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Abstract:

We analyse for the first time whether trade credit provided an alternative source of external finance to SMEs during the credit crisis. Using firm level panel data on over 40,000 Spanish SMEs we find that credit constrained SMEs depend on trade credit, but not bank loans, to finance capital expenditures and that the intensity of this dependence increased during the financial crisis. Unconstrained firms, in contrast, are dependent on banks loans not trade credit. Overall, this suggests substitution between bank loans and trade credit that is conditional on the level of financing constraints and is more intense during the crisis. (100 words).

Key words: SMEs, financing constraints, bank lending, trade credit, predictability.

JEL classification: G21, D21, L26

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Introduction

As the financial crisis began tearing through the fabric of the world's financial system in the third quarter of 2007 it became abundantly clear that firm access to finance was going to be an early victim. Exploiting the increasing availability of data since the inception of the crisis, researchers have begun to assess the damage caused by the credit crunch. Much of this effort has been focused on determining the existence and magnitude of the credit crunch, which financial institutions contracted the most, how the financial crisis propagated across national boundaries, and which firms were affected the most. However, relatively little research has been conducted on how the most vulnerable firms coped with the contraction of credit supplied by their banks. Some research has analyzed whether firms with multiple banking relationships were able to offset a reduction in the supply from one of their banks with more funding from a stronger bank (e.g., Iyer et al. 2010). Almost no research has examined whether firms were able to substitute one lending technology for another during the credit crunch. We address this gap in the evolving literature on the financial crisis by analyzing the most important alternative to bank lending, trade credit. Specifically, we analyze whether firms victimized by the credit crunch turned to trade credit as an alternative source of financing during the credit crunch.

Trade credit is ubiquitous. In nearly every developed and developing economy it is the most important alternative to bank loans as a source of external funding in the SME sector (Demirgüç-Kunt and Maksimovic 2001). In the U.S., for example, trade credit provides almost as much debt financing to SMEs as bank loans (31.3% of total debt financing vs. 37.2%) (Berger and Udell 1998). The importance of trade credit has not been lost on the academic community where a relatively larger number of papers have examined how trade creditors underwrite their "loans" and the extent to which they may have an idiosyncratic advantage over banks in extending credit. Moreover, evidence suggests that trade credit provides a safety valve for firms facing idiosyncratic liquidity shocks (e.g., Wilner 2000, Boissay and Gropp 2007, Cunat 2007).

Several papers have looked at whether this liquidity/safety value role for trade credit applies to macro shocks. Specifically, these papers have examined whether trade credit acts as a substitute for bank credit during during monetary shocks or financial crises (Calomiris, Himmelberg and Wachtel 1995, Choi and Kim 2005, Love, Preve and Sartia-Allende 2007, Taketa and Udell 2007, and Demiroglu, James and Kizilaslan 2012). In the only analysis of trade credit during the current financial crisis, the evidence suggests that in the U.S. stronger larger firms extended more trade credit during the current financial crisis and weaker larger firms received more trade credit (Garcia-Appendini and Montoriol-Garriga 2011). Missing from the literature is an examination of how firms in the most vulnerable sector of the economy, the SME sector, faired during this financial crisis and whether the most affected firms in this sector turned to trade credit as an alternative to bank lending.

We address this gap in the literature by analyzing the role of trade credit in funding Spanish SMEs during the financial crisis. Spain is an interesting venue for studying this phenomenon for several reasons. First, the performance of the Spanish economy during the crisis is crucial to the performance of the European Union and to the viability of the Euro zone. Unlike Greece, Ireland and Portugal – the three other hardest hit Euro zone economies – Spain is large and its eventual outcome could by itself determine that fate of the EU. While it is possible to imagine the Euro surviving a sovereign default by either Greece, Ireland and Portugal, it is much more difficult to imagine the Euro surviving a default by Spain.[1] Second, the crisis affected the major components of Spain's financial system in very different ways. About half of Spain's banking system consists of the cajas banks (i.e., savings banks) most of whom have shown losses during the financial crisis due in great part to rapid pre-crisis expansion fueled by spatial deregulation (see Illueca, Norden and Udell 2011).[2] The largest banks in Spain, however, were much more insulated – particularly in the case of BBVA and Santander – mostly because of cross-border diversification. This

[1] This is not to say that Spain is more likely to default than any of the others. Spain has less sovereign debt as a fraction of GDP. However, Spain's unemployment is the highest in the Euro zone.
[2] Five of the seven banks that failed the Europe's bank stress tests in 2010 were Spanish cajas.

allows for the possibility that larger firms who utilize these larger banks had better access to credit during the crisis – and they could use this access to large bank credit to finance the extension of more trade credit to vulnerable SMEs.

Third, due to data limitations there are only a limited number of countries where it is feasible to study how SMEs coped with the credit crunch. For example, there is no data set available in the U.S. that contains firm-level panel information on SME financing.[3] We can overcome this problem with our data from the Bureau-Van-Dijk Amadeus database on 40,215 SMEs covering the period 1994-2008. These data contain panel firm-level financial statement information including bank borrowings, trade credit usage and trade credit payment period.

Our analysis begins by identifying firms that are credit constrained using a disequilibrium model that allows us to determine when a firm's supply of credit is exceeded by its demand for credit. By way of preview we find that the fraction of credit-constrained firms significantly increases during the crisis. In the second step of our analysis we examine how funding differs between unconstrained firms and constrained firms and how this difference changes from pre- to post-crisis. We find that unconstrained firms depend on bank financing to fund capital expenditures while constrained firms depend on trade credit. More precisely, for unconstrained firms, bank funding predicts capital expenditures (but not trade credit) and for constrained firms, trade credit predicts capital expenditures (but not bank loans). We also find that the magnitude of these effects increases during the credit crunch. Taken together our analysis indicates three things: i) financially constrained firms are more dependent on trade credit to make their investment decisions; ii) the financial crisis was associated with a credit crunch that affected the SME sector by increasing the number of credit constrained firms; and, iii) capital expenditure sensitivity to trade credit increased during the crisis period.

[3] Unlike many other countries, the U.S. has chosen not to invest in a public credit register (see Miller 2003). The only comprehensive survey of small firm finance in the U.S., the Survey of Small Business Finance, was discontinued by the Federal Reserve just before the crisis began. While this survey had been tentatively schedule to be conducted in 2008, its non-panel construction would have limited its capacity to address the dynamics of trade credit studied here.

Our paper proceeds as follows. In the next section we briefly discuss the streams of literature that relate to our analysis: the literature on trade credit, the literature on the financial crisis and SME finance, and the intersection of these two literatures. In Section III we describe our data and our methodology. In Section IV we present our results. Section V offers some robustness checks. Section VI concludes.

I. Related Research

II.A. The Potential Advantages of Trade Credit

A considerable body of research has been devoted in recent decades to analysing the role of trade credit in providing firms with external finance. There is some evidence to indicate that trade creditors might even have an advantage over other lenders (specifically, banks) in providing credit to especially opaque firms. Among these arguments is the possibility that suppliers may act as "relationship lenders" because they have unique proprietary information about their customers (McMillan and Woodruff, 1999; Uchida *et al.*, 2011). Some papers find that suppliers obtain information about the true state of their customer's business that is not known to banks (Smith 1987, Biais and Gollier 1997). One paper shows that trade suppliers may have an advantage in enforcing unsecured debt contracts (Cuñat 2007). This advantage allows suppliers to extend more credit than banks when their customers are rationed in the bank loan market. Another paper has shown that smaller suppliers extend more trade credit to larger creditworthy borrowers as a mechanism to signal product quality (Klapper, Laeven and Rajan 2011).

Demirguç-Kunt and Maksimovic (2001) also emphasize that information about a firm's customers is potentially valuable and that sellers act on this information to extend credit on terms that are not available from banks. Some have suggested that this supplier information advantage in funding opaque firms may imply a complementarity between trade credit and bank loans (Cook, 1999; Ono, 2001; García-Appendini, 2006). However, this argument is not necessarily inconsistent with the view that bank loans are a less expensive substitute for

trade credit (e.g., Meltzer, 1960; Brechling and Lipsey, 1963; Ramey, 1992; Marotta, 1996; Uesugi and Yamashiro 2004; Tsuruta, 2008). It has been suggested that both views (substitutes and complements) can be reconciled by conditioning on whether firms are financially constrained or not (García Appendini, 2006).[4]

II.B. The Literature on SME Credit Access During the Current Financial Crisis

The literature on the impact of the current crisis on access to credit is now growing at a rapid rate as the passage of time makes more data available to the research community. Some of the earliest studies focused on the U.S. and found evidence of significant supply shocks to the terms and availability of credit to larger firms (e.g., de de Haas and van Horen 2010, Almeida et al. 2010, Ivashina Scharfstein 2010). As we noted earlier, however, the U.S. has not been a good venue to study the impact of the crisis on credit access by SMEs. Consequently, much of the research on how more informationally opaque firms were affected by the contraction of credit has been focused elsewhere, particularly Europe where SME data is more available.

Some of the credit crunch literature has focused on how the credit crunch may have propagated through the foreign operations of distressed global banks (e.g., Cetorelli and Goldberg 2009, 2011, Popov and Udell 2012). A key challenge in this literature is sorting out demand and supply effects.[5] Papers that have looked at credit crunch effects at the firm level have taken several different approaches. One approach has been to use application data to control for demand (e.g., Puri, Rocholl and Steffen 2011, Popov and Udell 2011, Ongena, Popov and Udell 2011, Presbitero, Udell and Zazzaro 2011). Another approach has been to use firm fixed effects in countries where multiple banking relationships are common in the SME sector (e.g., Albertazzi and Marchetti 2010,

[4] See Giannetti et al. (2011) and Uchida and Udell (2011) for comprehensive reviews of this now extensive literature.

[5] Occasionally natural experiments occur where supply shocks are necessarily insulated from demand shocks as in the case of Japanese subsidiaries in California during the Japanese financial crisis (i.e., Peek and Rosengren 1997). This, however, does not apply in this crisis.

Iyer et al. 2010, Jimenez, et al. 2011). Overall the literature suggests that the credit crunch in the SME sector was economically significant, that weaker banks (measured in a variety of different ways) contracted their credit more, and that weaker and more opaque firms were more adversely affected.[6]

II.C. The Intersection of the Crisis and Trade Credit Literatures

In order to fully assess the impact of the credit crunch on the SME sector all sources of external finance must be considered. One type of lending might substitute for another type of lending; and, one type of lender might substitute for another type of lender (Taketa and Udell 2007, Udell 2009). In this paper we study the most important alternative to bank lending, trade credit.

As we noted above some papers have analyzed whether trade credit and bank loans are substitutes or complements. We ask a more specific question in this paper: Did SMEs crunched out of the bank loan market turn to trade credit as an alternative source of finance during the crisis? There are three papers in the literature that are most directly related to our analysis of this question. One of these papers – the first chronologically - found that larger firms in the U.S. used their access to the commercial paper market to fund an increased extension of trade credit during monetary policy shocks (Calomiris, Himmelberg and Wachtel 1995). The second paper looked at the Japanese financial crisis of the 1990s (the "lost decade") – a crisis that in many ways mirrored the current U.S. financial crisis. This paper found little evidence that trade credit played much of a role as a lender of last resort in Japan (Taketa and Udell 2007). The lack of firm level data in this study, however, limited its ability to draw distinctions among firms with respect to their use of trade credit.

The third study is the most relevant to ours. It looked at trade credit during this crisis using U.S. data (Garcia-Appendini and Montoriol-Garriga 2011) [G-M]. This study found evidence that firms with large levels of pre-crisis liquidity extended more trade credit during the crisis. It also found that financially

[6] See Presbitero, Udell and Zazzaro (2011) and Popov and Udell (2012) for recent summaries of the literature on SME access to finance and the current financial crisis.

constrained firms utilized (received) more trade credit. This study, however, was limited to large firms with a market capitalization of $50 million or more or a book value of $10 million or more. (As we noted above, data limitations in the U.S. like Japan during the "lost decade" preclude firm-level analyses of SMEs.)[7] At first blush, it might seem reasonable to speculate that this finding on trade credit for large firms would also apply to SMEs based on the argument that if an effect is found for inherently more transparent (i.e., large) firms with access to the capital markets, it likely applies to firms that are less transparent (SMEs). But, some caution must be exercised in extrapolating this result on large U.S. firms to U.S. SMEs for several reasons. First, the magnitude of the effect might be quite different between large and small firms. Second, the financial crisis in the U.S. hit large banks first. Small banks who lend exclusively to SMEs were hit later and hit by different factors, most importantly commercial real estate. Finally, the G-M study can't tell us whether larger "liquidity unconstrained firms" were as willing to extend increased trade credit to smaller SMEs as they were to other large firms (who were likely bigger customers).

Thus, one big distinction between our paper and the G-M paper (i.e., the only other paper to study trade credit during the financial crisis) is that we specifically focus on trade credit provided to SMEs. We also differ significantly in terms of methodology. In particular, we employ a very different approach to the proxies used in the G-M study to measure whether firms are financially constrained. The three proxies used in G-M are the Kaplan-Zingales (1997) index, the Whited-Wu (2006) index, and the dividend payout measure. These measures are calibrated for large firms that pay dividends and have access to the capital markets (i.e., large firms that have access to debt sources beyond bank loans including the private placement market, the commercial paper market, the medium-term note market and the corporate bond market. These indexes are not appropriate for the SME market. In Spain, like many other countries, the only two meaningful sources of external finance for SMEs are bank loans and

[7] This study used Compustat data and the authors also effectively eliminated mid-sized firms with their size filter because of concerns about the quality of the accounting data for these firms.

trade credit.[8] So, we specifically model firms that are *bank constrained*, the relevant benchmark in an SME context. Also, our focus on the SME sector is particularly relevant in a European context where most firms and most employment reside in this sector.[9]

II. Data and Methodology

III.A. Empirical Strategy and Data

Our empirical strategy involves two main steps. First, we identify firms that are financially constrained. Specifically, we estimate the probability that a firm will experience borrowing constraints using a *disequilibrium model* that allows us to identify the set of (information-based and other) supply and demand factors that may affect the wedge between the costs of internal and external funding. This permits us to classify firms as constrained or unconstrained using both cross-section and times series information. In the second step, in order to assess the relative dependence on bank loans versus trade credit, we conduct an analysis of the effect of these two sources of external funding on investment using Granger predictability tests. That is, we test whether i) investment for unconstrained firms is sensitive to (i.e., caused by) bank loans; and ii) investment for constrained firms is sensitive to (i.e., caused by) trade credit. In some sense this can be viewed as looking at the "dual" of the cash flow-investment sensitivity approach where the sources of investment funding are either banks loans or trade credit.

Our data come from the Bureau-Van-Dijk Amadeus database and include annual information on 40,215 Spanish SMEs during 1994-2008. SMEs are defined as those with less than 250 employees[10]. Some of the firms were not active over the entire sample period because some start-ups/newer firms entered

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[8] In the U.S. commercial finance companies also provide a significant of SME finance (e.g., Berger and Udell 1998).

[9] This is not to say that the SME sector is unimportant in the U.S. where the SME sector is probably at least 40-45% of GDP depending on how one defines an SME.

[10] This is the standard definition of SMEs according to the European Commission's Recommendation 2003/361/EC. All SMEs in the sample are below 40 million of euros in total assets.

the data set and some distressed firms disappeared. This unbalanced panel consists of 540,329 observations. Also our dataset allows us to combine SME information with regional-level macroeconomic and bank market industry variables (i.e., local market power) which is critical in using our disequilibrium model to classify firms as either constrained our unconstrained. Definitions of our variables and sample means are provided in Table I.

III.B. Our Methodology – Step I: A Disequilibrium Model of Firm Financing Constraints

In order to identify whether firms are financially constrained we employ a disequilibrium model (Maddala, 1980) consisting of two-reduced form equations: a demand equation for bank loans, and a supply equation that reflects the maximum amount of loans that banks are willing to lend based on collateralizable assets. A third equation is added as a transaction equation restricting the value of loans as a min equation of desired demand and loan supply. Since demand and supply for bank loans are not observed (Cheng and Degryse, 2010, Kirschenmann, 2010), a disequilibrium model can solve this problem, by assigning the observations either to the demand or the supply equation. Maddala and Nelson (1974) and Maddala (1980) discuss the appropriate maximum likelihood method for this class of disequilibrium models, which has been used for empirical analysis of credit markets in different countries (see e.g. Sealey 1979; Perez 1998, Ogawa and Suzuki, 2000; Atanasova and Wilson, 2004; Steijvers, 2008 or Carbó et al., 2009).[11]

The loan demand ($Bank\ loans^{d}_{it}$), loan supply ($Bank\ loans^{s}_{it}$), and transactions equations ($Bank\ loans_{it}$) for firm *i* in period *t* are:

$$\begin{aligned} Bank\ loans^{d}_{it} &= \beta^{d}_{0} + \beta^{d}_{1}(Sales)^{d}_{it} + \beta^{d}_{2}Cash\ flow_{it} \\ &+\beta^{d}_{3}(Loan\ interest\ spread)_{it} + \beta^{d}_{4}\log(GDP) + u^{d}_{it} \end{aligned} \tag{1}$$

[11] We are assuming here that trade credit is more expensive than bank loans. Thus, we can focus on bank loans to determine whether firms are constrained in their access to external finance.

$$Bank\ loans_{it}^{s} = \beta_0^{d} + \beta_1^{s} Tangible\ assets_{it} + \beta_2^{s} Bank\ market\ power$$
$$+\beta_3^{s} Default\ risk_{it} + \beta_4^{s} \log(GDP) + u_{it}^{s} \quad (2)$$

$$Bank\ loans_{it} = Min(Bank\ loans_{it}^{d}, Bank\ loans_{it}^{s}) \quad (3)$$

Bank loan demand is modelled as a function of firm activity (*Sales*), internal financing (*Cash flow*), and the interest spread on bank loans (*Loan interest spread*). The latter is computed as the difference between the loan interest rate and the interbank interest rate[12]. The maximum amount of credit available to a firm (i.e., the supply) is modelled as a function of the firm's collateralizable assets (*Tangible assets*), the banks' market power in the area where the firm operates measured by the Lerner index (*Banks' market power*),[13] and a proxy for firm default risk (*Default* risk) which is defined as the ratio of operating profits over interest paid. All non-ratio variables are converted into ratios (of total assets) to reduce heteroscedasticity. As a consequence, the size (scale) effect of "total assets" in the demand function above is estimated as part of the constant term since the constant term is estimated as a coefficient of the reciprocal of total assets. Both the demand and supply equations contain *log(GDP)* to control for macroeconomic conditions across the regional markets where the SMEs operate[14].

The simultaneous equations system shown in (1), (2) and (3) is estimated as a switching regression model using a full information maximum likelihood (FIML) routine with fixed effects. According to the results from the disequilibrium model, a firm is defined as financially constrained in year *t* if the probability that the desired amount of bank credit in year *t* exceeds the maximum amount of credit available in the same year is greater than 0.5. Following Gersovitz (1980),

[12] The loan interest rate is computed as a ratio of interest expense to bank loans outstanding. We implicitly assume that the year-end loan balance is roughly equal to the weighted average balance during the year..

[13] See Cetorelli and Gambera (2001). The Lerner index is defined as the ratio "(price of total assets - marginal costs of total assets)/(price of total assets)". The price of total assets is directly computed from bank-level auxiliary data as the average ratio of "bank revenue/total assets" for the banks operating in a given region using the distribution of branches of banks in the different regions as the weighting factor. Marginal costs are also estimated from the auxiliary sample.

[14] Since some of the variables are computed from regional data, errors are clustered by region since these variables would be equal or very similar across firms in the same region.

the probability that a firm will face a financial constraint in year *t* is derived as follows:

$$\Pr(loan_{it}^{d} > loan_{it}^{s}) = \Pr(X_{it}^{d}\beta^{d} + u_{it}^{d} > X_{it}^{s}\beta^{s} + u_{it}^{s}) = \Phi\left(\frac{X_{it}^{d}\beta^{d} - X_{it}^{s}\beta^{s}}{\sigma}\right) \qquad (4)$$

where X_{it}^{d} and X_{it}^{s} denote the variables that determine a firm's loan demand and the maximum amount of credit available to a firm, respectively. The error terms are assumed to be distributed normally, $\sigma^2 = \mathrm{var}(u_{it}^{d} - u_{it}^{s})$, and $\Phi(.)$ is a standard normal distribution function. Since $E(loan_{it}^{d}) = X_{it}^{d}\beta^{d}$ and $E(loan_{it}^{s}) = X_{it}^{s}\beta^{s}$, $\Pr(loan_{it}^{d} > loan_{it}^{s}) > 0.5$, if and only if $E(loan_{it}^{d}) > E(loan_{it}^{s})$. This specification will also allow us to distinguish between those borrowers that get less in bank loans than they need (partially constrained) and those that don't get any loans at all (fully constrained).

III.C. Our Methodology – Step II: Dynamic Panel Data Predictability Tests

Using the classifications from our disequilibrium model we can now turn to our analysis of the sensitivity of investment to the two sources of SME external finance. We do this by using predictability tests designed for dynamic panel data models. In particular, we study the relationships between different sources of financing (bank loans and trade credit) and investment. If constrained SMEs can turn to trade credit as an alternative to bank loans, then we should find that trade credit predicts investment but bank loans do not. For unconstrained firms (who have access to bank loans) we should find that bank loans predict investment but trade credit does not. The variables are lagged (*l*) one, two and three years of the since these relationships are not necessarily contemporary but likely reflect long-term effects (Rosseau and Wachtel, 1998)[15].

Since our dataset consists of cross-section and time series firm-level observations, the predictability regressions include fixed effects (f). The

[15] An Augmented Dickey-Fuller (ADF) procedure is applied as a test for unit roots. First differencing the variables was sufficient to achieve stationarity.

empirical specification follows the Holtz-Eakin *et al.* (1988) approach on predictability tests for panel data. Given *N* firms (*i=1,…,N*), *t* time periods (*t=1,…,T*), and firm-specific fixed effects (f_i), bank loans - specifically "bank loans/total liabilities" - will predict investment if two conditions are met:

i) The bank loans ratio is statistically significant in a time-series regression of the firm investment rate:

$$\begin{aligned}(Capital\ expenditure_{it} / capital_{it-1})_t &= \alpha_0 + \sum \beta_i (Capital\ expenditure_{it} / capital_{it-1})_{t-l} \\ &+ \sum \gamma_i (Bank\ loans_{it} / total\ liabilities_{it})_{t-l} + \psi_t f_i + u_{it} \qquad (5)\end{aligned}$$

The investment rate variable is not significant when it is included in a time-series regression of the bank loans ratio:

$$\begin{aligned}(Bank\ loans_{it} / total\ liabilities_{it})_t &= \alpha_0 + \sum \beta_i (Bank\ loans_{it} / total\ liabilities_{it})_{t-l} \\ &+ \sum \gamma_i (Capital\ expenditure_t / capital_{t-1})_{t-l} + \psi_t f_i + u_{it} \qquad (6)\end{aligned}$$

If instead, the situation is reversed – so that the $\sum \gamma_i$ in the first set of regressions is not significant while in the second set $\sum \beta_i$ is significant, then investment predicts bank loans. Finally, if bank loans variable in equation (5) and the firm investment rate variable in equation (6) are both significant, then there will be predictability in both directions and it is likely that a third factor is driving both the evolution of firm investment and bank loans. As control variables, the predictability equations include *Interbank interest rates*, *Cash flow*$_t$*/capital*$_{t-1}$, *Sales growth* and the *Trade credit defaults*. The statistical significance of the predictability test is measured using an F-test.

The identification of the equation is easier when the individual effects and the lagged coefficients are stationary, so that the individual effects are eliminated. All variables are expressed in first-differences since standard Augmented-Dickey-Fuller tests suggest that first-differencing is sufficient to achieve stationarity.

To examine trade credit usage we run predictability tests between investment and our proxies for trade credit dependence. We use two proxies: *Accounts payable/total liabilities* and *Credit period*. *Trade credit payment period* is defined as the number of days that credit is extended from survey data in the

Amadeus database. To see if trade credit is used differentially by constrained versus unconstrained firms, the predictability equations are estimated separately for both constrained and unconstrained firms.

The vector of instrumental variables that is available to identify the parameters of the equations in first differences includes various additional lags of sales growth, cash generation and the ratio "tangible $assets_t$/ total $assets_{t-1}$", to proxy for asset tangibility and creditworthiness. A necessary condition for identification is that there are at least as many instrumental variables as other right-hand side variables. The standard Hansen test for identification is employed.

III. Results

The results for the disequilibrium model estimated over the entire sample period are shown in Table IIA. All of the key variables have the expected sign. We alternatively allow the coefficients to vary across three periods to reflect the possibility that our supply and demand functions change (Table IIB). The first period, 1994-2000, covers the recovery years after the credit crunch of the early 1990s; the second period, 2001-2006, captures the expansion years and the credit boom of the pre-crisis regime; and the third period, 2007-2008, captures the financial crisis. Table IIB also shows tests for differences between coefficients across time periods using the baseline estimations of Table IIA and covariance analyses for the different time periods. These tests show differences for some of the variables – cash flow generation and interest rates on the demand side, and tangibility and market power on the supply side.

In order to verify that our empirical estimations of the disequilibrium model are reasonable we examine whether they show an increase in the fraction of firms that are constrained during the crisis (Table III) and we examine whether constrained firms behave as we might have expected relative to unconstrained firms (Table IV). Table III shows in a year-by-year analysis (based on the estimations of the disequilibrium model shown in Table IIB) that indeed shows that the fraction of constrained firms increased during the crisis (2007-2008)

based on a variety of definitions for being constrained. These definitions include, among others, partially constrained firms (those that received less bank loans than they wanted) and fully constrained firms (those with a positive demand who received no bank loans). This is consistent with the general conclusion in the literature that SMEs faced a credit crunch during the current financial crisis (e.g., Jimenez et al. 2011, Popov and Udell 2011, and Puri Rocholl and Steffen 2011). Unlike the current literature on the credit crunch in the SME market, we use on our European data a different methodology to separate demand from supply effects, i.e., we do not depend on survey questions or other data on whether firms applied for credit, nor do we depend on firm fixed effects for firms that borrow from multiple banks (which may or may not be analogous to single-bank firms). Our approach involves estimating demand and supply effects separately for each firm.

Table IV shows that our key variables do indeed reflect differences between constrained and unconstrained firms that we would expect. For example, capital expenditures and cash flow are stronger for unconstrained firms and cash flow-investment sensitivity is less for unconstrained firms.

[INSERT TABLE IV HERE]

Now we turn to our main analysis - our tests on trade credit and financial constraints. The baseline results for the unconstrained firms are shown in Table V. We focus on the differences in firm dependence on bank loans and trade credit between the pre-crisis period (2001-2006) - panel A, and the crisis period (2007-2008) - panel B. That is, we focus on the transition from a bank credit boom period to a crunch period.[16] We note that the values from the Hansen test for over-identifying restrictions indicate that the instruments that we use are valid.

[16] We have also estimated the main equations for the earlier post-crunch period (1994-2000). The results are similar to the pre-crunch period of 2001-2006 although the coefficients showing loan-investment and trade-credit investment sensitivities are of a lesser magnitude. For the sake of simplicity we only report the results for the 2001-2006 and 2007-2008 periods. The results of the 1994-2000 period are available upon request to the authors. As a reference, the results of the predictability tests for the whole period (1994-2008) are shown in Appendix A both for constrained (Table A1) and unconstrained firms (Table A2).

Also note that since the coefficients are shown as log-differences of the variables, they can be interpreted as marginal effects.

The results in equations (1) and (2) in Table V (Panel A) show that bank loans predict investment but investment does not predict bank loans for unconstrained firms in the pre-crunch period. In equation (1), where investment is the dependent variable, a 1% increase in the ratio of loans to total liabilities has a marginal effect of 5% on the "capital expenditure$_t$/ capital$_{t-1}$" ratio. For the most part the other explanatory factors in equation (2) are also significant and exhibit the expected signs. The tests in equations (3) to (6) for unconstrained firms relate trade credit measured in two different ways (the ratio "accounts payable to total assets" and the trade credit payment period) to investment. None of the relationships among these variables were found to be significant. Panel B in Table V replicates all the equations for unconstrained firms for the crunch period. The main relationships found in the pre-crunch period hold but the magnitude of the bank loan-investment sensitivity declines to 3.27%. The tests for coefficient differences shown at the bottom of Table V show that the estimated impact of *Bank loans/total liabilities* $_{t-1}$ on investment in the pre-crunch period (0.0501) and in the crunch period (0.0327) are significantly different at the 1% level suggesting that the sensitivity of bank loans to firm investment declines during a credit crunch

[INSERT TABLE V HERE]

Next in Table VI we estimate the same six equations for constrained firms (i.e., partially constrained plus fully-constrained firms). Distressed firms are excluded from the analysis in order to just focus on viable firms suffering from borrowing constrains. Equations (1) and (2) for the pre-crunch period in Table VI (Panel A) show no evidence of predictability in either direction between investment and bank loans for constrained firms. However, unlike for unconstrained firms, trade credit -- measured either by "accounts payable/total liabilities" or the trade credit payment period -- predicts investment for constrained firms. In particular, a 1% increase in "accounts payable/total liabilities" predicts a 6.53% increase in the "capital expenditure$_t$/ capital$_{t-1}$" ratio

while the marginal effect of the trade credit payment period is 2.54%. These results also imply that trade credit is a substitute for bank lending in funding investment projects. As reflected in Panel B in Table VII, the sensitivity of investment to "accounts payable/total liabilities" is still positive but significantly lower in the crunch period (2.03%) However, the effect of lengthening the trade credit payment period on investment during the crunch is significantly higher than in the pre-crunch period (5.85%).

Taken together our results provide the strongest results yet in the literature that trade credit provides the most important alternative lending technology to bank loans for credit constrained SMEs and that trade credit plays an especially vital role during a credit crunch. Unlike prior studies that were confined to analyzing the behaviour of trade credit during macro shocks either from a large firm perspective (e.g., Calomiris, Himmelberg and Wachtel et al., 1995, Garcia-Appendini and Montoriol-Garriga 2011) or confined to analyzing aggregated SME data (Taketa and Udell 2007), we are able to analyze the role of trade credit using firm-level data.

[INSERT TABLE VI HERE]

V. Robustness checks

As a robustness check, we also run our tests on the sub-sample of just fully-constrained firms (also excluding distressed firms). These results are shown in Appendix A, table A3. The “accounts payable/total liabilities” and the credit period are also found to predict investment although the marginal effects are significantly lower (1.32% and 1.42%, respectively).

One potential criticism of our results is that the specification of the disequilibrium model may endogenously determine the financially-constrained status. As an alternative approach to analyzing financial frictions we also employ a switching regression model with two-regimes that enables us to investigate firm investment behavior by allowing a firm’s financial constraint to be endogenously determined by the model itself. This permits us to simultaneously estimate

investment behavior and financing constraints within a single model. In the switching regression model, potential biases stemming from unobservable variation in investment opportunities are addressed within the model. As shown by Almeida and Campello (2007) this model revolves around the marginal effect of asset tangibility on the impact of income shocks on spending under credit constraints. Even if the cash flow coefficient contains information about investment opportunities, it is unlikely that the bias is higher both for constrained firms and for firms showing larger asset tangibility. In particular, any bias that is systematically related to the financial constraints proxies will be differenced out by looking at the differences between firms with highly tangible assets and those with less tangible assets. This also allows us to examine the conditions under which investment is sensitive to bank loans and trade credit. However, while the disequilibrium model permits us to directly classify firms into financially constrained and unconstrained, the two-regime model instead investigates the investment behavior of different types of firms while allowing the state of a firm's financial constraint to be endogenously determined by the switching function.

The results using the two-regime switching regression model are shown in Appendix B. Panels A and B correspond to the regime regression and selection equations, respectively, when "loans/total liabilities" is included among the explanatory variables. Panels C and D correspond to the regime regression and selection equations, respectively, when "accounts payable/total liabilities" is an explanatory variable. Importantly, the likelihood test for the null hypothesis that a two-regime model dominates a one-regime model cannot be rejected at the 1% level. Consistent with our main results (i.e., our prior predictability tests), "loans/total liabilities" is only positively and significantly related to the investment ratio in the case of unconstrained firms. In particular, the marginal effect of a 1% increase in loans to total liabilities on "capital expenditure$_t$/ capital$_{t-1}$" is 4.6%. The ratio "accounts payable/total liabilities" is only found to affect the investment ratio positively and significantly for constrained firms with the marginal effect being 2.5%. Appendix B also shows that the estimated coefficients for constrained and unconstrained firms are significantly different and, in particular the cash-flow

investment sensitivity is larger for constrained firms, while the positive effects of asset tangibility on the ratio of investment is significantly higher in the case of unconstrained firms.

As an additional robustness check, the predictability tests were also estimated (not shown for simplicity) excluding those firms showing a cash-flow investment correlation higher than 90% since these firms may be particularly conservative in their investment decision-making investing only when they have the cash flow to do so (Hines and Thaler, 1995). Our main findings hold when these firms are excluded.

VI. Conclusions

There is a growing literature on the effect of the financial crisis on firm access to finance. Virtually all of the literature on the most vulnerable firms, SMEs, has been conducted in Europe because of a lack of firm-level data on SMEs in the U.S. Unlike large firms, SMEs do not have access to the capital markets and thus have a much more limited menu of alternative sources of external finance. Despite this vulnerability, there has been virtually no research on how SMEs changed their dependence on alternative sources of external finance during the financial crisis. Practically, speaking there are only two alternatives for SMEs that matter across most of the world: bank loans and trade credit.

In this paper we analyse whether trade credit provided an alternative source of external finance to SMEs during the current crisis using firm level panel data on over 40,000 Spanish SMEs. Like other recent studies using European SME data we find significant evidence of a general credit crunch in the SME sector during the crisis. But, for the first time, we also find that SME access to these two alternative sources of external finance varies across firms and that it changed during the crisis in interesting ways. Specifically, we find that credit constrained SMEs depend on trade credit, but not bank loans, to finance capital expenditures -- and that the intensity of this dependence increased during the financial crisis. Unconstrained firms, in contrast, are dependent on banks loans

not trade credit. Overall, this suggests a substitution between bank loans and trade credit that is conditional on the level of financing constraints and that is more intense during the crisis. That is, we find evidence that trade creditors play a role in the SME sector as lenders of last resort and this role becomes more important during a credit crunch.

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TABLE I. VARIABLES: DEFINITION AND SAMPLE MEANS

VARIABLE	DEFINITION	MEAN
MAIN INVESTMENT VARIABLE		
Capital expenditure$_t$ / capital$_{t-1}$	The ratio of total capital expenditures at end-year relative to the total amount of capital at the beginning of the year is our investment variable (Kaplan and Zingales, 1997; Fazzari *et al*., 2000).	0.34013
VARIABLES RELATED TO FINANCING DECISIONS		
Bank loans	Outstanding amount of loans in the liability side of firm's balance sheet (thousand of euros)	5,632.4
Banks loans/total liabilities	A ratio that reflects bank-leverage, the relevance of bank loans as a source of external finance.	0.21525
Credit period	Number of days the trade credit is extended to firms.	27.1134
Accounts payable / total liabilities	It reflects the importance of trade credit relative to other sources of financing.	0.30685
FIRM-LEVEL AND ENVIRONMENTAL CONTROL VARIABLES		
Total assets	Total assets on firm's balance sheet (thousand of euros)	9,694.2
Tangible assets	Fixed assets on firm's balance sheet (thousand of euros). This is considered as proxy of collateral.	1,513.7
Cash flow	Net income plus depreciation plus changes in deferred taxes.	1,653.8
Cash flow$_t$/ capital$_{t-1}$	This ratio is defined as cash flow in relative terms to the proportion of capital at the end of the previous year (Kaplan and Zingales, 1997, 2000; Fazzari *et al*., 2000)	0.42456
Sales	Total sales during the year (thousand of euros)	18,635.4
Sales growth	Sales growth offers another alternative measure of firm financing constraints. It has been employed as a measure of investment opportunities and current cash-flows, which are expected to reduce borrowing constraints and as an indicator of financial distress for constrained firms (Fazzari *et al*., 2000, Lamont *et al*., 2001).	0.4602
Interbank interest rates	The three-month interbank deposit rate, obtained from the Bank of Spain, and computed as the average monthly rate over the year. This interest rate controls for the costs of external financing. A shock to interest rates may affect both bank lending and trade credit (Nielsen, 2002; Fukuda et al., 2006).	0.06653
Loan interest spread	This spread is defined as the difference between loan interest rates and interbank rates. The loan interest rate is computed as a ratio of loan expenses and bank loans outstanding. We implicitly assume that the year-end loan balance is roughly equal to the weighted average balance during the year.	0.01123
Default risk	This risk variable is defined as the ratio of operating profits to interest paid. A proxy for operating risk showing how many times interest paid are covered by operating profits.	4.2985
Banks 'market power	Bank market power is measured estimating the Lerner index (%). This index defined as the ratio "(price of total assets - marginal costs of total assets)/price". Marginal costs are estimated from a translog cost function with a single output (total assets) and three inputs (deposits, labor and physical capital) using two stage least squares and bank fixed effects (Cetorelli and Gambera, 2001).	23.0280
Defaults on trade credit	This is a regional measure of the growth in defaults on trade credit in the region where the firm operates. It provides a control for trade credit quality. This is the only business default rate available at the regional level.	0.0243
Log (GDP)	Logarithm of regional GDP in the region where the firm is located	5.2962

TABLE II.A. ESTIMATED PARAMETERS OF THE DISEQUILIBRIUM MODEL

Switching regression model estimated by full information maximum likelihood (FIML) with fixed effects
p-values in parenthesis
Standard errors are clustered at the regional level

Demand for bank loans	**Coefficient**	**Std. Error**
Sales/total assets(t-1)	0.6084*** (0.000)	0.01
Cash-flow/total assets(t-1)	-2.3234*** (0.000)	0.07
Loan interest spread	-1.4103*** (0.000)	0.04
Log(GDP)	0.0243** (0.016)	0.10
Supply of bank loans		
Tangible fixed assets/total assets(t-1)	2.4625*** (0.000)	0.01
Banks' market power	-0.9918*** (0.004)	0.01
Default risk	0.000036 (0.820)	0.01
Log(GDP)	-0.0874** (0.011)	0.08
Reciprocal of total assets in the loan demand equation	352,325.5*** (0.000)	1,215.04
Reciprocal of total assets in the loan supply equation	223,325.6*** (0.000)	2,199.81
S.D. of demand equation	1.5629*** (0.000)	0.01
S.D. of supply equation	0.4803*** (0.000)	0.01
Correlation coefficient	0.6905*** (0.000)	0.05
Log likelihood	159,058	
Observations	540.329	
Number of firms	40.215	

** Statistically significant at 10% level*
*** Statistically significant at 5% level*
**** Statistically significant at 1% level*

TABLE II.B. ESTIMATED PARAMETERS OF THE DISEQUILIBRIUM MODEL: THREE PERIODS OVER THE BUSINESS CYCLE

Switching regression model estimated by full information maximum likelihood (FIML) with fixed effects
p-values in parenthesis
Standard errors are clustered at the regional level

	1994-2000		2001-2006		2007-2008		Coefficient differences (p-value)		
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	1994-2000 vs. 2001-2006	1994-2000 vs. 2007-2008	2001-2000 vs. 2007-2008
Demand for bank loans									
Sales/total assets(t-1)	0.6028*** (0.000)	0.01	0.4425*** (0.000)	0.01	1.3123*** (0.000)	0.01	0.004	0.002	0.001
Cash-flow/total assets(t-1)	-2.1636*** (0.000)	0.08	-1.7918*** (0.000)	0.08	-2.3563*** (0.000)	0.08	0.002	0.118	0.001
Loan interest spread	-1.4482*** (0.000)	0.04	-2.0518** (0.000)	0.04	-2.5684*** (0.000)	0.04	0.003	0.002	0.014
Log(GDP)	0.0215** (0.014)	0.11	0.0396** (0.016)	0.12	0.0294** (0.020)	0.10	0.018	0.041	0.021
Supply of bank loans									
Tangible fixed assets/total assets(t-1)	2.4108*** (0.000)	0.01	1.6152*** (0.000)	0.01	2.6896*** (0.000)	0.01	0.008	0.213	0.002
Banks' market power	-0.9630*** (0.002)	0.01	-0.3236*** (0.001)	0.01	-0.8125*** (0.003)	0.01	0.002	0.058	0.003
Default risk	0.000031 (0.831)	0.01	0.000030 (0.831)	0.01	0.000042 (0.831)	0.01	0.542	0.145	0.129
Log(GDP)	-0.0951** (0.016)	0.08	-0.0412*** (0.004)	0.09	-0.0214* (0.054)	0.08	0.003	0.005	0.003
Reciprocal of total assets in the loan demand equation	332015.2*** (0.000)	1028.19	343286.0*** (0.000)	1156.15	363258.3*** (0.000)	1156.15			
Reciprocal of total assets in the loan supply equation	204955.7*** (0.000)	2016.72	215158.8*** (0.000)	2170.12	210327.5*** (0.000)	2170.12			
S.D. of demand equation	1.4438*** (0.000)	0.01	1.6352*** (0.000)	0.01	1.3272*** (0.000)	0.01			
S.D. of supply equation	0.4321*** (0.000)	0.01	0.5428*** (0.000)	0.01	0.4725*** (0.000)	0.01			
Correlation coefficient	0.6559*** (0.000)	0.07	0.6930*** (0.000)	0.07	0.6583*** (0.000)	0.06			
Log likelihood	143864		150051		154806				
Observations	226.327		200.346		41.283				
Number of firms	34.218		35.184		25.181				

** Statistically significant at 10% level*
*** Statistically significant at 5% level*
**** Statistically significant at 1% level*

TABLE III. PERCENTAGE OF BORROWING CONSTRAINED FIRMS

	Fully-constrained	Partially-constrained	Constrained (fully plus partially constrained)	% Constrained firms among those always active over the sample period	% Distressed firms	Constrained to some extent with: (accounts receivable – accounts payable > 0)	Constrained to some extent with: (accounts receivable – accounts payable < 0)
Entire period (1994-2008)	6.07	29.89	35.96	31.14	6.85	6.79	28.82
1994	8.59	28.34	36.93	30.07	8.11	7.23	29.7
1995	7.63	25.22	32.85	29.87	7.87	6.32	26.53
1996	6.25	30.38	36.63	30.03	7.91	7.27	29.36
1997	6.57	27.41	33.98	29.11	7.12	6.49	27.49
1998	5.23	30.17	35.40	28.63	6.86	7.02	28.38
1999	5.01	30.15	35.16	28.15	6.37	7.19	27.97
2000	4.66	30.93	35.59	27.36	6.95	7.43	28.16
2001	4.53	30.18	34.71	27.12	7.03	6.49	28.22
2002	4.01	30.22	34.23	27.08	6.90	6.55	27.68
2003	3.89	30.03	33.92	26.83	6.64	6.23	27.77
2004	3.85	29.76	33.61	26.53	6.23	5.98	27.52
2005	3.94	29.83	33.77	26.90	6.38	5.41	27.44
2006	3.89	29.28	33.17	26.15	6.12	6.37	25.44
2007	4.53	34.59	39.12	30.41	7.43	7.14	27.39
2008	6.19	36.23	42.42	32.13	8.18	13.53	35.52

Note: Fully-constrained firms are those that do not receive any lending but having a positive demand. Partially-constrained firms are those getting less credit that desired. Constrained to some extent firms is the sum of fully-constrained and partially-constrained firms. Distressed firms are firms that go bankruptcy in a given year.

TABLE IV. DESCRIPTIVE STATISTICS BY FIRM FINANCING CONSTRAINT STATUS

	Fully-constrained	**Partially-constrained**	**Unconstrained**	**Always constrained firms**	**Firms constrained less than three years**	**Distressed firms**	**All firms**
% over all firms	6.07	29.89	64.04	19.26	6.32	6.85	100
Capital expenditure$_t$/ capital$_{t-1}$	0.169	0.308	0.404	0.206	0.359	0.050	0.340
Cash flow$_t$/ capital$_{t-1}$	0.123	0.253	0.326	0.163	0.316	0.042	0.313
(Cash flow$_t$ –Capital expenditure$_t$)/ capital$_{t-1}$	-0.082	-0.066	0.109	-0.070	0.052	-0.019	0.063
Sales growth	0.079	0.228	0.573	0.191	0.406	0.032	0.480
Inventory growth	-0.042	0.053	0.209	0.038	0.168	-0.071	0.0140
Cash flow-investment correlation	0.563	0.756	0.451	0.806	0.714	0.363	0.720

TABLE V. UNCONSTRAINED FIRMS: PANEL DATA PREDICTABILITY TESTS. FIRM FINANCING AND INVESTMENT - PRE (2001-2006) AND POST-CRUNCH (2007-2008) TESTS

2SLS with instrumental variables. (95% significance level)
(p-values in parentheses) Standard errors are clustered at the regional level

PANEL A. UNCONSTRAINED FIRMS (PRE-CRUNCH, 2001-2006)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Capital expenditure$_t$/ capital$_{t-1}$	*Bank loans/total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Accounts payable/ total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Credit period*
Constant	0.03164* (0.011)	0.01928* (0.012)	0.03150* (0.022)	0.01544* (0.023)	0.04296* (0.017)	-0.02259* (0.028)
Dependent variable$_{t-1}$	0.03533* (0.031)	0.02935* (0.020)	0.02144* (0.026)	-0.0314* (0.015)	0.02336* (0.011)	-0.01105* (0.019)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	-	0.7983 (0.121)	-	0.02561 (0.425)	-	0.02012 (0.263)
Bank loans/total liabilities $_{t-1}$	0.0501** (0.002)	-	-	-	-	-
Credit period $_{t-1}$	-	-	-	-	0.1016 (0.207)	-
(Accounts payable/ total liabilities) $_{t-1}$	-	-	0.1270 (0.453)	-	-	-
Interbank interest rates	-0.0152* (0.025)	-0.0095* (0.021)	-0.0102** (0.007)	-0.0223 (0.215)	-0.0118* (0.012)	-0.0085 (0.163)
Cash flow$_t$/ capital$_{t-1}$	0.4258** (0.002)	0.0172 (0.111)	0.1855** (0.011)	-0.2379 (0.132)	0.2217** (0.004)	0.3625 (0.219)
Sales growth	0.0101* (0.035)	0.0345 (0.321)	0.0076* (0.032)	-0.0221 (0.253)	0.0085* (0.023)	-0.0325 (0.140)
Defaults in trade credit	-0.0147* (0.037)	-0.0167* (0.033)	-0.0161* (0.021)	-0.0134* (0.017)	-0.0149* (0.020)	-0.0226* (0.018)
F-test for overall significance (p-value)	0.012	0.035	0.033	0.064	0.035	0.043
Hansen test (p-value)	0.140	0.148	0.168	0.182	0.168	0.142

PANEL B. UNCONSTRAINED FIRMS (CRUNCH, 2007-2008)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Capital expenditure$_t$/ capital$_{t-1}$	*Bank loans/total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Accounts payable/ total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Credit period*
Constant	0.0116* (0.039)	0.0132** (0.008)	0.0247* (0.031)	0.0078 (0.167)	0.0219* (0.034)	-0.0546* (0.029)
Dependent variable$_{t-1}$	0.0221* (0.011)	0.0724 (0.053)	0.0198* (0.033)	-0.0211* (0.011)	0.0178* (0.020)	-0.0232* (0.035)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	-	0.8908 (0.266)	-	0.0204 (0.595)	-	0.0142 (0.380)
Bank loans/total liabilities $_{t-1}$	0.0327** (0.005)	-	-	-	-	-
Credit period $_{t-1}$	-	-	-	-	0.1458 (0.139)	-
(Accounts payable/ total liabilities) $_{t-1}$	-	-	0.1146 (0.208)	-	-	-
Interbank interest rates	-0.0193* (0.016)	-0.0116* (0.016)	-0.0180* (0.012)	-0.0393 (0.221)	-0.0150* (0.014)	-0.0152 (0.228)
Sales growth	0.0137* (0.031)	0.0420 (0.102)	0.0154* (0.041)	-0.0288* (0.023)	0.0132* (0.008)	0.0193 (0.156)
Defaults in trade credit	-0.0191* (0.014)	-0.0224* (0.022)	-0.0187* (0.016)	-0.0151* (0.011)	-0.0257* (0.021)	-0.0603* (0.022)
F-test for overall significance (p-value)	0.019	0.083	0.048	0.080	0.007	0.032
Hansen test (p-value)	0.113	0.141	0.109	0.118	0.153	0.138

COEFFICIENT DIFFERENCES: PANEL A VS. PANEL B

	(1)	(2)	(3)	(4)	(5)	(6)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	-	0.068	-	0228	-	0.413
Bank loans/total liabilities $_{t-1}$	0.003	-	-	-	-	-
(Accounts payable/ total liabilities) $_{t-1}$	-	-	0.147	-	-	-
Credit period $_{t-1}$	-	-	.	-	0,281	-

* significantly different from zero at 5% level
** significantly different from zero at 1% level

TABLE VI. CONSTRAINED FIRMS: PANEL DATA PREDICTABILITY TESTS. FIRM FINANCING AND INVESTMENT - PRE (2001-2006) AND POST-CRUNCH (2007-2008) TESTS

2SLS with instrumental variables. (95% significance level)

(p-values in parentheses) Standard errors are clustered at the regional level

PANEL A. –CONSTRAINED FIRMS[(a)] (PRE-CRUNCH, 2001-2006)						
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Capital expenditure$_t$/ capital$_{t-1}$	*Bank loans/total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Accounts payable/ total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Credit period*
Constant	0.0216** (0.008)	0.0134* (0.022)	0.0327* (0.016)	0.0204* (0.026)	0.2935* (0.014)	-0.0261* (0.031)
Dependent variable$_{t-1}$	0.0221* (0.021)	0.0274* (0.012)	0.0170* (0.031)	-0.0481* (0.012)	0.02615* (0.010)	-0.0628* (0.010)
(Capital expenditure$_t$/ capital$_{t-1}$)$_{t-1}$	-	0.3193 (0.173)	-	0.0870 (0.396)	-	0.01027 (0.232)
Bank loans/total liabilities$_{t-1}$	0.1345 (0.301)	-	-	-	-	-
Credit period$_{t-1}$	-	-	-	-	0.0284** (0.008)	-
(Accounts payable/ total liabilities)$_{t-1}$	-	-	0.0653** (0.006)	-	-	-
Interbank interest rates	-0.0290* (0.026)	-0.0118** (0.002)	-0.0160* (0.017)	-0.0417 (0.602)	-0.0173* (0.024)	-0.0201 (0.171)
Cash flow$_t$/ capital$_{t-1}$	0.4328** (0.002)	0.0363 (0.127)	0.2182** (0.004)	-0.2863 (0.274)	0.2518* (0.012)	0.3725 (0.526)
Sales growth	0.0092* (0.013)	0.0184 (0.142)	0.0161* (0.011)	-0.0017 (0.411)	0.0173* (0.032)	0.0012 (0.485)
Defaults in trade credit	-0.0227* (0.027)	-0.0209* (0.0253)	-0.0177* (0.032)	-0.0219* (0.028)	-0.0240* (0.013)	-0.0228* (0.018)
F-test for overall significance (p-value)	0.003	0.062	0.011	0.067	0.009	0.021
Hansen test (p-value)	0.171	0.127	0.127	0.184	0.171	0.147
PANEL B. PARTIALLY & FULLY-CONSTRAINED FIRMS (CRUNCH, 2007-2008)						
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Capital expenditure$_t$/ capital$_{t-1}$	*Bank loans/total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Accounts payable/ total liabilities*	*Capital expenditure$_t$/ capital$_{t-1}$*	*Credit period*
Constant	0.0221* (0.011)	0.0135* (0.022)	0.0185* (0.022)	0.0233* (0.012)	0.0328* (0.028)	-0.0106* (0.045)
Dependent variable$_{t-1}$	0.0325* (0.023)	0.0202** (0.013)	0.0192* (0.013)	-0.0427* (0.037)	0.0316* (0.013)	-0.0228* (0.014)
(Capital expenditure$_t$/ capital$_{t-1}$)$_{t-1}$	-	0.3244 (0.463)	-	0.0742 (0.394)	-	0.0301 (0.281)
Bank loans/total liabilities$_{t-1}$	0.1424 (0.585)	-	-	-	-	-
Credit period$_{t-1}$	-	-	-	-	0.0585** (0.001)	-
(Accounts payable/ total liabilities)$_{t-1}$	-	-	0.0203** (0.005)	-	-	-
Interbank interest rates	-0.0187** (0.008)	-0.0113* (0.028)	-0.0207* (0.028)	-0.0531* (0.027)	-0.0121** (0.006)	-0.0179* (0.024)
Sales growth	0.0223 (0.274)	0.0183* (0.037)	0.0171** (0.010)	-0.0140 (0.332)	0.0135* (0.024)	0.0153* (0.021)
Defaults in trade credit	-0.0173 (0.064)	-0.0173* (0.012)	-0.0174* (0.013)	-0.0152* (0.026)	-0.0260* (0.011)	-0.0258* (0.014)
F-test for overall significance (p-value)	0.045	0.026	0.033	0.065	0.011	0.026
Hansen test (p-value)	0.176	0.124	0.137	0.169	0.172	0.134
COEFFICIENT DIFFERENCES: PANEL A VS. PANEL B						
(Capital expenditure$_t$/ capital$_{t-1}$)$_{t-1}$	-	0.332	-	0.415	-	0.604
Bank loans/total liabilities$_{t-1}$	0.088	-	-	-	-	-
(Accounts payable/ total liabilities)$_{t-1}$	-	-	0.075		-	-
Credit period$_{t-1}$	-	-	.	-	0,003	-

(a) Constrained means fully-constrained plus partially constrained.

* significantly different from zero at 5% level

** significantly different from zero at 1% level

APPENDIX A. PREDICTABILITY TESTS FOR THE ENTIRE PERIOD

TABLE A1. UNCONSTRAINED FIRMS: PANEL DATA GRANGER PREDICTABILITY TESTS. FIRM FINANCING AND INVESTMENT (1994-2008)

2SLS with instrumental variables. (95% significance level)
(p-values in parentheses)
Standard errors are clustered at the regional level

PANEL A. UNCONSTRAINED FIRMS ACCORDING TO THE DISEQUILIBRIUM MODEL

	(1)	(2)	(3)	(4)	(5)	(6)
	Bank loans/total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Accounts payable/ total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Credit period	Capital expenditure$_t$/ capital$_{t-1}$
Constant	0.01862* (0.012)	0.03482* (0.014)	0.01716* (0.027)	0.03626* (0.028)	-0.02086* (0.026)	0.04125* (0.023)
Dependent variable$_{t-1}$	0.02715* (0.028)	0.03703* (0.035)	-0.0326* (0.018)	0.02162* (0.029)	-0.01105* (0.031)	0.02256* (0.029)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	0.6732 (0.121)	-	0.02326 (0.415)	-	0.03850 (0.253)	-
Bank loans/total liabilities $_{t-1}$	-	0.05026** (0.003)	-	-	-	-
Credit period $_{t-1}$	-	-	-	-	-	0.0723 (0.215)
(Accounts payable/ total liabilities) $_{t-1}$	-	-	-	0.11628 (0.416)	-	-
Interbank interest rates	-0.01136* (0.024)	-0.01880* (0.023)	-0.02618 (0.225)	-0.01324** (0.009)	-0.01023 (0.165)	-0.01326* (0.023)
Cash flow$_t$/ capital$_{t-1}$	0.02025 (0.132)	0.4938** (0.004)	-0.25601 (0.140)	0.21052** (0.007)	0.21256 (0.239)	0.2426** (0.003)
Sales growth	0.03014 (0.205)	0.01252* (0.040)	-0.02628 (0.244)	0.0098* (0.040)	0.02856 (0.172)	0.01013* (0.031)
Defaults in trade credit	-0.01845* (0.043)	-0.01758* (0.033)	-0.01591* (0.020)	-0.01663* (0.025)	-0.02043* (0.017)	-0.01426* (0.035)
F-test for overall significance (p-value)	0.087	0.005	0.071	0.039	0.051	0.038
Hansen test (p-value)	0.131	0.147	0.161	0.195	0.116	0.184

PANEL B. UNCONSTRAINED FIRMS ACCORDING TO CASH FLOW-INVESTMENT CORRELATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
	Bank loans/total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Accounts payable/ total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Credit period	Capital expenditure$_t$/ capital$_{t-1}$
Constant	0.01428* (0.010)	0.01816* (0.027)	0.01258 (0.116)	0.04025* (0.034)	-0.0312* (0.021)	0.02256* (0.028)
Dependent variable$_{t-1}$	0.01020* (0.041)	0.02552* (0.014)	-0.02423* (0.014)	0.02126* (0.030)	-0.02354* (0.026)	0.01893* (0.025)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	0.856 (0.237)	-	0.02316 (0.551)	-	0.02705 (0.498)	-
Bank loans/total liabilities $_{t-1}$	-	0.06621 (0.132)	-	-	-	-
Credit period $_{t-1}$	-	-	-	-	-	0.1279 (0.137)
(Accounts payable/ total liabilities) $_{t-1}$	-	-	-	0.13628 (0.296)	-	-
Interbank interest rates	-0.01090* (0.020)	-0.01843* (0.020)	-0.03428 (0.210)	-0.01714* (0.015)	-0.00932* (0.013)	-0.01623* (0.011)
Sales growth	0.01362* (0.132)	0.01253* (0.028)	-0.02001 (0.387)	0.01262 (0.120)	0.02732* (0.036)	0.01975* (0.017)
Defaults in trade credit	-0.02115* (0.030)	-0.01458* (0.018)	-0.01426* (0.013)	-0.01351* (0.020)	-0.0756* (0.024)	-0.02130* (0.028)
F-test for overall significance (p-value)	0.091	0.016	0.077	0.044	0.026	0.012
Hansen test (p-value)	0.153	0.123	0.131	0.163	0.175	0.182

* significantly different from zero at 5% level
** significantly different from zero at 1% level

TABLE A2. CONSTRAINED FIRMS: PANEL DATA GRANGER PREDICTABILITY TESTS. FIRM FINANCING AND INVESTMENT (1994-2008)

2SLS with instrumental variables. (95% significance level)
(p-values in parentheses)
Standard errors are clustered at the regional level

PANEL A. PARTIALLY-CONSTRAINED FIRMS ACCORDING TO THE DISEQUILIBRIUM MODEL

	(1)	(2)	(3)	(4)	(5)	(6)
	Bank loans/total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Accounts payable/ total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Credit period	Capital expenditure$_t$/ capital$_{t-1}$
Constant	0.01153*	0.02482*	0.02402*	0.04452*	-0.01596*	0.02985*
	(0.028)	(0.010)	(0.030)	(0.018)	(0.022)	(0.016)
Dependent variable$_{t-1}$	0.02824*	0.02053*	-0.05650*	0.01905*	-0.07415*	0.02352*
	(0.014)	(0.023)	(0.024)	(0.034)	(0.012)	(0.014)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	0.3125	-	0.01105	-	0.01239	-
	(0.180)		(0.360)		(0.261)	
Bank loans/total liabilities $_{t-1}$	-	0.12177	-	-	-	-
		(0.315)				
Credit period $_{t-1}$	-	-	-	-	-	0.04205**
						(0.002)
(Accounts payable/ total liabilities) $_{t-1}$	-	-	-	0.06208**	-	-
				(0.004)		
Interbank interest rates	-0.01362**	-0.03626*	-0.03125	-0.01921*	-0.02408	-0.01789*
	(0.004)	(0.031)	(0.451)	(0.022)	(0.150)	(0.021)
Cash flow$_t$/ capital$_{t-1}$	0.03715	0.50245**	-0.30288	0.22569**	0.43258	0.22105**
	(0.143)	(0.003)	(0.260)	(0.003)	(0.309)	(0.007)
Sales growth	0.01915	0.01215*	-0.00158	0.01405*	0.00263	0.01965*
	(0.160)	(0.018)	(0.428)	(0.013)	(0.694)	(0.054)
Defaults in trade credit	-0.02058*	-0.02390*	-0.02305*	-0.01942*	-0.04077*	-0.02386*
	(0.0288)	(0.025)	(0.024)	(0.039)	(0.016)	(0.012)
F-test for overall significance (p-value)	0.070	0.004	0.084	0.014	0.029	0.008
Hansen test (p-value)	0.143	0.160	0.195	0.118	0.176	0.189

PANEL B. PARTIALLY-CONSTRAINED FIRMS ACCORDING TO CASH FLOW-INVESTMENT CORRELATIONS

	(1)	(2)	(3)	(4)	(5)	(6)
	Bank loans/total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Accounts payable/ total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Credit period	Capital expenditure$_t$/ capital$_{t-1}$
Constant	0.01115*	0.02061*	0.02890*	0.02118*	-0.02063*	0.03951*
	(0.027)	(0.012)	(0.014)	(0.034)	(0.038)	(0.041)
Dependent variable$_{t-1}$	0.02135**	0.03455*	-0.05623*	0.01215*	-0.02361*	0.03719*
	(0.010)	(0.017)	(0.042)	(0.023)	(0.012)	(0.023)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	0.20216	-	0.01624	-	0.01028	-
	(0.472)		(0.334)		(0.673)	
Bank loans/total liabilities $_{t-1}$	-	0.09120	-	-	-	-
		(0.585)				
Credit period $_{t-1}$	-	-	-	-	-	0.02128
						(0.269)
(Accounts payable/ total liabilities) $_{t-1}$	-	-	-	0.01145	-	-
				(0.135)		
Interbank interest rates	-0.01425*	-0.01544*	-0.06150*	-0.02150*	-0.01152*	-0.00953*
	(0.035)	(0.018)	(0.032)	(0.039)	(0.037)	(0.014)
Sales growth	0.02204*	0.01926	-0.01314	0.01054*	0.01402*	0.01715*
	(0.033)	(0.262)	(0.362)	(0.027)	(0.039)	(0.040)
Defaults in trade credit	-0.01923*	-0.01841	-0.01408*	-0.01901*	-0.02310*	-0.03253*
	(0.024)	(0.053)	(0.032)	(0.016)	(0.017)	(0.024)
F-test for overall significance (p-value)	0.034	0.031	0.076	0.042	0.026	0.017
Hansen test (p-value)	0.131	0.145	0.159	0.151	0.135	0.183

* significantly different from zero at 5% level
** significantly different from zero at 1% level

TABLE A3. FULLY-CONSTRAINED FIRMS: PANEL DATA GRANGER PREDICTABILITY TESTS. FIRM FINANCING AND INVESTMENT (1994-2008)

2SLS with instrumental variables. (95% significance level)

(p-values in parentheses)

	(1)	(2)	(3)	(4)
	Accounts payable/ total liabilities	Capital expenditure$_t$/ capital$_{t-1}$	Credit period	Capital expenditure$_t$/ capital$_{t-1}$
Constant	0.01412* (0.043)	0.04015* (0.014)	-0.02712* (0.014)	0.02109* (0.023)
Dependent variable$_{t-1}$	-0.05625* (0.031)	0.01628* (0.017)	-0.05126* (0.012)	0.01325* (0.028)
(Capital expenditure$_t$/ capital$_{t-1}$) $_{t-1}$	0.01283 (0.601)	-	0.01407 (0.429)	-
Credit period $_{t-1}$	-	-	-	0.01427** (0.004)
(Accounts payable/ total liabilities) $_{t-1}$	-	0.01322** (0.010)	-	-
Interbank interest rates	-0.03157 (0.331)	-0.02357* (0.028)	-0.03118* (0.013)	-0.03261* (0.031)
Cash flow$_t$/ capital$_{t-1}$	-0.20249 (0.418)	0.39453* (0.030)	0.22371 (0.571)	0.24053** (0.007)
Sales growth	-0.01194 (0.308)	0.01415* (0.014)	0.01215 (0.585)	0.01492* (0.016)
Defaults in trade credit	-0.01426* (0.043)	-0.01952* (0.030)	-0.03540* (0.014)	-0.01526** (0.004)
F-test for overall significance (p-value)	0.082	0.015	0.020	0.009
Hansen test (p-value)	0.183	0.168	0.175	0.198

* significantly different from zero at 5% level

** significantly different from zero at 1% level

Standard errors are clustered at the regional level

APPENDIX B. A SWITCHING REGRESSION MODEL OF INVESTMENT WITH UNKNOWN SAMPLE SEPARATION AND TWO-REGIME FOR CONSTRAINED AND UNCONSTRAINED FIRMS (1994-2008)

Maximum likelihood with fixed effects
(Standard errors in parenthesis)
Standard errors are clustered at the regional level

Panel A. Main estimations for constrained and unconstrained firms. Dependent variable**:** *Capital expenditure$_t$/ capital$_{t-1}$*			
	Constrained	**Unconstrained**	**p-values for coefficient differences**
Bank loans/total liabilities	0.0902 (0.064)	0.0506** (0.073)	0.000
Cash flow$_t$/ capital$_{t-1}$	0.2952** (0.016)	0.1244** (0.022)	0.000
Interbank interest rates	0.0954** (0.066)	0.1196** (0.073)	0.035
Assets tangibility	0.0980** (0.072)	0.1164** (0.071)	0.028
Panel B. Estimations for the Endogenous selection equation			
Regime selection variables			
Size	-0.1905** (0.128)		
Sales growth	-0.0573* (0.190)		
Tangibility	-1.4721** (0.215)		
Financial slack	0.863** (0.265)		
Log-likelihood (p-value in parenthesis)	5105.1 (0.000)		
Model P-value (single regime vs. two-regime)	0.000		

* significantly different from zero at 5% level
** significantly different from zero at 1% level

APPENDIX B. (CONTINUED)

Panel C. Main estimations for constrained and unconstrained firms. Dependent variable: *Capital expenditure$_t$/ capital$_{t-1}$*			
	Constrained	**Unconstrained**	**p-values for coefficient differences**
(Accounts payable/total liabilities) $_{t-1}$	0.0592** (0.036)	0.0305 (0.065)	0.000
Cash flow$_t$/ capital$_{t-1}$	0.2452** (0.028)	0.1128** (0.020)	0.000
Interbank interest rates	0.0725** (0.051)	0.1132** (0.076)	0.001
Assets tangibility	0.0843** (0.064)	0.1263** (0.064)	0.002
Panel D. Estimations for the Endogenous selection equation			
Regime selection variables			
Log(size)	-0.1610** (0.128)		
Sales growth	-0.0568** (0.140)		
Tangibility	-1.2105** (0.132)		
Financial slack	0.625** (0.214)		
Log-likelihood (p-value in parenthesis)	7360.4 (0.000)		
Model P-value (single regime vs. two-regime)	0.000		

* significantly different from zero at 5% level
** significantly different from zero at 1% level

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