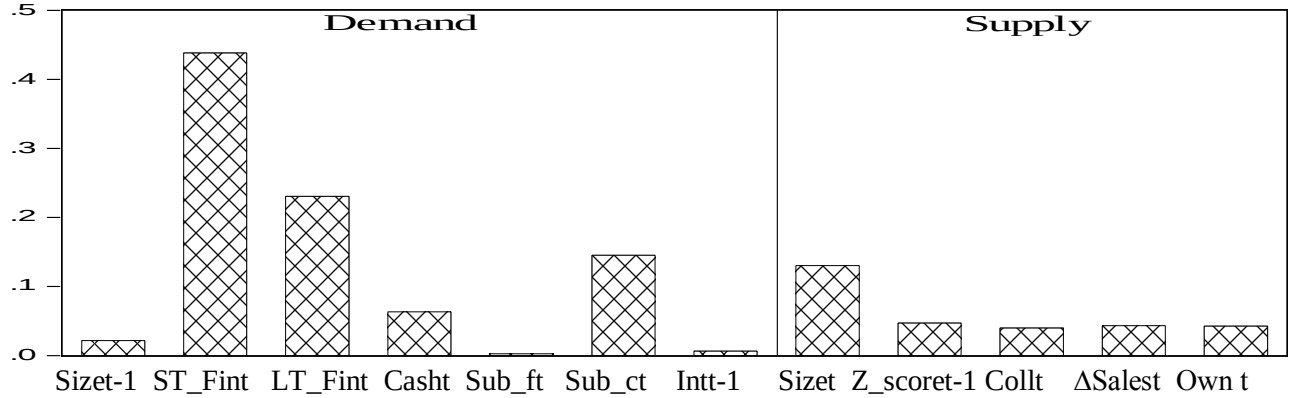

Figure 1 shows the relevance of explanatory variables used in Table 6, Column (b), to demand and supply of bank credit. The absolute value of every coefficient is multiplied by the 0.05-0.95 inter-quantile range of its correspondent variable.

By means of our disequilibrium model, we calculate the amount of bank credit requested by Italian SMEs and supplied by banks. After that, we estimate credit rationing by using the two models described in (7) and (8).In evaluating the demand for credit, we use the true values of short term financing needs (ST_Fin) and long term financing needs(LT_Fin),that are multiplied by the coefficients of the correspondent instruments(E[ST_Fin_t] and E[LT_Fin_t]). In case of non-rationed firms, the values of ST_FinandLT_Finarenot in fact downward biased.

Table 7 shows the percentage of rationed firms through the period 2007-2011. In our analysis we also include 2012 estimations: these are simply obtained by extrapolating the results of our model to 2012. The amount of rationing derives from the model reported in Table 6, Column (b). Credit rationing is evaluated according to both Equation (7) (Model 1) and Equation (8) (Model 2), as shown in Table 7, Columns (a) and (b), respectively. The results of the two models appear very similar.

Table 7: Credit rationing in the period 2007-2012

	Credit rationed SMEs (%)	Credit rationed SMEs (%)
	(a)Model 1	(b) Model 2
2007	27%	28%
2008	33%	34%
2009	31%	32%
2010	25%	26%
2011	18%	19%
2012	25%	23%

Table 7 reports credit rationing estimated according to Model 1 (Equation 7) and Model 2 (Equation 8). The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2012.

As predicted, our results suggest that Italian SMEs were credit rationed during the crisis, especially in the years 2008 and 2009. During the crisis, reduction in lending was caused by both demand-side and supply-side factors, as suggested by Hypothesis 1. More specifically, in the years 2008, 2009 and 2012 the supply effect was crucial, as shown in Figure 2.

Figure 2: Median demand and rationing in determining the credit growth of individual firms

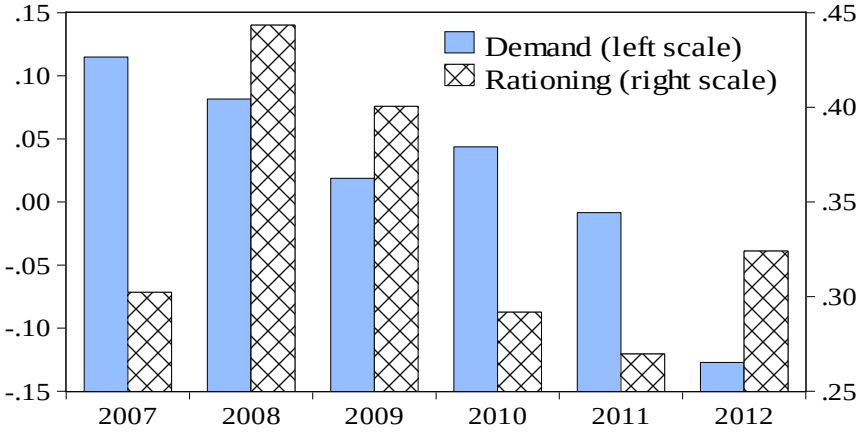

Figure 2 presents the median demand and rationing in determining the credit growth of individual firms. The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2012. 'Rationing' refers to the median of the difference between the increase in demand and supply of loans for rationed firms.

Figure 3: A comparison between our results and the ECB and Bank of Italy surveys

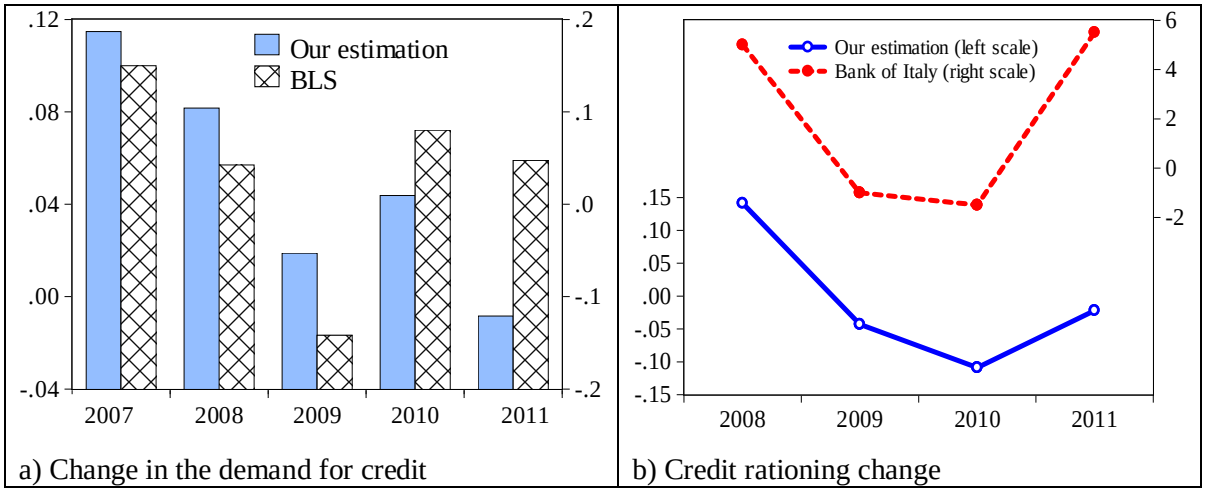

Figure 3a) reports the comparison between our estimations and the survey data from ECB's Bank Lending Survey (BLS), while Figure 3b) compares our estimations and the survey data collected by the Bank of Italy (2013b). Survey data relative to demand have been aggregated in order to get the same annual frequency as the balance sheets we used. We use the median values of all our single firm data. The demand for loans shown in Figure 3a) corresponds to the median value of the various credit demands, while credit rationing is measured following Equation 8. In Figure 3b) the scale of "rationing from Bank of Italy" is reported on the right, and the scale of estimated "credit rationing" is reported on the left.

Another important result is that individual rationing is a persistent phenomenon: firms rationed in *t* also tend to be rationed in *t+1* and *vice versa*. This emerges from the probit estimation shown in Table 8, where the variable "*rationing*" is defined as described in Equation (8). This estimation shows that the lagged dependent variable ("*rationing*" in *t*-1) is positive and strongly significant.

Table 8: Probit analysis applied to individual firm

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Year = 2008	-0.4171***	0.0094	-44.054	0.000
Year = 2009	-0.4916***	0.0096	-50.728	0.000
Year = 2010	-0.6729***	0.0098	-68.310	0.000
Year = 2011	-0.9299***	0.0103	-89.953	0.000
Year = 2012	-0.7385***	0.0134	-55.108	0.000
$Rationing_{t-1}$	0.0339***	0.0098	3.461	0.000
Mean dependent var	0.2665	Log likelihood	-53853	
S.E. of regression	0.4379	Avg. log likelihood	-0.5701	
Obs with Dep=0	69,283	Total obs	94,460	
Obs with Dep=1	25,177			

Table 8 reports the probit model for the period 2007-2012. The estimation is performed by means of the ML - Binary Probit (Quadratic hill climbing). The dependent variable takes value 1 if the firm is rationed, 0 otherwise. The covariance matrix is computed using second derivatives. The variable "rationing" is calculated following Equation (8). The sample consists of 113,503 observations of 33,066 non-listed Italian companies between 2007 and 2012.

4.2 Robustness checks

Our results prove extremely robust along several dimensions. A first robustness check is related to the empirical methodology. The disequilibrium model determines both the demand for credit and the corresponding bank supply to individual firms calculated on the basis of their balance sheets, and it is important to compare our results with those obtained by other methodologies. In particular, a useful comparison can be made between our findings and those obtained by the Italian section in the ECB's Bank Lending Survey (BLS).

Information about aggregate credit demand from the quarterly BLS corresponds to Question 4 of the survey ("*Over the past three months, how hasthe demand for loans or credit lines to enterprises changed at your bank, apart from normal seasonal fluctuations?*"). The answers, collected by the Bank of Italy, are used to construct both percentages and "diffusion" indices, whose historical behaviour is however very similar. Data on credit rationing are obtained by Bank of Italy (2013b), which in "Indagine sulle imprese industriali e dei servizi" collected data on about 4,500 industrial, service and construction firms with more than 20 employees.

Although we used an econometric analysis which is different from BLS, our results should be qualitatively consistent with the survey given that the phenomena under analysis are the same. Figures 3a) and b) report the comparison between our estimations and the survey data collected by ECB and Bank of Italy. Survey data relative to demand have been aggregated in order to get the same annual frequency as the balance sheets we used, and we use the median values of all our single firm data. The demand for loans shown in Figure 3a) corresponds to the median value of the various requests for credit, while credit rationing is measured as the percentage of companies for which demand is higher than supply. The behaviour of the variables from the different sources does not appear to conflict with our estimations, which therefore appear to be credible, from this point of view at least. Our econometric result appears indeed to supply useful information about the balance sheet items which determine the demand from, as well the supply of credit to, Italian SMEs.

A further exercise is related to the choice of variables. More specifically, variations of Equations (5) and (6) are estimated in order to assess the robustness of our results. First, in Equation (5), the following two variables are tested to account for financing needs: (i) sales to account (Atanasova and Wilson 2004; Carbo-Valverde et al. 2009) over total assets in place of the increase in working capital over total assets, and (ii) the amount of investment over value added(De Mitri et al. 2010) in place of the amount of investment over total assets. We also replace in Equation (5) non-bank financial debt over total assets and commercial debt over total assets with non-bank financial debt over total financial debts and commercial debt over total sales, respectively. In both cases, however, the new variables are found to be unsatisfactory in terms of significance.Second, we substitute in Equations (5) and (6) the dependent variable (change in natural logarithm of total amount of bank loans between *t* and *t-1*) with the ratio between the increase in credit loans and firm size, both in *t* and *t-1*(De Mitri et al. 2010). These results substantially confirm previous evidence.

Moreover, we check the robustness of our results by employing the usual normal distribution instead of Student-t. All the coefficients of explanatory variables show the correct sign and are significant, apart from our proxy for the ability to provide collateral. However, residual distributions are too fat-tailed to be consistent with normality, and the dynamic of credit rationing is much flatter than in case of estimations coming from a Student-t distribution.

After that, as in case of fixed effect in pooled estimation techniques, we consider the possibility of a different constant in every firm estimation. Since it is not feasible to estimate so many coefficients in our maximum likelihood procedure, we bypassed the problem by subtracting from any firm variable its corresponding average. This expedient yielded approximated values. The other coefficients show the same sign as our original model, but interest rates and collateral parameters are no longer significant, probably because they are more important in influencing firm behavior than the credit demand for a given firm through time.

Moreover, since corporate governance literature indicates a certain non-linearity in the relevance of ownership structure, we include in Equation (5b)a quadratic term (Own^2), which is actually found to be negative and significant. However, when considering the quadratic form, the numeric impact of ownership structure on credit supply also remains decreasing and monotonic as in the original linear version. Finally, our last robustness check covers the use of yearly dummies in place of the macroeconomic variables (Economic Sentiment Indicator, real GDP, willingness to lend and credit deterioration) used in Equations (5a), (5b) and (6). These estimations, however, are found to be similar to those shown in Table 6, and, in particular, the coefficients of the yearly dummies in both credit demand and supply equations have a correlation of more than 0.70 with the influence of our macroeconomic variables.

5. Conclusions

On the basis of a large panel data set of private Italian SMEs, this paper estimates a disequilibrium model of demand and supply of credit in the period 2007-2011.To our knowledge, this is the first study that investigates the Italian credit market during the recent crisis by applying a disequilibrium model. This model allows us to separate financially constrained and unconstrained firms on the basis of demand factors.

The results of our study show that, over the period 2007-2011, private Italian SMEs were credit rationed, especially in the years 2008 and 2009. This evidence is consistent with surveys conducted by the Bank of Italy and the European Central Bank. On the demand side, firms which requested more bank credit are smaller firms, showing higher short and long term financing needs, fewer available internal sources and fewer substitutes for bank finance. On the other hand, higher interest rates applied by financial companies lowered the requirement for bank credit.

On the supply side, banks reduced lending more to smaller firms presenting a high level of default risk. Banks preferred to allocate new credit to Italian SMEs which could offer collateral and showed bigger increases in sales. Our results also show that banks consider a strong ownership concentration a negative element in willingness to lend. Private firms where ownership is concentrated in fact show a high cost of capital and are often characterized by the presence of a large shareholder trying to deprive small owners of their part of residual income. On the contrary, in widespread ownership firms, shareholders exert control over one another and, moreover, all of them can offer personal collateral to banks. Our results suggest that, during the crisis, reduction in lending was caused by both demand-side and supply-side factors. More specifically, in the years 2008, 2009 and 2012 the supply effect was crucial. Another important result of our estimations is that individual rationing is a persistent phenomenon.

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