Borrowing constraints and firm dynamics

Sónia Félix
Banco de Portugal

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Abstract
What is the impact of credit market frictions on firm dynamics? In this paper we investigate the role of partial credit constraints on the firm's investment and probability of survival. We consider the probability of credit rationing estimated using a disequilibrium model to identify SMEs that were affected by borrowing constraints in the period between 2010 and 2012. We find that firms that were estimated to have been partially credit constrained in this period have lower contemporaneous probability of survival and invest less, *ceteris paribus*. (JEL: C41, D22, G21, G33)

That said, credit conditions remain very heterogeneous across countries and sectors. According to the latest ECB survey on credit access by small- and medium-sized enterprises (SMEs), supply constraints remain especially strong for SMEs in stressed countries. The percentage of financially constrained but viable SMEs – i.e. those with positive turnover in the last six months seeking a bank loan – varies from a minimum of 1% in Germany and Austria to a quarter of the total population in Spain and as much as a third in Portugal.
by Mario Draghi, ECB Forum on Central Banking, 2014

Introduction

Borrowing constraints have important implications for firm dynamics. Firms may be forced to operate at a smaller scale than desired, may forgo investment opportunities, and may not be able to overcome temporary liquidity needs in the presence of negative shocks. While the heterogeneity underlying firm dynamics is not yet fully understood, it is well established that firm dynamics are an important determinant of aggregate outcomes (Hopenhayn and Rogerson (1993), Melitz (2003), and Klette and Kortum (2004)).

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E-mail: scfelix@bportugal.pt

The theoretical literature has emphasized the role of financing constraints in explaining firm dynamics, namely the firm's investment and exit decisions. Fazzari *et al.* (1988) explain the behaviour of aggregate investment based on financial constraints. Albuquerque and Hopenhayn (2004) develop a theory of endogenous borrowing constraints and find that these are important determinants of firm growth and survival. Cabral and Mata (2003) find that the firm size distribution of Portuguese manufacturing firms is quite skewed to the right but evolving over time toward a more symmetric one. The explanation relies on the presence of financing constraints for young and smaller firms. Cooley and Quadrini (2001) introduce financial-market frictions in a model of industry dynamics with persistent shocks and show that the combination of these can explain the dependence of firm dynamics on size and age. Furthermore, the models of firm dynamics document that smaller firms may be more sensitive to the worsening of credit market conditions during recessions (Perez-Quiros and Timmermann (2000)) and a tightening of monetary policy (Gertler and Gilchrist (1994)).

Little empirical evidence can be found on the importance of the firm's capital structure for firm dynamics. Audretsch and Mahmood (1994) use data from the Netherlands and show that the firm and industry debt structures do not significantly influence the likelihood of new firm survival. In contrast, Mata *et al.* (2010) document that firms with a higher share of long-term debt survive more. Farinha *et al.* (2018) establish this argument with respect to new firms. Farinha and Prego (2013) show that the firms' investment decisions are correlated with the firms' financial standing. Recently, Carreira and Teixeira (2016) use firm-level data for Portugal and show that credit market conditions in the period between 2004 and 2012 explain firm exit, especially in the case of large firms, and employment change.

Portuguese small and medium-sized enterprises (SMEs) were substantially affected by credit constraints during the economic and financial crisis. Farinha and Félix (2015) estimate a disequilibrium model for the period between 2010 and 2012 and document that approximately 15 percent of Portuguese SMEs were partially credit constrained. In particular, the smaller and the younger firms were the most credit constrained in this period. Moreover, the authors estimate that in this period Portuguese SMEs searched for bank loans mainly to finance their operational activity and not for investment. The smaller firms and those with smaller amounts of internal resources are estimated to have higher demand for bank loans. In turn, firms with a higher capacity to generate cash-flows and pay their debt and with more assets to pledge as collateral are estimated to borrow more from banks.

In this study we present a very simple empirical model to investigate the impact of borrowing constraints on the firm's investment and exit decisions. We proceed with the analysis in two steps: first, we pick the credit demand and credit supply estimates of the credit disequilibrium model estimated in Farinha and Félix (2015), to determine the probability of credit rationing

and to identify which firms were partially credit constrained in the period between 2010 and 2012; and second, we estimate how firm's investment and exit probability responded to the firm's credit conditions.

The results suggest that financial-market frictions are important to explain the firm's investment and probability of survival. Firms that were estimated to have been partially credit constrained in the period between 2010 and 2012 are less likely to survive, *ceteris paribus*. The estimates also suggest that firm's investment is negatively correlated with the presence of financing constraints. Overall, these results suggest that financing constraints played a role in explaining firm dynamics in this period.

The paper proceeds as follows. In the next section we present the data. Section 3 presents the empirical methodology and discusses the results. Section 4 concludes.

Data description

The variables included in the analysis were computed using the Portuguese dataset Simplified Corporate Information - IES - which consists of detailed balance sheet data and covers the population of virtually all Portuguese nonfinancial corporations. In the estimation of the disequilibrium model, Farinha and Félix (2015) consider a sample of Portuguese SMEs in the period between 2005 to 2012. Nevertheless, the relevant period for the estimation starts in 2010 because it is imposed in the estimation that firms stay at least for four consecutive years in the sample.[1]

The estimation of the credit disequilibrium model allows us to identify which firms were credit constrained. The disequilibrium model is comprised of three equations: one equation for the demand of new loans, one equation for the supply of new loans, and one equation that links the observed quantity of credit with the unobservable credit demand and supply. Loan demand is assumed to depend on the firm's economic activity, availability of substitute (internal and external) funds, and the cost of bank credit. Loan supply is assumed to be determined by a set of variables that measure the firm-specific credit risk and firm collateral.[2] The formal details of the model and a description of the determinants of the demand and supply of new loans are presented in Farinha and Félix (2015). Based on these estimates it is possible to identify the firms that were granted a new loan in the period between 2010

1. Moreover, the authors also consider the Rivers and Vuong (1988) estimation strategy to deal with the endogeneity problems raised by some variables and consider the first differences of the explanatory variables lagged one and two periods as instruments of the endogenous variables.

2. The estimation of the credit disequilibrium model relies on firm balance sheet data and, therefore, the authors do not account for bank-specific characteristics in the specification of the credit supply function.

and 2012 but in a lower amount than they had applied for, which we call partially credit rationed firms. It is important to consider the fact that the obtained results on borrowing constraints are conditional on the estimated model and the time period under analysis.

A firm exit in year t is defined by its absence from the IES in that year, provided that this absence does not constitute a reporting gap.[3] We follow Farinha and Prego (2013) and define the firm's investment rate as the ratio between the change from year *t-1* to year *t* in net fixed assets, i.e. not adjusted for depreciations, and total assets. Observations below the 1^{st} and above the 99^{th} percentiles of the investment rate distribution were not considered in the analysis in order to avoid extreme values.

We end up with a sample of 51,872 observations in the period between 2010 and 2012. The main descriptive statistics of the variables considered in the estimated models are presented in Table 1.

	Mean	**St. dev.**	**Q1**	**Q2**	**Q3**
Investment rate	-0.012	0.091	-0.039	-0.014	0.005
Probability of partial rationing	0.218	0.250	0.018	0.119	0.330
Exit	0.025				
Very small firms	0.573				
Small firms	0.356				
Medium firms	0.071				

TABLE 1. Main descriptive statistics.

Number of observations: 51,872 (17,037 firms in 2010, 17,713 firms in 2011, and 17,122 firms in 2012). The average number of observations per firm in the sample is approximately 2.37. Q1, Q2, and Q3 correspond to the first, second (median), and third quartiles of the investment rate and probability of partial credit rationing distributions. Exit, very small firms, small firms, and medium firms are dummy variables and, therefore, the mean corresponds to the fraction of firms in the sample.

Empirical methodology and results

Empirical methodology

In this study we consider the probability of partial credit rationing calculated in Farinha and Félix (2015) to determine which firms were credit constrained in the period between 2010 and 2012. Then, to assess the importance of borrowing constraints on the firm's investment and likelihood of survival we consider the following baseline equation:

3. We considered IES data until 2014 to identify a firm exit.

$$y_{it} = \beta_0 + \alpha_i + \delta_s + \lambda_t + \beta_1 BorrowingContraints_{it} + \beta_2 Size_{it} + u_{it}, \quad (1)$$

where y_{it} assumes two outcomes: exit and investment rate of firm i in year t. We consider two different specifications of the variable $BorrowingConstraints$: the probability of partial credit rationing as estimated in Farinha and Félix (2015), and a dummy variable that equals one whenever the probability that the latent credit demand is higher than the supply of credit exceeds 0.5, and zero otherwise (*Partial rationing*).[4] *Size* is a categorical variable for firm size with categories very small, small, and medium-sized firms.[5] The terms δ_s and λ_t denote a set of sector of economic activity and time fixed effects, respectively. Sector of economic activity fixed effects account for time-invariant specific (observed and unobserved) sectoral characteristics and time fixed effects capture the cyclical position of the economy. The term α_i denotes a vector of firm fixed effects that account for firm (observed and unobserved) time-invariant heterogeneity. Firm fixed effects are only included in the investment specification because of the single failure per firm data that would lead to the inconsistency of the fixed effects in the exit model.

The investment model is estimated by ordinary least squares and the exit model is estimated using the complementary log-log estimator, which is suitable to deal with transition discrete data, namely the estimation of the probability of firm exit at a certain moment conditional on having survived until that moment.[6] The logarithm of duration is included in the exit model in order to account for duration dependence, i.e. how the hazard rate varies with survival times.

Results

The estimation results of equation (1) are reported in Table 2. According to the estimates presented in column (1), borrowing constraints played a role in explaining investment dynamics in this period. The results suggest that a one standard deviation increase in the probability of being credit constrained contributes to decrease the investment rate by 1.6 percentage

4. We follow the work conducted in Farinha and Félix (2015) and consider 0.5 as the threshold to identify partially credit constrained firms. In the original work, the authors considered different thresholds in a reasonable neighborhood of 0.5 and the results on credit rationing are qualitatively the same.

5. The classification of firms according to size follows the European classification of SMEs.

6. The complementary log-log model (cloglog) arises as a suitable estimator for discrete duration data in which only two outcomes are possible in each time interval - the firm either exits the market or continues operating - and has the advantage of allowing a neat interpretation of the estimates in terms of the hazard ratio. An alternative model to deal with discrete-time transition data is the logit model. The estimation of the exit specification using the logit model yields very similar average marginal effects to those obtained with the cloglog model.

points. Furthermore, according to the estimates presented in column (2), the investment rate of SMEs that were estimated to have been partially credit constrained is on average 2.7 percentage points lower than that of their counterparts, *ceteris paribus*. In the sampling period, the average investment rate equals -1.2 percent.

	Investment		Exit	
	(1)	(2)	(3)	(4)
Probability of partial rationing	-0.0642***		1.3443***	
	(0.0040)		(0.1352)	
Partial Rationing		-0.0273***		0.6432***
		(0.0018)		(0.0868)
ln time			-0.1842**	-0.1886**
			(0.0880)	(0.0882)
Firm size dummies	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	No	No
Economic activity sector fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Number of firms	25,763		25,758	
Number of observations	51,872		51,834	

TABLE 2. The impact of financing constraints on the firm's investment and likelihood of survival.

The dependent variable in columns (1) and (2) is the firm's investment rate and in columns (3) and (4) is firm exit. All specifications include sector of economic activity and time fixed effects. Firm fixed effects are included in the investment specifications presented in columns (1) and (2). Ordinary least squares estimates presented in columns (1) and (2), and complementary log-log estimates reported in columns (3) and (4). The logarithm of duration is included in the exit model specifications in order to account for duration dependence. Robust standard errors clustered at the firm level in parentheses. *** and ** denote statistical significance at 1 and 5 percent, respectively.

The estimates reported in columns (3) and (4) suggest that financing constraints are important to explain the probability of survival of Portuguese SMEs. In particular, the estimated average marginal effect after fitting a complementary log-log model equals 0.034[7], which implies that the higher the probability of being affected by borrowing constraints the higher the likelihood of firm exit. Moreover, according to the estimates reported in column (4), firms that were estimated to have been partially credit constrained in the period between 2010 and 2012 are on average 1.61 percentage points less likely to survive, *ceteris paribus*. The average exit rate for the firms in the sample in this period is approximately 2.5 percent and therefore this estimate implies that credit constrained firms are on average 64 percent less likely to

7. In the complementary log-log model, the probability of exit is given by $\Pr[exit = 1|\mathbf{x}] = 1 - \exp[-\exp(\mathbf{x}'\beta)]$ and, therefore, the marginal effect depends on the values of the estimated coefficients and the values of the explanatory variables. In this study we consider the average marginal effect.

survive than their counterparts. The duration dependence term is estimated to be negative in both columns (3) and (4), which suggests that the probability of firm exit decreases with time.

Overall, these results suggest that financing constraints are important to explain market dynamics, namely investment and exit decisions, in the period between 2010 and 2012.

Summing up

Farinha and Félix (2015) estimate that a substantial fraction of Portuguese SMEs were affected by borrowing constraints in the period between 2010 and 2012. The authors consider a credit disequilibrium model to estimate the probability that the firm's latent credit demand is higher than credit supply, conditional on the observed amount of bank loans.

It is well established in the firm dynamics literature that financing constraints are an important determinant of firm growth and survival. This study contributes to the empirical literature on borrowing constraints and firm dynamics by analyzing the investment behaviour and exit decisions of Portuguese SMEs that were estimated to have been partially credit rationed in those years. Bank loans are a significant source of funding for Portuguese SMEs and, therefore, a credit market tightening may have important implications for firm dynamics. The results suggest that credit constrained firms are significantly less likely to survive than their counterparts. Moreover, it is estimated that in this period firm's investment is negatively correlated with the presence of financing frictions in the credit market.

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