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Abstract

A conventional assumption that deserves testing is that Small and medium enterprises (SMEs) are most affected by credit crunch. In this respect, a disequilibrium model is designed to analyse the determinants of credit rationing upon a balanced panel of 2,370 French mature SMEs over the period 2002-2010. According to the estimates of simultaneous equations, the desired demand for bank credit is determined by exogenous factors from the supply-side. The credit supply-side validates better trade-off theory, whereas the credit demand-side validates better pecking-order theory. The average share of rationed SMEs is seven per cent of the sample, suggesting that access to bank loans is not a major issue for French mature SMEs.

Keywords: balanced panel; capital structure; credit rationing; disequilibrium model; France; SMEs.
JEL: G21, G23

Introduction

Small and Medium-sized Enterprises (SMEs) must dispose of the financial resources necessary to maintain their business. As for external financing, SMEs depend on banks, especially for short-term loans, and the financial market does not offer an alternative solution. Banks often consider the business projects of SMEs are riskier than those of larger companies. SMEs report discrimination in terms of access to finance and the risk assessment by banks that impose higher premium, increasing thereof the cost of credit.

The objective of banks is to contract with a borrower who can meet his commitments and whose probability of default is very low. This objective hardly coincides with the financial specificities of SMEs that are often considered to be riskier. In most SMEs, the entrepreneur concentrates ownership and direction or control in his/her own hands and imposes his/her choice of allocation of funds. SMEs often lack resources (staff, finance and time); their economic environment is characterized by uncertainty; personal relationships are more frequent; one of the major difficulties is their inability to provide reliable and accurate market information (Berger and Udell 1998). SMEs that are denied access to credit face rationing, which hinders their development and survival (Beck and Demirgüç-Kunt 2006). The exposure of SMEs to credit rationing is explained by both the ex-ante and ex-post asymmetry of information surrounding the loan agreement.

The measurement of credit rationing is a complicated exercise because both credit supply and demand are not directly observable. Various approaches addressing the existence of such a phenomenon have used opinion surveys or proxy variables, which raise problems that the modeling and estimation techniques of disequilibrium models seem to have overcome. The purpose of this article is to estimate a disequilibrium model (Maddala and Nelson 1974) in order to document the main determinants of credit rationing for a sample of 2,370 French SMEs selected in the DIANE database over nine years (2002-2010), to identify financially constrained enterprises and to calculate their proportion.

This article is structured as follows: Section 1 presents the theory of credit rationing applied to SMEs. Section 2 is dedicated to econometric methodology and empirical measurements of

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credit rationing; it specifies the disequilibrium model and the related assumptions. Section 3 presents the sample, estimates and results. Section 4 calculates the proportion of firms rationed on the credit market. Section 5 recapitulates and discusses the main findings.

1. Credit rationing theory and SMEs

Credit rationing theory (Stiglitz and Weiss 1981) is built upon the assumption of non-observability of the borrowers and the existence of information asymmetries. Credit rationing is an equilibrium wherein some borrowers get credit, whereas a priori identical other borrowers are denied credit, although they may be willing to pay a high interest rate. This theory includes adverse selection according to which the higher the expected returns of an investment project, the higher the risk. High lending rates can attract reckless borrowers driving to the occurrence of moral hazard and have a negative impact on the expected receipts of lenders (Adair and Adaskou 2011). The setting of a credit cost such as supply and demand are in balance does not design a rational behavior on the part of banks (Levratto 1992), which are risk averse thereby rationing loans rather than raising the required interest rate or collateral (Cieply 1997).
Credit rationing theory has been challenged as a special case by Su and Zhang (2017), who do not however deny its existence.

Stiglitz and Weiss (1981) assume that credit rationing also exists when several groups of borrowers are observable by the lender. Hence, companies applying for risky projects will be discriminated. This case illustrates the situation of SMEs on the credit market to the extent that they are riskier than larger firms (Psillaki 1995). Yan (1997) points out that the risk of credit rationing is an increasing function of the probability of bankruptcy. Given the importance of SME defaults, credit rationing is a significant issue for these companies.

In order to encourage companies to comply with timely payback, banks have several ways to reduce the consequences of information asymmetry. They offer revealing contracts that aim to gauge the degree of risk of the potential borrower over time; such contracts consist in various combinations of the required interest rate and of collateral (Besanko and Thakor 1987, Deshon and Freixas 1987). They also aim to build a customer relationship over time that improves the assessment methods of banks facilitating the provision of lower-cost credit (Haubrich 1989, Diamond 1989).

2. Econometric methodology

2.1. Empirical measures of credit rationing

The various approaches testing the existence of rationing in the credit market are based either on the results of opinion surveys or the use of proxy variables, or on cross-sectional data upon the financial sensitivity of the actual behavior of companies. Among the studies based on the survey technique, that of Cieply (1997) examines the opinions and behaviours of a sample of 40 account managers facing asymmetric information: their behaviours comply with the predictions of credit rationing theory and the existence of a customer relationship allows the bank to protect itself against moral hazard and opportunism. While such surveys illustrate the existence of rationing, they provide no measure; Moreover, the results are questionable because the data contain biases.

Fazzari et al. (1988), Hoshi et al. (1991) and Harhoff and Körting (1998) use surrogate variables and exogenous classification of firms: those more likely vs. less likely to be exposed to financial constraints, which poses two problems (Atanasova and Wilson 2004). First, some of the proxy variables are endogenous because they result from firm decisions (e.g., capital structure) and thus are not appropriate measures of credit rationing. Second, the classification

is rigid, ignoring the mobility of firms from the group of constrained companies to that of the unconstrained ones and *vice versa* (Adair and Fhima 2013).

The development of econometric modeling and estimation techniques for disequilibrium markets help avoid the problems faced by the aforementioned approaches. The models of disequilibrium address the existence of credit rationing and the potential constraints of access to bank credit for companies, and measure the impact of their characteristics on these constraints (Kremp and Sevestre, 2013).

Two papers apply the disequilibrium model to the credit rationing of SMEs in France over the 2000s. Kremp and Sevestre (2013) analyse a sample of 64,581 independent SMEs including microenterprises from the Central Bank database (FIBEN-Banque de France) over 2004-2010. They find that young SMEs are more rationed than mature SMEs and that rationing increased from 2007 to 2010. Alexandre and Buisson-Stéphan (2014) study the impact of the 2008 recession, in terms of credit rationing upon a sample of 3,957 SMEs over 2000-2008; microenterprises are excluded from the sample whose source is not mentioned. They find that the SMEs most exposed to credit rationing are younger, experience higher growth rate, generate cash flow and have fewer assets to provide as collateral.

2.2. The disequilibrium model: demand and supply of bank credit

The disequilibrium model (Maddala and Nelson, 1974) consists in three equations: the demand function equation (1), the supply function equation (2) and an equation that corresponds to the condition according to which the quantity observed results from the minimum quantity respectively offered and requested (3). The model is designed as follows:

$$\begin{cases} L_t^d = \beta_1 X'_{1t} + u_{1t} & (1) \\ L_t^s = \beta_2 X'_{2t} + u_{2t} & (2) \\ L_t = min\left(L_t^d, L_t^s\right) & (3) \end{cases}$$

L_t^d and L_t^s respectively denote the amount of bank credit requested during period *t* and the amount of bank credit offered during period *t*, unobservable variables that must be determined and explained; L_t stands for the observed amount of bank credit, which is the minimum between the amount of bank credit offered and the amount requested, X'_{1t} and X'_{2t} respectively denote the vector of independent exogenous variables that influence the credit demand and supply, β_1 and β_2 are their respective coefficients, and u_{1t} and u_{2t} are the error terms.

The estimation of a disequilibrium model is carried out in three steps (Maddala 1983, Steijvers 2008, Adair and Fhima 2013, Alexandre and Buisson-Stéphan 2014). The first step concerns the estimation of the coefficients of each explanatory variable of the supply and demand equations under the assumption of credit market equilibrium; the equilibrium is stated by the following equality: the quantity of the credit actually granted is equal to the amount of the credit demanded by the firms, which is equal to the quantity of the credit offered by the banks ($L_{it} = L_{it}^d = L_{it}^s$). The second step, based on the estimated coefficients, calculates the adjusted values of credit demand and supply for each firm in the sample; thus, unobservable values of credit demand and supply are identified. The final step determines the rationed companies for each year. A company that is partially or totally rationed is deemed to be such when the amount of credit requested is greater than the amount of credit offered by the bank: $L_{it}^d > L_{it}^s$. Hence, the share of rationed enterprises is measured by simply comparing the adjusted values of credit demand and supply.

2.3. Variables and testable hypotheses regarding the bank credit supply

The size of the firm (*SIZE*) is a synthetic indicator of the risk associated with the core business of the firm. According to the trade-off theory (Modigliani and Miller, 1963), the risk of bankruptcy would be weaker for large firms than for small businesses due to the diversification of their investments; therefore, size must be positively correlated with the supply of credit. SMEs that increase their payroll can be viewed by lenders as successful companies that have growth opportunities and are less prone to bankruptcy risk. However, credit applications from companies with growth opportunities may be rejected by banks that view such demand as signalling a risky business. Our first hypothesis (*H1*) is stated as follows: the supply of credit is a function of the size of the firm - positive as for trade-off theory vs. negative as for the theory of bankruptcy costs.

Age (*AGE*) corresponds to the difference between the first year of observation and the date of establishment of the company: its historical record grows as time goes by. According to pecking order theory (Myers and Majluf 1984) and assuming that the company's self-financing capacity increases with age, older firms should use less bank credit. Conversely, according to agency theory (Jensen and Meckling 1976) the relationship between the age of the firm and the supply of credit should be positive: older firms enjoy a better reputation and more robust experience, which is a positive signal on the quality of potential investments that can lessen agency costs (Adair and Adaskou 2011). Our second hypothesis (*H2*) is stated as follows: the supply of credit is a function of the age of the firm, increasing as for the agency theory vs. decreasing as for the pecking order theory.

The credit risk (*RISK*) corresponds to the probability of default of the company that would not be able to face its commitments. This probability (p) is obtained from the score (S)[3] by the following formula:

$p = 1/1 + \exp S$

We classify SMEs according to three types of Basel II credit risk:
if $p < 20\%$, the company is considered to be low or medium risk (*LMR*);
if $20\% \leq p < 25\%$, the company is considered to be high risk (*HR*);
if $p \geq 25\%$, the company is considered to reach unsustainable risk (*UR*).

With respect to asymmetry of information, *LMR* and *HR* companies should be less indebted than *UR* firms. Our third hypothesis (*H3*) is stated as follows: credit risk exerts a negative influence on the supply of credit, according to both the trade-off theory and pecking order theory.

The requirement for collateral (*COLL*) plays a major role in the credit relationship (Lopez-Gracia and Sogorb-Mira 2008): the lenders use it to mitigate the default risk and it is a self-selection device for borrowers. Such requirement may deter executives from underinvesting and making discretionary deductions (Jensen and Meckling 1976; Myers 1977). Corporate assets or the personal contributions of managers tame moral hazard (Voordeckers and Steijvers 2006); in case of default, sequestrated guarantees increase the losses of the company, which is therefore encouraged to choose less risky projects (Besanko and Thakor 1987, Berger and Udell 1990). Collateral reduces agency costs and drives creditors to grant long-term loans (Jensen and

[3] The score function is: *S = 0.3665 + 0.0388*FA 0.3801*FIR + 0.0217*CF + 0.0524*P + 0.0809*NI 0.00495*PE*. FA stands for financial autonomy, FIR for financial interest rate, CF for cash flow, P for performance, NI for net income and PE for personnel expenses. FA (%) = (Equity / Total balance sheet)*100. FIR (%) = (Interest / net turnover)*100. CF (%) = (Cash flow before distribution / Net sales + Operating subsidies)*100. P (%) = (Current result before tax / Net sales + Operating subsidies)*100. NI (%) = (Net income / Net equity)*100. PE (%) = (Personnel expenses + Employee profit-sharing / Value added)*100. See Altman (1968) and Modrik (2016) for the default risk.

Meckling 1976, Harris and Raviv 1990). According to Titman and Wessels (1988), companies with (tangible) assets that can stand as collateral are more indebted.

In contrast, Stiglitz and Weiss (1981, 1987) argue that the requirement of higher collateral can lead the borrower to undertake riskier projects, in order to offset the opportunity cost of collateral sequestration. This requirement also crowds out agents who have a strong aversion to risk.

In turn, Bester (1985, 1987) challenges Stiglitz and Weiss's argument, arguing that the provision of assets as collateral can reveal the quality of the business. The risky borrower chooses a contract combining low collateral with high interest rate, whereas the risk-averse borrower prefers a contract requiring a larger amount of collateral and a lower interest rate. These revealing contracts can substitute to the expensive collection of information on companies (Adair and Adaskou 2015).

The collateral of a company can be calculated according to the share of property, plant and equipment and inventory in the balance sheet (Titman and Wessels 1988, Bourdieu and Collin-Sédillot 1993). Our fourth hypothesis (*H4*) is stated as follows: the supply of credit increases vs. does not increase if companies are able to offer more assets as collateral.

The industry (*INDUST*) influences the supply of credit, in as much as each industry is characterised by specific operating modes and is also a synthetic indicator of the risk relating to core business of the company (Psillaki et al. 2010). It may also reflect differences in the tax treatment or information of the creditors upon growth prospects of the companies (Bédué, 1997). This variable is measured by four dummy indicators (manufacturing, trade, construction and services) corresponding to the French Activity Nomenclature (NAF), level 60 (Adair and Adaskou 2011). Our fifth hypothesis (*H5*) is stated as follows: the industry wherein the company operates has a specific effect on the supply of credit.

A firm is considered to be either independent (*OWN*) or owned by a third party shareholder, according to the share in ownership of third parties (including other companies) in the capital of the firm (see Appendix 2). In this respect, two variables are included: dummy independent and dummy owned. Third party owned companies may send a good signal to lenders who provide more credit than to their independent counterparts. Conversely, the control over capital structure and debt strategy are less constrained for independent firms than for owned enterprises. Our sixth hypothesis (*H6*) is stated as follows: Compared with third party owned firms, the supply of credit to independent firms is larger vs. weaker, with respect to trade-off theory vs. pecking order theory.

Table 1 Hypotheses tested regarding the supply of bank credit

Hypotheses	Variables	Calculus	Code	L_t^s
H1	Risk of bankruptcy with respect to the size of the firm	Ln(Total assets)	*SIZE*	+
H2	Reputation and experience of the firm as a dynamic prospect	2002 - Establishment date	*Age*	+ or -
H3	Credit risk	*Dummy* variable	*RISK*	+ or -
H4	Required collateral with respect to moral hazard	(Property, plant and equipment + inventories) / Total assets (t-1)	*COLL*	+ or -
H5	Business risk related to the industry	*Dummy* variables (*manufacturing; *trade; *construction and *services).	*INDUST*	+ or -
H6	Ownership (independent of third party owned firm)	*Dummy* variable	*OWN*	+ or -

Source: Authors

2.4. Variables and testable hypotheses regarding the demand for bank credit

The level of activity (*SALES*) can influence the cash flow and drive the company to borrow (Atanasova and Wilson 2004, Steijvers 2008). In accordance with pecking order theory, a company experiencing sustained growth confronts to a significant need for external financing; indebtedness seems to be the most satisfactory source of funding (Ziane 2004). The combination of high growth and very limited access to financial markets drive SMEs to rely heavily on bank financing (Chittenden et al. 1996). Conversely, agency theory asserts that growth opportunities can lead to moral hazard: companies have to take more risk and struggle to convince their lenders to grant them credit. The level of business activity is measured by the ratio of sales to total assets in the previous year (Adair and Adaskou 2011). Our seventh hypothesis (*H7*) is formulated as follows: the demand for credit is a function of the level of activity of the company, which is positive according to pecking order theory vs. negative according to agency theory.

The output capacity or Gross Value Added (*GVA*) can be constrained by the lack of internal resources, which drives the company to seek external financing (Atanasova and Wilson 2004, Steijvers 2008, Alexandre and Buisson-Stéphan 2014). According to pecking order theory, the need for external financing is due to the fact that the company cannot finance its output level with its own self-financing capacity. This variable is approximated by the logarithm of value added. Our eighth hypothesis (*H8*) is stated as follows: the demand for credit is an increasing vs. decreasing function of the level of output of the firm, with respect to pecking order theory vs. agency theory.

Liquidity (*LIQ*) is an indicator of the ability for the company to finance its own business cycle (Alexandre and Buisson-Stéphan, 2014). This variable is approximated by the ratio of short-term current assets to current liabilities, within less than one year. This ratio gauges whether short-term resources cover liabilities and whether the company may avoid credit rationing. If the ratio is below 1, the company may not be able to meet its commitments. If it is beyond 1, the company will be able to meet its commitments. A large ratio over 1, equivalent to a positive working capital, may however prove to be too high, implying that the company does not make efficient use of its assets. Our ninth hypothesis (*H9*) is that credit demand is a decreasing function of liquidity.

Cash flow (*CASHF*) measures the internal resources available for financing the business thanks to the wealth generated by its activity, which is congruent with pecking order theory. The various studies that have tested this theory on French SMEs (Adair and Adaskou 2015) show that these companies first resort to internal financing and do look for external resources only when their self-financing capacity is exhausted. The available internal resources variable is approximated by the cash flow to t total assets of the previous year. Our tenth hypothesis (*H10*) is stated as follows: demand for bank credit is a decreasing function of available cash flow with respect to pecking order theory.

Trade credit (*TCREDIT*) is an important source of short-term funding for SMEs. Unsatisfied credit demand can be offset by trade credit, which then represents a substitute for short-term bank debt (Atanasova and Wilson 2004). This credit is easily accessible even in a context of slow growth or recession, when banks are reluctant to grant credit. Business relationships between companies and their suppliers are generally more harmonious than between firms and banks (Dietsch 1998). According to trade-off theory, indebtedness of a company towards its trading partners may be perceived by banks as a signal of good payback capacity, which may drive an increase in bank credit. This complementary relationship between trade credit and bank

credit would therefore be positive. According to pecking order theory, trade credit is a significant and less risky source of short-term financing for SMEs: the substitution relationship between trade credit and bank credit would therefore be negative (Adair and Adaskou 2011). This variable is measured by the amount of trade payables net of trade receivables, compared to total assets of the previous year. Our eleventh hypothesis (*H11*) is stated as follows: the relationship between demand for bank credit and trade credit is positive vs. negative with respect to trade-off theory vs. pecking order theory.

The Euro interbank offered rate (*EURIBOR*) at one year represents the benchmark interest rate for each year of the sample, upon which the bank fixes the cost of the debt for each company (Atanasova and Wilson, 2004). Our twelfth hypothesis (*H12*) is as follows: the demand for credit is a decreasing function of EURIBOR.

Table 2 Hypotheses tested regarding the demand for bank credit

Hypotheses	Variables	Calculus	Code	L_t^d
H7	Level of activity of the firm	Turnover / Total assets (t-1)	*SALES*	+
H8	Level of output of the firm	Ln(value added)	*GVA*	+
H9	Liquidity	Current assets / Current liabilities	*LIQ*	-
H10	Available internal resources	Cash-flow / Total assets (t-1)	*CASHF*	-
H11	Trade credit	Trade credit to customers-trade credit from suppliers / Total assets (t-1)	*TCREDIT*	+ or -
H12	Interest rate benchmark for the bank	Euro interbank offered rate (average one year)	*EURIBOR*	-

Source: Authors

The variables that can influence the supply of credit are the following:
$X'_{2t} = SIZE\ (+\ or\ -), AGE\ (+), Dummy\ RISK\ (+\ or\ -), COLL\ (+\ or\ ),$
$Dummy\ INDUST\ (+\ or\ -), Dummy\ INDEP(+\ or\ -)$

The variables that can influence the demand for credit are the following:
$X'_{1t} = SALES\ (+), GVA\ (+), LIQ\ (-), CASHF\ (-), TCREDIT\ (+\ ou\ -), EURIBOR\ (-)$

3. Sample, Descriptive Statistics, Estimation and Results

3.1. Sample

The information comes from the DIANE database listing the accounts of French companies. The selection of SMEs is based on the available corporate accounts (updated 2010), according to eight criteria complying with the definition for SMEs from the European Commission (see Appendix 1). These currently operating businesses are not listed on the financial market and have provided accounts for the years 2002 to 2010; the average workforce is below 250 employees, total assets are at most 43 million euros and the turnover is below 50 million euros; they are selected according to their industry according to the French Activity Nomenclature (see Appendix 2). We obtain a balanced panel of 2,370 mature SMEs and 21,330 observations over 2002-2010.

3.2. Descriptive statistics

According to Table 3, 806 strictly independent SMEs account for one-third (34.01%), whereas 1,564 third party owned SMEs represent about two-thirds (65.99%) of the sample[4]. By and large, slightly over half the SMEs is directly owned (D Indicator). This distinction is important:

[4] DIANE database includes ownership indicators corresponding to the concentration (or dilution) of ownership over the capital of a company *vis-à-vis* its shareholders (Appendix 2).

irrespective of the type of credit (fixed rate, overdraft or leasing), indebtedness of independent SMEs is more expensive than for third party owned SMEs, given the average effective interest rate and charged fees (Chai and Nguyen, 2011).

Table 3 Distribution of the sample according to ownership indicators

Indicators of ownership	Frequency	Share (in %)
Total independent companies (A)	806	34.01
Companies owned by third party shareholder(B)	241	10.17
Companies owned by third party shareholder (C)	7	0.3
Companies owned by third party shareholder (D)	1,316	55.53
Total companies owned by third party shareholder **(**B, C and D**)**	1,564	65.99
Total companies	2,370	100

Source: Authors from DIANE database

Table 4 reports descriptive statistics of the variables for the sample of selected SMEs. We observe that the median company is almost 15 years old and owns 3.116,050 million euros assets; its solvency ratio indicates that equity represents almost two thirds of total debt; one third of total assets is available for collateral; eventually, its liquidity ratio (1.70) shows that it is able to finance its own business cycle, its short-term resources covering up its short term expenses.

Table 4 Descriptive statistics of explanatory variables

	Mean	Median
Total assets (in €)	4,561.41	3,116.05
Value added (in €)	2,108.74	1,601.28
Age (in years)	18.76	14.88
Solvency ratio	1.08	0.65
Financial expense coverage ratio	62.62	10.82
Cash flow from operations	0.10	0.09
Collateral	0.37	0.33
Activity	2.06	1.84
Ln(value added)	7.38	7.38
Liquidity ratio	2.17	1.70
Trade credit	0.06	0.06
EURIBOR	0.029	0.023

Source: Authors from DIANE database

3.3. Estimates and results

In Table 5 regarding credit supply, fixed effects model (*Within*) and the random effects model (*FGLS*) display rather low R2. *Within* is most relevant because it expresses the share of the intra-individual variability of the dependent variable explained by those of the explanatory variables. With respect to the fixed effects model and the random effects model, the Fisher test and the Wald test are both significant at 1% threshold. The Breusch-Pagan test shows that random effects are globally significant at the 1% threshold.

Table 5 Results from estimations of the disequilibrium model

Bank credit supply (L_t^s)	**Coefficients**			
Estimator	**OLS**	***Within***	***FGLS***	**Hausman-Taylor**
SIZE	0.004***(0.001)	0.058***(0.002)	0.035***(0.002)	0.052***(0.002)
AGE	-0.001***(0.000)	-0.006***(0.000)	-0.002***(0.000)	-0.005***(0.000)
RISK Dummy *LMR*[a]	-0.036***(0.003)	-0.035***(0.002)	-0.034***(0.002)	-0.036***(0.002)
RISK Dummy *HR*	-0.034***(0.003)	-0.021***(0.002)	-0.021***(0.002)	-0.021***(0.002)
Collateral (*COLL*)	0.285***(0.005)	0.287***(0.007)	0.289***(0.006)	0.288***(0.006)
*Dummy*Trade (*INDUST*)[b]	0.012***(0.002)	--	0.012**(0.006)	0.009*(0.006)
Dummy Construction (*INDUST*)	-0.009***(0.003)	--	-0.004(0.007)	-0.004*(0.008)
Dummy Services(*INDUST*)	0.07***(0.003)	--	0.066***(0.007)	0.055***(0.009)
Dummy Ownership (*OWN*)[c]	0.004**(0.002)	--	0.009**(0.005)	0.008*(0.006)
Constant	0.059***(0.011)	-0.263***(0.014)	-0.173***(0.014)	-0.233***(0.015)
R^2	0.21	0.14	0.21	
Fisher Test	629.61	640.71		
Prob>F	0.000	0.000		
Wald chi2			3569.31	3674.99
Prob>chi2			0.000	0.000
Breusch-Pagan Test			38769.42	
Prob>chi2			0.000	
Hausman Test *Within vs. FGLS*			788.29	
Prob Hausman			0.000	
Demand for credit (L_t^d)				
Estimator	**OLS**	***Within***	***FGLS***	**Hausman-Taylor**
Level of activity (*SALÉS*)	0.016***(0.001)	0.052***(0.001)	0.043***(0.001)	
Output capacity (*GVA*)	-0.009***(0.001)	0.003***(0.001)	0.000(0.001)	
Liquidity (*LIQ*)	-0.003***(0.000)	0.000(0.000)	0.000(0.000)	
Cash flow (*CASHF*)	-0.052***(0.013)	-0.198***(0.010)	-0.188***(0.010)	
Trade credit (*TCREDIT*)	-0.122***(0.005)	0.135***(0.006)	0.079***(0.006)	
Interest rate (*EURIBOR*)	0.000(0.001)	- 0.001**(0.000)	0.001*(0.000)	
Constant	0.265***(0.010)	0.237***(0.010)	0.247***(0.010)	
R^2	0.041	0.126	0.003	
Fisher Test	149.850	454.500		
Prob>F	0.000	0.000		
Wald chi2			2088.280	
Prob>chi2			0.000	
Breusch-Pagan Test			41451.560	
Prob>chi2			0.000	
Hausman Test *Within vs. FGLS*			809.170	
Prob Hausman			0.2	

*** p<0.01, ** p<0.5 and * p<0.1. Standard deviations in parentheses.

[a] *UR* (unsustainable risk) is considered as reference.

[b] Manufacturing industry is considered as reference.

[c] Third- party owned company is considered as reference.

Source: Authors

The Hausman test upon *Within* vs. *FGLS* is significant at the 1% threshold, implying that the specific effects are correlated with the explanatory variables and that *Within* would be preferable. However, *Within* does not allow to estimate the impact of an invariant variable over time (here industry and the ownership of the company) because data are transformed into difference compared to the individual average. *Between* (inter-individual averages) could be used although the results are very close to those of OLS.

We eventually designed an instrumental variable model including constant variables that provides convergent and efficient estimates when the disturbances are correlated with some

explanatory variables of the model (Adair and Adaskou, 2015). The instruments used are as follows; first, time-variant explanatory variables, twice exogenous, expressed both as individual averages and as deviations from the individual mean; second, time-invariant explanatory variables, twice exogenous; and finally, time-variant explanatory variables, simply exogenous, expressed as deviations from individual averages (Hausman and Taylor, 1981). The explanatory variables that we assume to be endogenous and that vary over time are credit risk and the age of the company. Exogenous variables varying over time are the size and collateral. Time-invariant exogenous variables are industry and ownership of the firm.

Regarding credit demand in Table 5, R2 also proves rather weak. With respect to both the fixed effects and the random effects model, the Fisher test and the Wald test are both significant at 1% threshold. The Breusch-Pagan test shows that random effects are globally significant at the 1% threshold. The Hausman test proves non-significant at the 10% threshold, which implies it does not allow us to differentiate *Within* vs. *FGLS*. Hereafter, we comment on the results of the random effects model (*FGLS*).

3.3.1. Results relating to the bank credit supply function

The size variable (*SIZE*) exerts a positive and very significant effect on the decision to grant bank credit. When increasing by 1%, credit supply increases by 5.2%. This result validates trade-off theory (TOT) and rejects the thesis according to which growth opportunities would be interpreted by banks as a signal of a risky business. SMEs extending their workforce would be considered by banks as businesses enjoying growth opportunities and less exposed to the risk of bankruptcy (Adair and Adaskou, 2015). Hypothesis *H1*, a positive correlation of size with the supply of short-term and long-term credit is thus verified, in accordance with Steijvers (2008), although opposite to Alexandre and Buisson-Stéphan (2014) who observe a negative relationship.

The age variable (*AGE*) is negative and very significant. This result invalidates the predictions of the agency theory (TOT) and validates those of the pecking order theory (POT) according to which mature companies own more capital and resort less to bank credit. Hypothesis *H2* according to which credit supply is a decreasing function of the age of the firm is thus verified. This result is in agreement with that of Steijvers (2008) concerning the determinants of the short-term credit supply, but it disagrees on the determinants of long-term credit supply (Steijvers, 2008) as well as with that of Alexandre and Buisson-Stéphan (2014).

As for credit risk (*RISK*), the dummy variable *UR* (unsustainable risk) standing as a reference, dummy variables *LMR* (low or medium risk) and *HR* (high risk) are negative and significant. Low-, medium- and high-risk businesses use less credit than those facing unsustainable risk. This result can be explained by self-selection, encouraging low-risk, medium and high-risk companies to avoid bank loans and use other financing sources such as trade credit and self-financing. Hypothesis *H3* is validated, credit risk has a negative influence upon bank credit supply, which is compatible with both TOT and POT.

Collateral (*COLL*) exerts a positive and very significant effect on the decision to grant credit. Companies with property, plant and equipment and inventory in their balance sheet are more indebted than others. Hypothesis *H4* is verified, validating agency theory (TOT) in agreement with Steijvers (2008) and Alexandre and Buisson-Stéphan (2014).

Industry (*INDUST*) influences the supply of bank credit, dummy variables are positive and significant. Banks supply more credit to firms operating in the services than to those in the trade industry. The construction industry is less indebted compared with the manufacturing industry. Hypothesis *H5* is verified.

Ownership (*OWN*), is significant and weakly positive, the dummy for companies owned by a third party shareholder standing as a reference. Independent companies use bank credit more than owned companies. Hypothesis *H6* is validated for TOT but not for POT.

3.3.2. Results from the desired bank credit demand function

The level of activity (*SALES*) is highly positive and very significant. A 1% increase raises the demand for credit by around 5.2%. This result confirms the predictions of the pecking order theory (POT), according to which debt is the most appropriate external funding source for firms experiencing sustained growth (Ziane 2004). Hypothesis *H7* is therefore verified in agreement with Steijvers (2008) and Alexandre and Buisson-Stéphan (2014).

The output capacity (*GVA*) exerts a positive and very significant effect, whereby an increase raises the demand for credit. Companies unable to finance their business cycle with internal resources call on external financing. Hypothesis *H8* validates pecking order theory (POT), in line with Steijvers (2008), but opposite to Alexandre and Buisson-Stéphan (2014) who observe a negative relationship.

Liquidity (*LIQ*) is positive but not significant. It is unclear whether short-term resources can cover liabilities and whether firms are in position to avoid credit rationing. Hypothesis *H9* is therefore neither confirmed nor invalidated.

Cash flow (*CASHF*) is negative and very significant: demand for credit is a decreasing function of the internal resources of the company. This result is consistent with the predictions of pecking order theory (POT). Hypothesis *H10* is confirmed in accordance with Steijvers (2008), in contrast with Alexandre and Buisson-Stéphan (2014) who observe a positive relationship.

Trade credit (*TCREDIT*) is positive and very significant: an increase in trade credit raises the demand for bank credit. This result confirms trade-off theory (TOT) contending that trade credit complements bank credit. Hypothesis *H11* is therefore verified in agreement with Alexandre and Buisson-Stéphan (2014).

The interest rate (*EURIBOR*) is weakly negative and significant: the demand for credit declines as the cost of debt increases. Hypothesis *H12* of a negative correlation is thus confirmed in line with Alexandre and Buisson-Stéphan (2014).

4. Share of SMEs rationed on the credit market

Table 6 Share of SMEs rationed on the credit market (2002-2010)

Year	Total number of SMEs	Number of rationed SMEs	Rationed SMEs (%)	Variation rate (%)
2002	2,370	235	10.0	--
2003	2,370	211	9.0	-10.21
2004	2,370	177	7.0	-16.11
2005	2,370	159	7.0	-10,17
2006	2,370	155	7.0	-2.52
2007	2,370	153	6.0	-1,29
2008	2,370	133	6.0	-13.07
2009	2,370	114	5.0	-14.29
2010	2,370	107	5.0	-6.14
2002-2010	21,330	1,444	7.0	--

Source: Authors' calculations from DIANE.

The share of SMEs financially constrained by banks is determined by comparing the adjusted credit supply and demand values of the models previously estimated. A company is rationed in year *t* if the probability that the desired demand for credit exceeding the amount granted in the same year is beyond 0.5 (Gersovitz 1980). This estimation method allows a switch between rationing and non-rationing regimes: a non-rationed enterprise in one year could be rationed another year (Antanasova and Wilson 2004, Adair and Fhima 2013). In Table 6, once the companies are classified for every year according to the rationed vs non-rationed regimes, we calculate the share of rationed SMEs over the total sample.

Over 2002-2010, the share of French SMEs applying for credit that are totally or partially rationed on the bank credit market is seven per cent on average. We observe that this share declines from one year to the next, including in 2009-2010 during which mature SMEs prove resilient. This result corresponds to that found by Kremp and Sevestre (2013) who explain such low share by the implementation of credit mediation since the end of 2008, hence encouraging banks not to restrict their credit supply to SMEs. Only firms in bad financial position, i.e. for which banks would expect a significant default risk, have faced serious obstacles in accessing bank credit.

5. Conclusion and discussion

We studied the determinants of the credit rationing on a balanced panel of 2,370 French SMEs observed from 2002 to 2010. We measured the share of rationed SMEs over a period of 9 years, in particular, the impact of the 2008 recession. We used a simultaneous disequilibrium model that accounts for the existence of credit rationing and provides an endogenous classification of rationed and non-rationed enterprises.

Statistically significant estimates show that the desired demand for bank credit is determined by exogenous factors such as the collateral required by the banks and the interest rate. Trade-off theory and agency theory (TOT) are best validated by variables attributed to credit supply (size, credit risk, collateral, industry and ownership). Conversely, pecking order theory (POT) is best validated by variables attributed to the demand for credit (level of activity, value, added and cash flow), whereas trade credit validates trade-off theory (TOT) and age validates pecking order theory (POT).

The extent of credit rationing is a controversial issue. We estimate that seven per cent is the average share of rationed French SMEs in operation for a decade, a share pretty close to that of 7.30-8.80 per cent rationed SMEs found by Kremp and Sevestre (2013), whereas it is nearly six times lower than the 45.3 per cent rationed French SMEs according to Alexandre and Buisson-Stéphan (2014). This wide discrepancy over a similar time span may be due to a selection bias in the sample or the database itself, and to econometric modelling. Noteworthy is that age is a major criterion: our sample includes mature SMEs that survived at least since 2002; they prove less rationed and more resilient than young SMEs. This result is congruent with the result of Kremp and Sevestre (2013) and corollary to that of Alexandre and Buisson-Stéphan (2013) who observe rationing affects upon young SMEs.

It is worth mentioning our sample includes only mature French SMEs whether independent or not, whereas Kremp and Sevestre use a larger sample comprising only independent SMEs that are both mature and young. Size variable exerts a positive and very significant effect on the decision to grant bank credit to SMEs, whereas Kremp and Sevestre (2013) find a negative impact. We find that older companies have more equity and use less bank debt; furthermore, an increase trade credit is a strong driver of demand for credit. Both these results oppose that of Kremp and Sevestre (2013). As for other findings, our results are in agreement with that of Kremp and Sevestre (2013): SMEs with larger disposable collateral are more indebted, demand

for credit declines as the cost of debt rises and proves a decreasing function of the internal resources of the company.

Our study faces limitations due to the nature of book data, the approximate measurement of some variables and the heterogeneity of SMEs. It is dependent on the analytical tools we used, notably the lack of estimation of fixed effects; data essential for better measurement of the risk are lacking in the database, such as the duration of credits or the number of contracted loans.

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Appendix

Table A1 Thresholds for SMEs from the 1st of January 2005

Business categories	Employees	Turnover	Total balance sheet
Medium-sized enterprise	50-249	€ 50 million	€43 million
Small business	10-49	€ 10 million	€ 10 million
Microenterprise	0-9	€ 2 million	€ 2 million

Source: European Commission

Table A2 Classification of Industries (French Nomenclature Level 60)

Number	Industry	Code
1	Agriculture and Food Industry; Energy	10-16, 23, 40-41
2	Consumer Goods Industry	17-19, 35-37
3	Automotive Industry	34
4	Capital Goods Industry	29-33
5	Intermediate Goods Industry	20-22, 24-28
6	Construction	45
7	Trade	50 à 52
8	Services (transportation, real estate, business services, personal services, education, health and social work)	60-62, 63-64, 70-71, 72-74, 55, 90, 92-97, 80-85

Agriculture, forestry and fishing activities (01-05), financial activities (65-67), public administration and associative activities (75, 91-99) were excluded, because they operate with a different mode of financing.
Source: INSEE