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The Impact of the Great Recession on Manufacturing Firms

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BANK CREDIT LENDING TO SMALL AND MEDIUM ENTERPRISES: WAS THERE A CREDIT CRUNCH IN ITALY?

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Bank credit lending to small and medium enterprises: was there a credit crunch in Italy?

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1. Italian companies and access to credit

Economic growth depends on access to credit, and in Italy this is a particularly sensitive issue for various reasons.

The first is the difficult economic climate, characterized by forecasts for very low GNP growth following years of decline and high levels of unemployment especially among young people. The second reason is the high level of public debt, which lowers availability of public resources and the state's ability to stimulate the economy. The third reason is the low availability of risk capital, revealed by the frequency with which important Italian manufacturers have been taken over by overseas companies.

For all these reasons, in a market like Italy heavily dependent on banks, where public and private capital is limited, economic recovery relies on the banking system. Banks are private companies and like other firms their objective is profit-making. But they are a particular type

[1] This study is the result of collaboration between Massimo Regalli, Maria-Gaia Soana and Giovanni Verga. Section 1 is the work of Massimo Regalli, Sections 2 and 3 of Maria-Gaia Soana and Section 4 of Giovanni Verga.

of firms and play a key role in society: they affect the business system and thus the system of the whole country. Their role and behavior are thus widely studied.

In recent years the Italian business system has had difficulty in accessing credit (Visco, 2014; ECB, 2014a; ECB, 2014b) and banks have been given the blame for failing to finance debt. On their side, however, banks claim that the financial crisis has been characterized by a big fall in demand for credit (Bank of Italy, 2014a) and a sharp deterioration of the two assets underpinning lending capacity: business outlook and associated guarantees. Clearly the situation since 2007 has generated uncertainty as far as outlook is concerned; GDP has fallen and internal demand is much lower (Visco, 2014). The picture for guarantees, on the other hand, is more complex. The Basel Committee on Banking Supervision guidelines on assessing credit worthiness have altered the role of guarantees in credit disbursement. At the same time there has been a sharp deterioration in the values of property traditionally used as collateral. It is important to note that as well as this deterioration, there has also been a significant loss of appeal of real estate collateral for banks (Bank of Italy, 2014b).

Credit access is particularly problematic for smaller firms, which are a characteristic of the Italian economy in all areas. The European Commission (2014) notes, "*This is one of the most problematic areas for the Italian SME sector. … Banks are less willing to provide loans to SMEs, and this, together with higher rejection and unacceptable loan rates, signals a drying up of private-sector financial support, compounded by diminished access to public sector financial support, either national or European*."

Assessments of the debt level of Italian firms also have an impact. Panetta (2014) for example notes "*Italian firms' leverage is also relatively high by international standards. According to the financial accounts, in 2012 it exceeded the euro-area average and the figure for Germany by 6 percentage points and was 14 points higher than in France. Comparable gaps existed in the years before the crisis*".

And the Governor of the Banca d'Italia (2014) writes, "*Italian firms' indebtedness and dependence on bank credit are signs of their financial vulnerability. With almost €1.3 trillion in financial debt and €1.6 trillion in net equity, Italian firms' overall leverage is 44 per cent; bank loans account for 64 per cent of the total debt. For the euro area these ratios are considerably lower, averaging 39 and 46 per cent respectively*."

In this context, this paper discusses demand and supply of credit to Small and Medium Enterprises (SME) during the financial crisis in Italy (2007-2012). The aim is to establish whether the shortfall and rationing of bank loans made to SMEs is due to a fall in demand or in supply.

Various studies have been made on the European market in this field. Specifically, Puri et al., (2009) identify a substantial supply effect on bank credit to retail customers in Germany in the period 2006-2008. On the other hand, Rottmann and Wollmershauser (2010) state that "*most surprisingly, in the current financial crisis, in which banks are more involved than in the previous recessions due to massive write-downs of toxic assets, the indications of a credit crunch are rather weak"* in Germany. Moreover, Jimenéz et al. (2012) find that "*weakness in bank balance sheets reduces the supply of bank credit in Spain in crisis times (credit crunch)*". On the Portuguese market, Iyer et al. (2010) find that the interbank liquidity shock led to credit supply contraction in the period 2007-2009 primarily for entrepreneurial firms, which "*cannot compensate the reduction in loan supply via obtaining credit from other, less affected, banks, or from other sources of credit*". These findings are confirmed by Popov and Udell (2011). Their analysis, carried out on 16 emerging European markets, demonstrates that "*SMEs report higher credit constraints in localities dominated by branches or subsidiaries of banks, which have low equity capital and low Tier 1 capital ratios, and which have recorded losses on financial assets*". Reductions in credit lending during the crisis affected also the French market. On this point, Kremp and Sevestre (2012) state that "*even during the financial crisis, credit rationing remained quite limited for French SMEs. Even though banks*

decreased their loan supply by adopting more restrictive lending standards, especially regarding weaker firms, firms' demand for new loans decreased even more strongly due to the deterioration of the economic environment".

Lastly, Italian SMEs too have suffered financial constraints during the crisis. On this point, Presbitero et al. (2012) show that "*in the post-Lehman period* (from October 2008 to September 2009, Author's note) *Italian firms had a 7.8% higher probability of being credit rationed. Moreover, the credit crunch has been more severe in provinces with larger shares of branches owned by distantly managed banks*". This is confirmed by Albertazzi and Marchetti (2010), who show that "*the dampening effect on credit supply of less-capitalized banks has been quite sizeable*" in Italy in the period September 2008-March 2009. By analyzing the impact of the credit supply restrictions across firm types, Albertazzi and Marchetti (2010) also find that "*larger less-capitalized banks have reallocated their credit away from riskier firms. Quite strikingly, this fight to quality has not been observed for smaller less-capitalized banks*". Artola and Genre (2011) on the other hand, in a Europe-wide study for the period 2009-2010 note that "*surprisingly enough, in Italy, the predicted probability of being financially constrained turns out to be significantly lower for small and medium firms than for large companies*."

The present paper is based in this context. Specifically, it investigates the existence of credit rationing in the Italian corporate bank loan market by estimating a demand-supply disequilibrium model for bank credit in the period 2007-2012. From this model, we derive the proportion of credit rationed companies using a panel data set of private Italian SMEs.

2. Sample and methodology

Following previous literature (Ogawa and Suzuki, 2000; Atanasova and Wilson, 2004), we use a panel data set to estimate the disequilibrium model of Italian SME corporate bank

lending. Our database consists of 35,541 Italian unlisted SMEs[2] in the period 2007-2012. We exclude from the sample financial and public service companies and eliminate those firm-year observations reporting negative sales, total assets, interest rates, liquidity indexes and equity capital. Data are obtained from the Bureau Van Dijk AIDA database (Analisi Informatizzata delle Aziende. The final sample consists of 121,425 observations, as shown in Table 1.

Table 1
Distribution of observations over years

Year	Number of firms	Number of firms - percentage	Number of firms (cumulative)	Number of firms - percentage (cumulative)
2007	20,385	16.79	20,385	16.79
2008	21,888	18.03	42,273	34.81
2009	23,804	19.60	66,077	54.42
2010	24,890	20.50	90,967	74.92
2011	26,206	21.58	117,173	96.50
2012	4,252	3.50	121,425	100.00
Total	121,425	100.00	121,425	100.00

Table 1 shows the number of observations of 35,541 non-listed Italian companies in the period 2007-2012. Source -AIDA.

Looking at the distribution of observations across the industries (Table 2) "Wholesale", "Construction" and “Wood and paper paste” industry contribute most with almost 43% of total observations.

The sample is in general representative of the Italian economy as a whole. Table 3 reports some descriptive statistics for the variables used, while Table 4 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.

[2] According to EU guideliness, the main characteristics of an SME are: (i) fewer than 250 employees and (ii) annual turnover not exceeding 50 million euro, and/or the annual balance sheet total not exceeding 43 million euro. We therefore eliminated from the initial sample those firms whose turnover was below 2 million euros (EU definition - micro firms) and over 50 million euros (EU definition - large firms).

Table 2
Distribution of observations over industry

Sector	2007	2008	2009	2010	2011	2012
Agriculture	411	427	437	457	486	100
Mining	116	109	115	120	117	19
Manufacturing	969	1,026	1,128	1,204	1,261	187
Textiles and clothes	1,176	1,233	1,272	1,319	1,345	211
Wood and paper paste	2,184	2,284	2,475	2,495	2,629	446
Metallurgy	1,803	1,913	2,079	2,145	2,242	335
Electronics	1,905	2,024	2,202	2,265	2,348	383
Automotive	287	302	325	352	349	57
Furniture	393	410	415	436	425	55
Other manufacturing	340	360	377	382	400	49
Energy	456	511	582	630	707	107
Construction	2,553	2,751	2,996	3,187	3,380	530
Wholesale	4,073	4,406	4,822	4,949	5,175	840
Retail commerce	684	767	850	926	992	185
Transport	876	943	1054	1,112	1,164	200
Service	235	255	278	286	313	39
Communication	164	181	197	202	211	38
Informatics	220	265	303	334	386	59
Advisory	606	692	768	865	913	211
Tourism	410	450	511	554	621	95
Education	26	32	36	39	42	12
Health	351	373	386	418	465	66
Entertainment	76	87	100	104	120	19
Other services	69	85	94	107	114	9
Total	20,385	21,888	23,804	24,890	26,206	4,252

Table 2 shows the number of observations of 35,541 non-listed Italian companies in the period 2007-2012 over different industries. Source - *AIDA Database*).

Table 3
Descriptive statistics (I frattili al 5% non li metti?)

Variables	Mean	Median	Std. Dev.	Skewness	Kurtosis
$Size_t$	16.25	16.19	0.94	0.38	4.69
$Size_{t-1}$	16.23	16.15	0.97	0.56	5.33
ST_Fin_t	-6.00	0.00	526.53	-255.00	75,201
LT_Fin_t	5.20	-0.01	524.99	17.87	16,030
$Cash_t$	4.21	3.41	6.87	-5.57	228.00
Sub_f_t	2.80	0.00	7.49	4.50	29.34
Sub_c_t	25.64	22.84	16.71	0.94	4.03
Int_{t-1}	5.68	5.15	3.98	0.94	4.08
Z_score_{t-1}	1.56	1.44	0.91	2.05	15.31
$Coll_t$	0.22	0.16	0.21	1.10	3.70
$\Delta Sales_t$	-2.73	0.00	59.92	-2.17	53.54
Own_t	2.93	4.00	1.19	-0.39	1.46

Table 3 shows descriptive statistics of the sample. The sample consists of 121,425 observations of 35,541 non-listed Italian companies between 2007 and 2012.

Table 4
Correlation matrix

	$Size_t$	$Size_{t-1}$	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
$Size_t$	1.000	0.922	0.024	-0.010	-0.020	0.028	-0.350	-0.058	-0.432	0.202	-0.045	0.061
$Size_{t-1}$	0.922	1.000	-0.041	-0.010	-0.045	0.027	-0.347	-0.057	-0.447	0.179	-0.236	0.064
ST_Fin_t	0.024	-0.041	1.000	0.000	0.012	0.002	-0.000	0.004	0.009	0.003	0.059	-0.002
LT_Fin_t	-0.010	-0.010	0.000	1.000	-0.001	0.003	0.003	-0.002	0.000	-0.000	0.001	-0.002
$Cash_t$	-0.020	-0.045	0.012	-0.001	1.000	-0.069	-0.040	-0.049	0.189	0.060	0.094	0.020
Sub_f_t	0.028	0.027	0.002	0.003	-0.069	1.000	-0.127	0.037	-0.101	0.062	-0.013	-0.025
Sub_c_t	-0.350	-0.347	-0.000	0.003	-0.040	-0.127	1.000	0.049	0.364	-0.347	0.111	-0.018
Int_{t-1}	-0.058	-0.057	0.004	-0.002	-0.049	0.037	0.049	1.000	0.015	-0.010	-0.026	-0.005
Z_score_{t-1}	-0.432	-0.447	0.009	0.000	0.189	-0.101	0.364	0.015	1.000	-0.319	-0.067	-0.011
$Coll_t$	0.202	0.179	0.003	-0.000	0.060	0.062	-0.347	-0.010	-0.319	1.000	-0.000	-0.045
$\Delta Sales_t$	-0.045	-0.236	0.059	0.001	0.094	-0.013	0.111	-0.026	-0.067	-0.000	1.000	-0.010
Own_t	0.061	0.064	-0.002	-0.002	0.020	-0.025	-0.018	-0.005	-0.011	-0.045	-0.010	1.000

Table 4 shows the correlation matrix of the independent variables. The sample consists of 121,425 observations of 35,541 non-listed Italian companies between 2007 and 2012.

As suggested by Ogawa and Suzuki (2000), Atanasova and Wilson (2004), Carbo-Valverde et al. (2009), and Kremp and Sevestre (2012), 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. In order to test the existence of a disequilibrium in the credit market (i.e. credit rationing), we calculate the following simultaneous equation model (Laffont and Garcia, 1977; Kremp and Sevestre, 2012): (i) a demand equation L_t^d; (ii) a supply equation L_t^s; (iii) and a transaction equation L_t.

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

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

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

where x_{1t} and x_{2t} are exogenous and independent vectors, β_1 and β_2 are their coefficients and ε_{1t} and ε_{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. In estimating SME demand and supply of credit in Italy we use the same log-likelihood method (LLM) used by Kremp and Sevestre (2012), although our specification is somewhat simpler because we do not consider firms with zero-bank loans. Since LLM estimators may present convergence problems, we supply the EViews 7 routine with realistic starting values derived from a non-linear LS estimator. The condition for discriminating between demand and supply of credit is estimated by the system (1)-(2)-(3). It can be easily simplified as:

$$L_t = L_t^d [L_t^d \leq L_t^s] + L_t^s [L_t^d > L_t^s] \quad (4)$$

or

$$L_t = L_t^d + (L_t^s - L_t^d)[L_t^d > L_t^s], \quad (5)$$

where the logical symbol [xRy] corresponds to 1 if xRy is true, and to 0 otherwise. Equation (5) can thus be expressed as:

$$L_t = (\beta_1 x_{1t} + \varepsilon_{1t}) + (\beta_2 x_{2t} + \varepsilon_{2t} - \beta_1 x_{1t} - \varepsilon_{1t}) [\beta_1 x_{1t} - \beta_2 x_{2t} > \varepsilon_{2t} - \varepsilon_{2t}] \quad (6)$$

$$L_t = \beta_1 x_{1t} + (\beta_2 x_{2t} - \beta_1 x_{1t}) [\beta_1 x_{1t} - \beta_2 x_{2t} > \varepsilon_{2t} - \varepsilon_{2t}] + \varepsilon_{1t} + (\varepsilon_{2t} - \varepsilon_{1t}) [\beta_1 x_{1t} - \beta_2 x_{2t} > \varepsilon_{2t} - \varepsilon_{2t}] \quad (7)$$

that can be estimated in the approximated form:

$$L_t = \beta_1 x_{1t} + (\beta_2 x_{2t} - \beta_1 x_{1t}) [\beta_1 x_{1t} - \beta_2 x_{2t}] + \textit{residuals} \quad (8)$$

in order to obtain starting coefficients, even if these are biased, to use as starting values for the EViews maximum likelihood iterations. Moreover, we define:

$$\varepsilon_d = L_t - \beta_1 x_{1t} \text{ if } L_t \text{ is a demand} \quad (9)$$

$$\varepsilon_s = L_t - \beta_2 x_{1t} \text{ if } L_t \text{ is a supply} \quad (10)$$

$$\sigma_d = \sigma(\varepsilon_d) \text{ and } \sigma_s = \sigma(\varepsilon_s), \quad (11)$$

$$\rho = \text{correlation between } \varepsilon_d \text{ and } \varepsilon_s \quad (12)$$

$$\varphi(.) = \text{the normal N(0,1) density function} \quad (13)$$

$$\Phi(.) = \text{the cumulative normal N(0,1) density function} \quad (14)$$

The components of ε_d independent from ε_s (corresponding to the residuals of the regression of ε_d on ε_s) are given by:

$$\varepsilon_d' = \varepsilon_d - (\rho\sigma_d / \sigma_s)\varepsilon_s. \quad (15)$$

Similarly,

$$\varepsilon_s' = \varepsilon_s - (\rho\sigma_s / \sigma_d) \quad (16)$$

are the components of ε_s independent from ε_d. The standard deviations of ε_d' and ε_s' are

$$\sigma_d' = \sigma_d\ (1-\rho 2)1/2 \quad (17)$$

and

$$\sigma_s' = \sigma_s(1-\rho 2)1/2 \quad (18)$$

respectively. The basic idea is that the probability that the actual L_t is ?????a supply is higher the lower ε_d'. If L_t is much lower than its corresponding estimated demand, the possibility of a rationing is high. In terms of probability,

$$\text{Prob}(L_t \text{ is a supply}) = [1 - \Phi(\varepsilon_d'/\sigma_d')]. \quad (19)$$

On the other hand, the lower the actual loans compared to their estimated supply, the more likely that the demand is low and there is no rationing (that is, L_t is a demand):

$$\text{Prob}(L_t \text{ is a demand}) = [1 - \Phi(\varepsilon_s'/\sigma_s')]. \quad (20)$$

The contribution to the likelihood of an observation t is therefore:

$$[\varphi(\varepsilon_d'/\sigma_d')/\sigma_d'] [1 - \Phi(\varepsilon_s'/\sigma_s')] + [\varphi(\varepsilon_s'/\sigma_s')/\sigma_s'] [1 - \Phi(\varepsilon_d'/\sigma_d')]. \quad (21)$$

The demand equation L_t^d (1) we estimated is the following:

$$L_t^d = \alpha + \beta_1 \text{Size}_{t-1} + \beta_2 \text{ST\_Fin}_t + \beta_3 \text{LT\_Fin}_t + \beta_4 \text{Cash}_t + \beta_5 \text{Sub\_f}_t + \beta_6 \text{Sub\_c}_t + \beta_7 \text{Int}_{t-1} + \beta_8 \text{Year}_t + \varepsilon \quad (22)$$

where ‘Size’ is the firm size calculated as the natural logarithm of firm's total assets, ‘ST_Fin’ is the short-term financing need estimated through the increase in working capital[3] over total assets, ‘LT_Fin’ is the long-term financing need proxied by the amount of firm investment over total assets, ‘Cash’ is the internal available resources calculated as the company cash flow over total assets, ‘Sub_f’ is the financial substitute for bank finance estimated as the firm non-bank financial debt over total assets, ‘Sub_c’ is the commercial substitute for bank finance proxied by the firm commercial debt over total assets, ‘Int’ is the cost of bank debt calculated as the ratio of firm interest expenses over total debt and ‘Year’ is the year dummies.

We expect that firm size, internal available resources, substitutes for bank finance and cost of bank debt are inversely related to credit demand. On the contrary, we assume that firms with more financing needs show a higher demand for bank credit.

The supply equation L_t^s (2) we estimated is the following:

$$L_t^s = \alpha + \gamma_1 Size_t + \gamma_2 Z\_score_{t-1} + \gamma_3 Coll_t + \gamma_4 \Delta Sales_t + \gamma_5 Own_t + \gamma_6 Year_t + \varepsilon \quad (23)$$

where ‘Size’ is the firm size calculated as the natural logarithm of firm's total assets, ‘z_score’ is the firm default risk estimated by the Altman Z-score calculated for private companies, ‘Coll’ is the ability to provide collateral proxied by tangible assets over total assets, ‘ΔSales’ is the change in sales measured by the change of natural logarithm of sales between *t* and *t*-1, ‘Own’ is the ownership concentration and ‘Year’ is the year dummies.

Following Albertazzi and Marchetti (2010), we proxy the firm default risk by the 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

[3] Working capital is calculated as the sum of trade credit and inventories, net of commercial debt.

combination of five business ratios, weighted by coefficients, according to the following formula:

$$Z = 0.717x_1 + 0.847x_2 + 3.107x_3 + 0.420x_4 + 0.998x_5 \quad (24)$$

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.

Moreover, we measure ownership concentration by 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 holding together 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).

We expect firms with smaller size and bigger decrease in sales to be more financially constrained. But we assume that banks prefer to offer credit to firms characterized by low default risk degree, high ability to provide collateral and lower concentrated ownership.

We measure credit rationing according to two different models. The first model (Kremp and Sevestre, 2012) consists of computing the unconditional probability of a partial credit rationing as follows:

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

$$= \Pr(((X_d b_d - X_s b_s) / \sigma) > ((u_s - u_d) / \sigma)) = \Phi((X_d b_d - X_s b_s) / \sigma) \quad (25)$$

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, the second model estimates the conditional probability, i.e. the probability of partial rationing, conditional on the observed amount of loans (Gersovitz, 1980, Kremp and Sevestre, 2012). Conditional probability, which differs from unconditional probability when the variances of the disturbances of the supply and demand equations significantly differ from each other, is calculated as follows:

$$\Pr(\text{Partial rationing}/NL_t) = \frac{f_s(NL_t)(1-F_d(NL_t))}{f_d(NL_t)(1-F_s(NL_t)) + f_s(NL_t)(1-F_d(NL_t))} \qquad (26)$$

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 is credit rationed when this probability is greater than 0.5.

3. Results

Results of the disequilibrium model for corporate bank lending 2007-2012are reported in Table 5. The residual distribution is assumed to be a Student's t with three degrees of freedom[4] and we suppose that standard deviations of both demand (σ_d) and supply (σ_s) residuals are the same.

Table 5
Demand and supply of credit

	Variables	Coefficient	Std. Error	Probability
L_t^d	const	2.073***	0.148	0.000
	Year 2009	-0.410***	0.019	0.000
	Year 2010	-0.489***	0.019	0.000
	$Size_{t-1}$	-0.053***	0.008	0.000
	ST_Fin_t	0.674***	0.026	0.000
	LT_Fin_t	-0.002*	0.001	0.077
	$Cash_t$	-4.143***	0.125	0.000
	Sub_f_t	-1.377***	0.093	0.000
	Sub_c_t	-0.073	0.049	0.135
	Int_{t-1}	-0.234***	0.001	0.000
L_t^s	const	-1.975***	0.541	0.0003
	Year 2008	-0.107	0.097	0.2683
	Year 2010	0.109	0.119	0.3612
	$Size_t$	0.132***	0.031	0.0000
	Z_score_{t-1}	0.773***	0.057	0.0000
	$Coll_t$	1.630***	0.216	0.0000
	$\Delta Sales_t$	0.868***	0.025	0.0000
	Own_t	-0.264***	0.023	0.0000
	Log likelihood	-73242.77		
	Avg. log likelihood	-0.671		
	N. of observations	121,425		
	Number of Coefs.	20		

Table 5 reports the disequilibrium model for the period 2007-2012 applied to Equations (1), (2) and (3), where the dependent variable is the change in natural logarithm of total amount of bank loans between *t* and *t*-1. The estimation was performed by means of the LLM (log-likelihood method) statistical package E-views 7. The sample consists of 121,425 observations of 35,541 non-listed Italian companies between 2007 and 2012.

As regards the demand equation, all economic independent variables are significant at 1% level except for long-term financing needs and commercial substitutes for bank finance. More specifically, the dependent variable is inversely related to firm size, long-term financing needs, internal available resources, financial substitute for bank finance and cost of bank debt. This

[4] This distribution best shows the ?residual kurtosis ? kurtosis of residuals.

has three implications. First, small firms requested more bank credit than large ones, as suggested by previous literature (Atanasova and Wilson, 2004; Carbo-Valverde et al., 2009; Iyer et al., 2013). Second, the demand for short-term loans increases if long-term financing needs decrease and if a firm has fewer internal available sources (Atanasova and Wilson, 2004; Carbo-Valverde et al., 2009; Iyer et al., 2013). Third, SMEs with more available substitutes for bank finance (i.e. non-bank financial debts and commercial debts) and higher cost of bank credit show a lower demand for loans.

Moreover, the dependent variable is directly related to short-term financing needs: this suggests that companies registering bigger increases in working capital in the year *t* compared to year *t*-1 exhibit the most demand for short-term credit.

Examining the time dummies, the results show that the demand for bank credit was lower in 2009 and 2010, dummies for other years (2007, 2008 and 2011) being not significant. (For this reason they are not shown in Table 5).

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, the Altman Z-score, ability to provide collateral and change in sales show a significant positive effect on the amount of bank credit supplied to the company. This means that banks prefer to offer credit to larger firms (as suggested by Carbo-Valverde et al., 2009) and to companies characterized by low default risk degree, and confirms the "*flight to quality effect*" found by Albertazzi and Domenico (2010). Moreover, the amount of tangible assets available to offer as collateral appears to exert a positive effect on the possibility of obtaining loans from banks because the ability to provide collateral is considered a risk mitigant by banks, as in previous literature (Carbo-Valverde et al., 2009; Kremp and Sevestre, 2012). Furthermore, our results show that firms with bigger decreases in sales are more financially constrained. Finally, ownership structure is negatively related with the dependent variable: this means that banks consider a strong ownership concentration a negative element in

lending decisions. This result can be explained by the fact that private companies with concentrated ownership 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 other hand, in firms with widespread ownership, shareholders exert control over one another and, moreover, each individual can offer personal collateral to banks.

By means of our disequilibrium model, we calculate the amount of bank credit requested by Italian SMEs and supplied by banks. We estimate credit rationing by using the two models described in (25) and (26). Table 6 shows the percentage of rationed firms in the period 2007-2012.

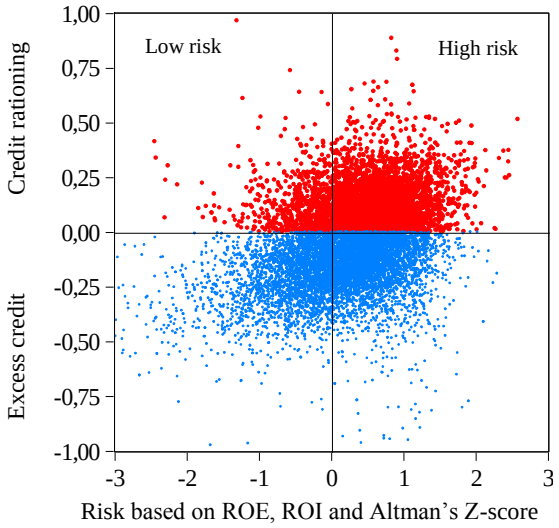
Table 6
Credit rationing in the period 2007-2012

	SMEs credit rationed (%) Model 1	SMEs credit rationed Model 2
2007	36.5%	31.3%
2008	35.6%	32.4%
2009	28.0%	26.4%
2010	25.7%	24.9%
2011	35.6%	35.2%
2012	39.1%	39.0%

Table 6 reports credit rationing estimated according to Model 1 (Equation (25)) and Model 2 (Equation (26)). The sample consists of 121,425 observations of 35,541 non-listed Italian companies between 2007 and 2012.

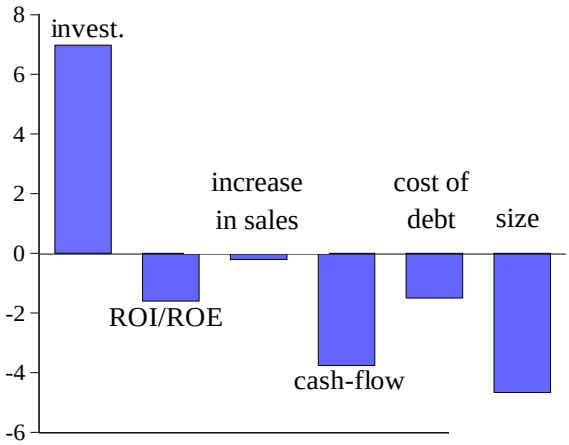
As predicted, our results suggest that Italian SMEs have been credit rationed during the crisis, especially in the years 2007, 2008, 2011 and 2012. During the crisis, reduction in lending was caused by both demand-side and supply-side factors. More specifically, in the period 2009-2010, demand was very low, but in the years 2007, 2008, 2011 and 2012, the supply effect was crucial. Specifically, our results show that credit rationing increased in 2012, especially for riskier firms, i.e. companies characterized by low profitability (measured by ROE and ROI) and high default risk (measured by Altman's Z-score), as reported in Figure 1.

Figure 1
Credit rationing, profitability and default risk in 2012



On the demand side, we find that SMEs demanding more bank credit during 2012 are those companies characterized by small size, high investments, low profitability, low cost of debt capital and a decrease in cash flow and sales, as shown in Figure 2.

Figure 2
Determinants of credit demand by Italian SMEs in 2012



Another important result of our estimations is that individual rationing is a persistent phenomenon: firms rationed in *t* also tend to be rationed in *t+1* and *vice versa*. After defining

the variable "*rationing*" as described in Equation (25), we apply a probit estimation (Table 7). This estimation shows that the lagged dependent variable ("*rationing*" in *t*-1) is positive and strongly significant.

Table 7
Probit analysis applied to individual firm rationing

	Coefficient	Std. Error	z-Statistic	Prob.
constant	-1.601	0.048	-32.91	0.0000
% Rationed firms year t-1	0.022	0.011	-85.99	0.0000
Δ % Rationed firms (%) year t	0.036	0.001	32.08	0.0000
Rationing t-1 of firm i	1.232	0.002	14.02	0.0000
McFadden R-squared	0.154	Obs with Dep=0		55,575
Obs with Dep=1	25,160	Total obs		80,735

Table 7 reports the probit model for the period 2007-2012. The estimation was performed by means of the ML - Binary Probit (Quadratic hill climbing). The covariance matrix is computed using second derivatives. The variable "rationing" is calculated following Equation (25).

The behaviour of the variables from the two different sources does not appear to conflict, thus confirming our results.

4. Conclusions

On the basis of a large panel data set of private Italian SMEs, our paper estimates a disequilibrium model of demand and supply of credit in the period 2007-2012. 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 2007-2012, private Italian SMEs were credit rationed, especially in the years 2007, 2008, 2011 and 2012. 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 companies showing higher short term financing needs, fewer internal available 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 which presented a high degree 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 deciding for lending. Private firms 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 shareholders of their part of residual income. On the other hand, in firms with widespread ownership, shareholders exert control over one another and, moreover, each individual 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. Another important result of our estimations is that individual rationing is a persistent phenomenon.

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