DEBT OVERHANG, CREDIT DEMAND AND FINANCIAL CONDITIONS

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Abstract

The empirical literature on the debt overhang hypothesis has estimated the relationship between investment and leverage at the firm level, which does not allow to disentangle between a firm's decision not to invest as it is highly indebted and its ability to obtain the necessary resources. Using annual Spanish credit data from the Central Credit Register and non-financial corporations' annual accounts from the Integrated Central Balance Sheet Data Office Survey for the period 2004-2019, we study the impact of corporate debt on non-financial firms' demand for bank loans, as a proxy for their willingness to invest. We find a negative relationship between firms' leverage and demand for bank credit, thus supporting the debt overhang hypothesis. We then study whether such relationship is affected by financial conditions and find that a reduction in short-term interest rates mitigates the effect of firms' leverage on demand for credit.

Keywords: credit demand, corporate investment, debt overhang, financial conditions, interest rates, leverage.

JEL classification: E22, E41, E43, E52, G21, G32.

Resumen

Tradicionalmente, la literatura empírica que ha estudiado el problema del exceso de deuda sobre la inversión empresarial ha estimado directamente la relación entre esta y el apalancamiento, sin diferenciar entre la decisión de una empresa altamente endeudada de no invertir y su capacidad para reunir los recursos necesarios para hacerlo. Usando datos de crédito concedido a sociedades no financieras españolas procedentes de la Central de Información de Riesgos del Banco de España y de las cuentas anuales de estas empresas obtenidas de la Central de Balances del Banco de España para el período 2004-2019, estudiamos en este trabajo el impacto que el nivel de endeudamiento de las empresas tiene sobre su demanda de crédito, como *proxy* de su demanda de inversión. Nuestros resultados confirman la existencia de una relación negativa, en consonancia con la hipótesis del *debt overhang*. Adicionalmente, analizamos si dicha relación se ve afectada por las condiciones financieras, y encontramos que una reducción de los tipos de interés a corto plazo mitiga el efecto negativo del apalancamiento de las empresas sobre su demanda de crédito.

Palabras clave: demanda de crédito, inversión empresarial, endeudamiento, condiciones financieras, tipos de interés, apalancamiento.

Códigos JEL: E22, E41, E43, E52, G21, G32.

1. Introduction

During the years that preceded the Global Financial Crisis, Spanish firms financed the growth of their balance sheets largely by borrowing, which led to a substantial increase in corporate debt levels. As a result, aggregate non-financial corporations' debt rose from 58 % of GDP at the end of 2000 to its historical high of almost 120 % in 2010. The deterioration of firms' financial positions was accompanied by a contraction in investment, with aggregate fixed capital formation decreasing by 38 % from 2007 to 2013. The subsequent economic recovery was characterized by an intense deleveraging process by which aggregate non-financial corporations' debt decreased to 72 % of GDP in 2019. However, at the beginning of 2020 many Spanish business sectors faced an unprecedented loss in revenues due to the containing measures adopted to prevent the spread of the Covid-19 pandemic that forced them to resort to debt financing to support current expenditure. As a result, aggregate non-financial corporations' debt increased since the end of 2019 by 14 percentage points to 86 % of GDP at the beginning of 2021, thus raising concerns of potential negative effects of higher corporate debt on future investment. In order to prevent disruption of financing flows and maintain favorable financial conditions, monetary authorities preserved a very high degree of monetary accommodation after the pandemic outbreak. However, the subsequent surge in inflation caused a change in the monetary policy stance and an increase in interest rates.

[Graph 1 here]

The observed evolution raises the questions of whether debt overhang reduced Spanish firms' investment demand in the aftermath of the Global Financial Crisis and whether financial conditions played a role. The answer to these questions are particular relevant in the post-Covid 19 context, since debt overhang could become an arduous burden for those non-financial firms most affected by the pandemic and discourage their investment, thus limiting their growth opportunities. Moreover, higher borrowing costs, which especially affect firms with high leverage[1], could reinforce the debt overhang problem and further reduce firms' incentives to take on additional debt to finance future investment.

This paper introduces a novelty approach to investigate the debt overhang hypothesis focusing on firms' borrowing decisions. Since the main reason for firms to borrow is to finance capital expenditures (Amiti and Weinstein, 2018), and given the predominance of non-listed and bank-dependent small firms in Spain[2], if debt overhang affects investment

[1] Variable rate loans constitute the majority of the outstanding bank debt of non-financial corporations in Spain.
[2] During the analyzed period, on average, the number of small firms (defined as those with less than 50 employees) accounted for more than 98 % of total firms in Spain, whereas the bank credit relative to total corporate debt was 67 %. The relative importance of bank credit has decreased from 73 % in 2004 to 53 % in 2019.

decisions it will likely do so through the demand for bank loans. Using Spanish credit data and non-financial corporations' annual accounts for the period 2004-2019, we study the impact of corporate debt on non-financial firms' demand for bank loans, as a proxy for their investment demand. We then study whether the relationship between credit demand and corporate indebtedness is affected by financial conditions. Our results suggest that corporate leverage has a negative effect on the future demand for bank credit at the firm level and that this effect is mitigated by looser financial conditions, captured as a drop in the EONIA interest rate.

The impact of firms' leverage on investment decisions is a central issue in the corporate finance literature. In a world without financial frictions, the Modigliani-Miller (MM) irrelevance proposition states that the value of a firm is unaffected by its capital structure and that it is irrelevant whether investment is financed by issuing debt, raising capital or reinvesting profits. This implies that, in perfect capital markets, a firm's investment decisions are independent from its financing decisions. In this case, real firm decisions, motivated by the maximization of shareholders' claims, are independent of financial factors such as cash flows, leverage or dividend payments. However, there are many reasons why the MM theorem may fail, such as the deadweight costs of financial distress and the tax shield of debt, as analyzed in the trade-off theory of capital structure. The MM theorem also fails in the presence of asymmetric information and agency problems between shareholders, debt holders and managers that can influence investment incentives, resulting in decisions that do not maximize the value of the firm. One of these agency problems is the so-called "debt overhang", which was first analyzed by Myers (1977). In particular, he postulated that high levels of outstanding debt may reduce the incentives of shareholders and managers to raise new financing to undertake positive net-present-value investment projects, since part of the return would accrue to the existing debt holders. As a result, highly leveraged firms are less likely to exploit profitable investment opportunities as compared to firms with low levels of leverage.

Consistently with Myers' (1977) debt overhang theory, but without explicitly focusing on firms' investment decisions, the existing empirical literature generally finds a negative relationship between corporate leverage and investment spending at the firm level. For example, using information on Canadian and US publicly traded companies, respectively, Aivazian, et al (2005) and Cai and Zhang (2011) find that an increase in the leverage ratio is associated with lower investment in the future. Aivazian et al (2005) show that this negative effect is stronger for firms with low growth opportunities, while Cai and Zhang (2011) provide evidence of a negative relation between leverage and stock prices which is stronger for more leveraged firms. In addition, cross-country studies such as Kalemli-Ozcan, Laeven

and Moreno (2019) for European firms or Borensztein and Ye (2018) for emerging market and developing economy firms, also document that high levels of corporate debt impose a sizable negative effect on investment at the firm level. These studies mostly rely on firm-level balance sheet information for non-financial corporations and do not make a distinction between the firms not willing to take on additional debt to finance investment, as in Myers (1977), and the firms not being able to take on additional debt because banks do not want to lend to them.

With regards to the relevance of financial conditions, according to the monetary transmission mechanism, the monetary policy stance influences firms' investment decisions through two channels . First, through the so-called "interest rate channel", monetary policy can boost firms' demand for fixed capital formation by reducing the firm-specific user cost of capital. Second, more indirectly, through the "firm balance sheet channel", monetary policy can raise asset valuations and hence strengthen firms' balance sheet and increase their net worth, thus affecting their ability to fund new investment. In particular, according to the financial accelerator view (Bernanke and Gertler, 1989), monetary policy varies the external finance premium, i.e. the difference between the cost of raising external finance and the cost of internal finance, which depends inversely on the borrowers' net worth (Freixas and Rochet, 2008; Tirole, 2006).

The empirical studies that investigate the role of firms' financing conditions for the monetary transmission mechanism focus on the bank lending channel and argue that some observable firms' characteristics such as size, age, leverage and liquidity are likely to influence the external finance premium. These works gather conflicting evidence on corporate leverage reinforcing or reducing the effect of monetary policy shocks on investment, although the conventional wisdom in the literature is that investment by financially constrained firms, i.e. more leveraged ones, reacts more to monetary policy changes (as supported by the Bernanke and Gertler's (1989) financial accelerator theory). For example, Gertler and Gilchrist (1994) find that following a tightening of monetary conditions small firm sales decline at a faster pace than large firm sales, whereas Jeenas (2018) gathers evidence that investment by firms with a higher leverage ratio or a lower liquidity ratio are relatively more responsive to a monetary policy contraction. Similarly, Cloyne, Ferreira, Froemel and Surico (2019) find that, in response to a change in interest rates, younger firms not paying dividends adjust both their capital expenditure and borrowing significantly more than older firms paying dividends. Within the empirical literature that find the opposite results, Ottonello and Winberry (2020) and Vats (2021), with data for US quoted firms, provide evidence that, in response to contractionary monetary policy shocks, firms with lower leverage reduce investment relative to others. These studies argue

that financially unconstrained firms are more responsive to monetary shocks because they face a flatter marginal cost curve for financing investment[3]. Finally, other authors suggest that the sign of the relationship may depend on the period of analysis (Lakdawala and Moreland, 2019)) or on whether policy rates are at the zero-lower bound (Ippolito et al, 2018). Nevertheless, these studies focus on the response of actual investment to changes in financial conditions depending on firms' financial structure, rather than examining the potential change in firms' investment incentives.

Our contribution to the literature is twofold. First, our empirical approach follows the theoretical mechanism stated by Myers (1977) directly estimating the relationship between leverage and borrowing decisions at the firm level. In contrast with previous studies, we investigate the link between corporate leverage and firms' willingness to take on additional debt, instead of focusing on actual investment which may be also influenced by banks' decision not to provide credit to highly leveraged firms. In particular, our empirical methodology involves two steps. On the first step, by means of bank-firm level loan data from the Spanish Central Credit Register, we follow the approach proposed by Amiti and Weinstein (2018) to separate the observed loans growth between bank supply and firm demand shocks, as in Arce, Mayordomo and Gimeno (2020). On the second step, we analyze the relationship between firms' credit demand and their leverage ratios at the firm level employing an OLS regression with firm and industry-location-time fixed effects, controlling for the rest of the determinants of credit demand, which are assumed to be similar to those usually considered for investment in the literature. Our second contribution is to investigate the role of financial conditions on the impact of corporate leverage on firms' borrowing decisions. In contrast with the literature that studies the bank lending channel of monetary policy through the supply of credit, we focus instead on firms' credit demand and investigate whether and how the dependence of firms' borrowing decisions on leverage is influenced by changes in interest rates. Thus, unlike previous studies, we do not analyse the role of firms' financial position on the investment channel of monetary policy but investigate the relevance of the financial conditions that firms face for the debt overhang problem, considering credit demand as a proxy of the firms' willingness to invest.

The rest of the paper proceeds as follows. Section 2 describes the firm-level data set used in the paper. Section 3 explains our empirical strategy to test the debt overhang problem focusing on bank credit demand and presents the main results. Section 4 investigates the role of financial conditions. Section 5 includes some robustness checks and Section 6 concludes.

[3] Ottonello and Winberry (2020) argue that the marginal cost curve for a risk-free firm is flat when capital accumulation can be financed without incurring default risk, but becomes upward sloping when the borrowing required to achieve the chosen investment creates default risk and therefore a credit spread.

2. Data

The database is constructed by combining two sources of bank and firm-level information for the period 2004 to 2019: The Banco de España's Central Credit Register (CCR) and firm balance-sheet and profit and loss accounts from the Banco de España's Central Balance Sheet Data Office (CBSDO). In addition, we obtain data on the EONIA rate from the European Central Bank to capture the financial conditions that firms are subject to and data on real GDP growth and inflation from the Spanish National Statistics Institute to account for economic conditions.

The Spanish CCR contains monthly information on all outstanding loans to non-financial firms granted by all credit institutions operating in Spain. We can claim that we virtually have the whole population of loans to firms. We aggregate the outstanding amount of credit of each firm in each bank at the end of each year to obtain the total annual bank-firm credit exposure. In addition, the database provides information about the borrower and bank identity, which will permit obtaining our credit demand measure at the firm level and matching it with characteristics of the firm.

We complement the information from the Spanish CCR with firm-level data from the CBSDO. This database provides information on the financial accounts of more than 750,000 non-financial corporations with an adequate reporting quality on an annual basis by combining administrative data at the annual level from accounts filed with the mercantile registries in Spain with information coming from surveys to non-financial firms conducted by the Central Balance Sheet Office of Banco de España. We match this firm-level information with CCR data using the unique firm fiscal identifier. The final merged database contains a total of over 3.3 million firm-level observations distributed in a range between 162,168 and 242,047 observations per year.

1) Firm characteristics

We define our main variable of interest, leverage, as the firm's long-term liabilities-to-assets ratio[4]. The use of liabilities with long-term maturity is motivated by Myers' (1977) suggestion of short-term debt as a possible solution to the debt overhang problem. According to Myers, debt that matures before an investment option is to be exercised does not induce suboptimal investment decisions.

We proxy actual *investment* with the annual log change in the firm's gross capital stock (i.e. including property, plant and equipment and real estate investments)[5]. As the CBSDO

[4] For robustness, we use instead the firms' total liabilities-to-assets ratio in all specifications and obtain similar qualitative results. These results are available upon request.

[5] Gross capital stock refers to the cumulative flow of investments. Therefore, in the gross stock assets are assumed to retain their full productive capacity until removed from the stock (i.e. amortization is not subtracted).

information is obtained on a voluntary basis the attrition rate is large, so that we cannot compute investment data for firms that are not in the sample for two consecutive years. Moreover, the Spanish economy is dominated by small firms, some of which do not invest. Therefore, the number of observations that we use in the part of the analysis focused on actual investment is lower than for the rest[6].

Following the empirical literature that investigates the linkages between firm heterogeneity and investment, the firm-specific characteristics that we include as control variables in our analysis are size, age, profitability, liquidity, debt burden and tangibility. We define *size* as the natural logarithm of the firm's assets and *age* as the natural logarithm of the number of years (plus 1) since the creation of the firm. We measure *profitability* with the ordinary net profit-to-asset ratio (ROA)*, liquidity* with cash and equivalents divided by assets, *debt burden* with interest expenses divided by liabilities and *tangibility* with tangible fixed assets divided by total assets, which is a proxy for collateral that the company can pledge to obtain secured credit.

2) Financial and macroeconomic conditions

Following Jiménez, Ongena, Peydró and Saurina (2012), and fully in line with the literature analyzing the credit channel at the micro level (Jayaratne and Morgan, 2000; Kishan and Opiela, 2000; Ashcraft, 2006; Black, Hancock and Passmore, 2009) we proxy financial conditions as the annual change in the Euro Overnight Index Average rate (EONIA)[7]. We justify the choice of the EONIA as we consider that this rate in Spain was fairly exogenous during the analyzed period. The reason behind this consideration is that monetary policy, and thus the interest rate, is set for the whole euro area since 1999 while Spain accounted for just around 11 percent of the euro area output as an average during the period 2004-2019. Moreover, its business cycle was not very synchronized with those of the core countries (Giannone, Lenza and Reichlin, 2010).

To account for macroeconomic conditions, we include the annual real GDP growth rate and the average inflation rate, which is measured as the annual change in the consumer price index.

[6] For robustness, we have repeated the rest of the analysis with this smaller sample and obtain similar qualitative results. These results are available upon request.

[7] As a robustness check we use the annual change in the three-month EURIBOR and the results are similar to those employing the EONIA rate (as the correlation between the two variables equals 0.99). Since our aim is to capture financial conditions affecting firms' demand for credit instead of identifying their reaction to monetary surprises we do not consider high-frequency monetary shocks in our analysis. Given that most of the loans to Spanish non-financial corporations are short-term or at flexible rate, we think that either the EONIA and the EURIBOR are good proxies for financial conditions faced by firms.

Table 1 provides a set of summary statistics of the variables used in our analysis. We winsorize our sample at the top and bottom 1 % of observations of each variable to mitigate the effect of outliers.

[Table 1 here]

3. Testing the debt overhang hypothesis

We begin with the simple approach most commonly followed in the literature that estimates the relationship between leverage and investment at the firm level:

$$\Delta\, Ln\, K_{it} = \alpha_i + \alpha_{stp} + \gamma_1 leverage_{it-1} + \gamma_2\, X_{it-1} + \xi_{it} \qquad [1]$$

Where $\Delta\, Ln\, K_{it}$ is the annual log change in the firm's gross capital stock of firm i in year t and $leverage_{it-1}$ is the leverage ratio of firm i at time t-1. The vector $\mathbf{X}_{\text{it-1}}$ comprises a set of firm-specific characteristics, also lagged one period, that have been mentioned in the previous section. In addition, we include firm fixed effects α_i to control for (observed and unobserved) time-invariant heterogeneity (e.g. legal form, managerial skills or business model) that affect firms' investment and sector-province-year fixed effects α_{stp} to control for the business cycle at a disaggregated level and to capture differences in how sectors in different provinces are exposed to aggregate shocks.

Column (1) in Table 2 reports the estimates of equation (1), for the period 2004-2019. The results show that leverage is negatively related with investment at the firm level. In particular, an increase of 1 percentage point in a firm's leverage ratio is associated with a decrease of 13 basis points in firm's investment in the following year.

[Table 2 here]

Although the simple approach enables us to establish to what extent firms' leverage constitutes a drag on firms' actual investment, it does not tell us if this effect is due to debt overhang, i.e. to highly leveraged firms not being willing to take on additional debt to finance investment, as in Myers (1977). The result we obtain could also be due to financially constrained firms not being able to take on additional debt because banks do not want to lend to them.

To measure the effect of firms' leverage on their willingness to borrow, as a proxy for their disposition to invest, we first obtain an estimate of the firm's demand for credit. We use the approach proposed by Amiti and Weinstein (2018), which consists in separating the change in credit between time-varying firm borrowing and bank supply shocks. Following Arce, Mayordomo and Gimeno (2020), we apply this methodology to the bank-firm-year data obtained from the Banco de España's CCR by estimating the following equation:

$$\Delta \, \boldsymbol{Ln\ Credit_{ibt}} = \boldsymbol{\alpha_{it}} + \boldsymbol{\beta_{bt}} + \boldsymbol{\xi_{ibt}}, \qquad [2]$$

where $\Delta \, \boldsymbol{Ln\ Credit_{ibt}}$ denotes the annual log change in outstanding credit of firm $\boldsymbol{i}$ with bank $\boldsymbol{b}$ in year $\boldsymbol{t}$. $\boldsymbol{\alpha_{it}}$ denotes firm-time fixed effects à la Khwaja and Mian (2008) that capture the firm's borrowing shock, which is identified thorough differences in credit growth between firms borrowing from the same bank. This can be interpreted as the change in lending due to a variation on firm's credit demand. In analogous fashion, $\boldsymbol{\beta_{bt}}$ denotes bank-time fixed effects that capture the bank's supply shock. In addition, $\boldsymbol{\xi_{ibt}}$ captures other shocks influencing credit growth which are assumed to be orthogonal to the bank and firm effects.

We thus use the estimated value of $\boldsymbol{\alpha_{it}}$ as a proxy of the change in credit demand at the firm level. Table 1 presents the summary statistics of this variable which has been winsorised at the 1% level.

We next analyze the relationship between firms' borrowing decisions (i.e., firms' credit demand) and their leverage ratios, controlling for the rest of their determinants. We consider that firms' borrowing decisions are closely linked to investment decisions, so that the same firm specific-characteristics that determine investment are likely to be relevant for borrowing. Following the literature that investigates the linkages between firm heterogeneity and investment, we estimate the following equation[8]:

$$\Delta \, \boldsymbol{Ln\ CreditD_{it}} = \boldsymbol{\alpha_i} + \boldsymbol{\alpha_{stp}} + \boldsymbol{\gamma_1 leverage_{it-1}} + \boldsymbol{\gamma_2 \, X_{it-1}} + \boldsymbol{\xi_{it}} \qquad [3]$$

Where $\Delta \, \boldsymbol{Ln\ CreditD_{it}}$ is the annual change, in logarithms, in the demand for bank credit by firm i at time t[9] and $\boldsymbol{leverage_{it-1}}$ is the leverage ratio of firm i at time t-1. The vector $\mathbf{X_{it-1}}$ comprises the same set of firm-specific characteristics included in equation (1), also lagged one period. In addition, we include firm fixed effects $\boldsymbol{\alpha_i}$ and sector-province-year fixed effects $\boldsymbol{\alpha_{stp}}$.

Column (2) in Table 2 reports the estimates of equation (3), which show that more leveraged firms demand less bank credit. Specifically, an increase of 1 percentage point in the leverage ratio is associated with a decrease of more than 0.7 percentage points in in credit demand growth during the following year.

[8] An alternative approach for assessing debt overhang would be estimating the effect of firms' leverage on investment controlling for banks' credit supply, i.e. introducing bank credit supply to each firm as a control in equation (2). However, the bank credit supply shocks $\boldsymbol{\beta_{bt}}$ estimated in equation (1), by construction, are the components of lending that vary only at bank level (for example, a bank cutting back on lending because it is credit constrained) while firm factors are kept constant given the inclusion of firm-time fixed effects. Not surprisingly, when estimating equation (2) including bank credit supply at the firm level as an additional variable we obtain that the coefficient on leverage is kept unchanged. Moreover, an increase of 1 percentage point in bank credit supply to a firm is associated with an increase of just 2.5 basis points increase in investment.

[9] The dependent variable $\Delta \, \boldsymbol{Ln\ CreditD_{it}}$ in equation (3) is equal to the estimated coefficient $\boldsymbol{\alpha_{it}}$ in equation (2).

4. Role of financial conditions

We now assess the role that financial conditions faced by firms can have on debt overhang. Specifically, we test whether the effect of firm's leverage on demand for bank credit depends on financial conditions, as captured by changes in interest rates. We follow the literature on the investment channel of monetary policy and formulate our empirical specification as in Ottonello and Winberry (2020)[10]:

$$\Delta\, \boldsymbol{Ln\ CreditD_{it}} = \boldsymbol{\alpha_i}+\boldsymbol{\alpha_{stp}} + (\boldsymbol{\gamma_1} + \boldsymbol{\beta_1}\, \Delta\, \boldsymbol{r_t}) * \boldsymbol{leverage_{it-1}} + \boldsymbol{\gamma_2}\, \boldsymbol{X_{it-1}} + \boldsymbol{\xi_{it}} \quad [4]$$

Where $\Delta\, \boldsymbol{r_t}$ captures the financial conditions using the average annual change in the EONIA rate. To make the estimated coefficient β_1 easily interpretable, we normalize the sign of the change in interest rates so that a positive value corresponds to a cut in interest rates, thus to an expansionary shock. The vector $\mathbf{X}_{\text{it-1}}$ comprises the same set of firm-specific characteristics included in the previous equations and we also include firm fixed effects $\boldsymbol{\alpha_i}$ and sector-province-year fixed effects $\boldsymbol{\alpha_{stp}}$.

The interaction term of the change in interest rates with leverage ($\Delta\, \boldsymbol{r_t} * \boldsymbol{leverage_{it-1}}$) captures the possibility that a change in interest rates influences the relationship between the firm's leverage and its demand for credit. $\boldsymbol{\beta_1}$ measures, precisely, the relevance of interest rate changes in explaining the role of leverage in a firm's demand for credit[11]. This interpretation of the interaction term differs from the one in the bank lending channel literature, which focuses on the role of monetary policy for firm's investment and how financial constraints[12] and in particular, leverage, may affect this relationship.

[Table 3 here]

The results of the estimation of equation (4) are presented in column (1) of Table 3. We find that a reduction in interest rates results in a positive effect on firm's credit demand through its interaction with leverage. Therefore, the loosening of financial conditions contributes to weakening the negative relationship between leverage and demand for credit, thus mitigating the debt overhang problem.

The introduction of sector-province-year fixed effects, $\boldsymbol{\alpha_{stp}}$, does not allow us to include the change in interest rates, $\Delta\, r_t$, in equation (4), as it has only variation in the time dimension.

[10] Ottonello and Winberry (2020) use US firms' quarterly data for the period 1983q3 to 2014q4. We do not follow Ottonello and Windberry 2020's approach in the use of the interaction of within-firm variation in financial position with the monetary shock. They argue that this approach ensures that the results are not driven by permanent heterogeneity in responsiveness across firms.

[11] The relationship-lending channel argues that, especially in bank-based economies, the dependence of firms to bank credit may reduce the sensitivity to monetary shocks of their use of this type of finance.

[12] See García-Posada, 2018 for a review of credit constraint measures and their effects on the real economy.

Having omitted Δr_t is equivalent to assuming that its coefficient equals zero. To address the potential identification problem associated with the exclusion of Δr_t, in regression (4), we formulate an alternative specification:

$$\Delta \boldsymbol{LnCreditD_{it}} =$$

$$= \boldsymbol{\alpha_i} + (\boldsymbol{\gamma_1} + \boldsymbol{\beta_1}\Delta \boldsymbol{r_t}) * \boldsymbol{leverage_{it-1}} + \boldsymbol{\beta_2}\,\Delta \boldsymbol{r_t} + \boldsymbol{\beta_3}\,\boldsymbol{X_{it-1}} + \boldsymbol{\beta_4}\,\Delta \boldsymbol{Y_t} + \boldsymbol{\xi_{it}} \quad [5]$$

This specification differs from equation (4) not only in the inclusion of the variable of interest, $\Delta \boldsymbol{r_t}$ and of a set of macro variables ($\Delta \boldsymbol{Y_t}$), but also in the removal of time-sector-province fixed effects, $\boldsymbol{\alpha_{stp}}$. Following Jiménez et al (2012), we include as additional macro variables the average annual growth of GDP and of the consumer price index in the specification, to account for economic conditions. This approach implies that we assume that all variation common to all firms arises only because of the change in financial and economic conditions.

The results are presented in column (2) of Table 3. The estimate for the relationship between leverage and credit demand is qualitative robust to the one reported in column (1), when we did not include the direct effect of changes in interest rates on demand for credit. Moreover, the interaction term of interest rates with leverage is also positively related to credit demand. Finally, the coefficient that captures the direct effect of a change in interest rates, $\boldsymbol{\beta_2}$, has the expected positive sign, so that declines in interest rates are accompanied by an increase in firm's borrowing from banks.

The results presented in Table 3 on the relevance of financial conditions are aligned with most of the literature that analyzes how firm's heterogeneity affects monetary policy transmission, which finds that firms with a higher leverage ratio are relatively more responsive to a monetary policy change (Jeenas, 2018; Cloyne et al 2020).

5. Estimating credit demand taking into account credit risk

When estimating credit demand as in Amiti and Weinstein (2018) we are making the assumption that banks' credit supply is the same to all firms in a given period (and that firms' credit demand is the same for all banks). However, banks might lower their credit supply to more leveraged firms as they are likely to involve higher credit risk. To account for this difference in banks' credit supply depending on credit risk, we classify firms into four buckets based on quartiles of the distribution of firms' leverage ratios[13] and estimate the following equation:

$$\Delta\, \boldsymbol{Ln\ Credit_{iblt}} = \boldsymbol{\alpha_{it}} + \boldsymbol{\beta_{blt}} + \boldsymbol{\xi_{ibt}}, \quad [6]$$

[13] We define here leverage as the firm's total liabilities-to-assets ratio to proxy for credit risk. For robustness, we use instead the firms' long-term liabilities-to-assets ratio and obtain similar results. These results are available upon request.

where $\boldsymbol{Credit_{iblt}}$ denotes borrowing by firm $\boldsymbol{i}$ to bank $\boldsymbol{b}$ at time $\boldsymbol{t}$ taking into account the quartiles of the firms' leverage distribution $\boldsymbol{l}$. $\boldsymbol{\alpha_{it}}$ denotes firm-time fixed effects à la Khwaja and Mian (2008) that capture the firm's borrowing shock whereas $\boldsymbol{\beta_{blt}}$ denotes bank-time fixed effects that capture the bank's supply shock that takes into account firms' leverage distribution and can be interpreted as the change in lending due to a variation on banks' credit supply, taking into account that credit supply may be different depending on firms' credit risk.

We estimate again equations (3), (4) and (5) replacing the dependent variable, credit demand, for that estimated by equation (6) and find similar results than previously. These results are presented in column (1), (2) and (3) of Table 4, respectively, and do not qualitatively differ from those obtained in previous sections.

[Table 4 here]

6. Conclusions

In this paper we have studied the impact of high levels of debt on non-financial firms' investment decisions in Spain, through their credit demand. We have showed that more leveraged firms demand less credit. We have also studied whether the relationship between credit demand and corporate indebtedness is affected by monetary conditions and have found that a reduction in short-term interest rates mitigates the effect of firms' leverage on demand for credit.

These results are particularly relevant in the post COVID-19 period given the high volumes of debt accumulated by many Spanish firms, as a consequence of the increase in their liquidity needs during the pandemic. As our results have shown, debt overhang problems may emerge during the recovery phase and contribute to a dampening of the demand side by depressing business investment. Moreover, the monetary policy tightening in response to increasing inflationary pressures in 2021-22 added to uncertainty about debt vulnerabilities, as more indebted firms could reduce further their demand for credit and thus their investment.

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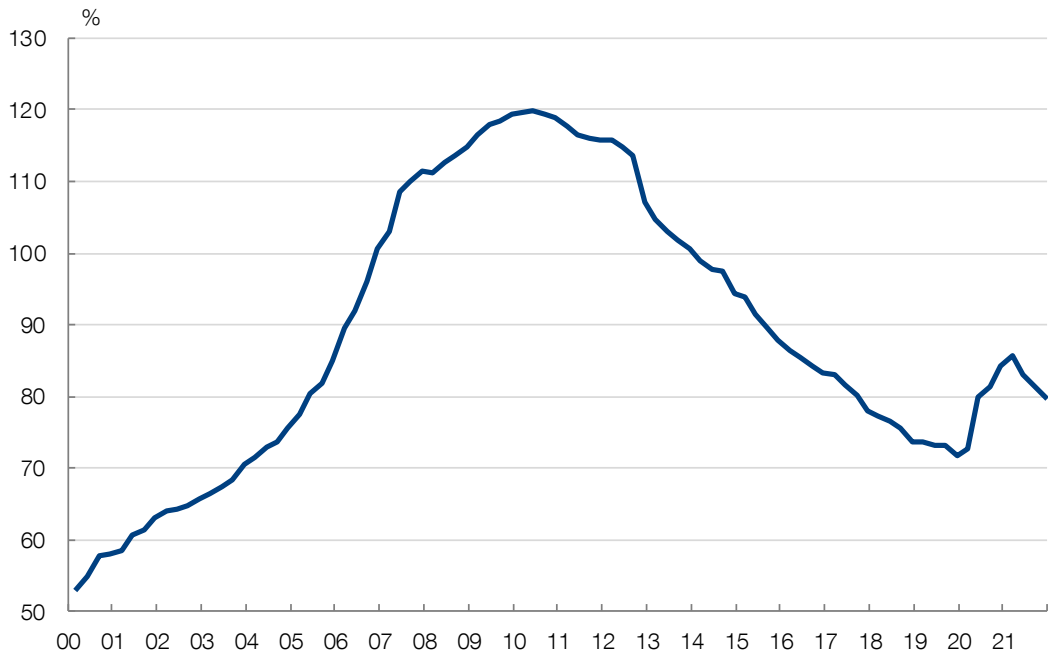
GRAPH 1. NFC DEBT TO GDP RATIO IN SPAIN

This figure shows the evolution of the debt to GDP ratio of Spanish non-financial corporations, where aggregate debt is obtained from the Banco de España's financial accounts of the institutional sectors.



Source: Banco de España

TABLE 1. SUMMARY STATISTICS FOR VARIABLES

Variable	*Description*	*Mean*	*Std. Dev.*	*Min*	*Max*
Credit demand	Annual change of credit demand (ln)	1.340	121.991	-643.858	708.310
Investment	Annual change of gross fixed capital stock (ln)	25.992	62.633	-113.434	397.008
Leverage ratio	Long-term liabilities / total assets (%)	25.727	26.126	0.000	112.121
Liquidity ratio	Cash and equivalents / total assets (%)	8.576	13.144	-10.178	71.088
Age	Years (+ 1) since the creation of the firm (ln)	2.490	0.679	0.000	5.288
Size	Total assets (ln)	6.527	1.449	3.028	10.568
Fin. expenditures	Interest expenses / total liabilities	2.719	2.565	0.000	14.639
ROA	Net profit / total assets (%)	0.427	14.311	-76.104	41.085
Tangibility	Tangible fixed assets / total assets (%)	34.633	28.928	0.000	98.375
Eonia	Euro Overnight Index Average rate (%)	1.050	1.472	-0.392	3.865
GDP	Annual real GDP growth (%)	1.401	2.438	-3.760	4.100
Inflation rate	Annual average CPI growth (%)	1.852	1.475	-0.500	4.090

TABLE 2. TESTING DEBT OVERHANG

This table reports the results obtained from the estimation of equations (1) and (3) in columns (1) and (2), respectively. Column (1) reports the effect of firms' leverage on firms' investment as predicted by the simple approach and column (2) reports the effect of firms' leverage on the growth of firms' credit demand. The dependent variables are Δ Ln K, the annual log change of gross fixed capital stock, and *Δ Ln CreditD*, the annual log change, in the demand for bank credit. The explanatory variable of interest in both equations is *Leverage*, measured as the lagged long-term liabilities-to-assets ratio. Standard errors clustered at the firm level are reported in brackets. The first lag of the following variables is also included as firm controls: liquidity, age, size, financial expenditures, ROA and tangibility. In addition, the regressions include firm fixed effects and sector-province-year fixed effects. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Δ Ln K_{it}	Δ Ln $CreditD_{it}$
	(1)	(2)
$Leverage_{t-1}$	-0.134***	-0.742***
	[0.003]	[0.006]
Observations	2,813,512	3,201,057
R-squared	0.480	0.271
Firm controls	YES	YES
Firm FE	YES	YES
Sector-province-year FE	YES	YES
Adj. R-squared	0.338	0.080

TABLE 3. DEPENDENCY OF THE ASSOCIATION BETWEEN BORROWING AND FIRM'S LEVERAGE ON FINANCIAL CONDITIONS

This table presents the results of the estimation of equations (4) and (5) in columns (1) and (2), respectively. The dependent variable in both equations is *Δ Ln CreditD*, which is the annual log change of firm's demand for bank loans. The explanatory variables of interest in column (1) are *Leverage*, measured as the long-term liabilities-to-assets ratio, and the interaction between this variable and financial conditions, captured by the change in the EONIA (*Δ r*), whose sign is normalized so that a positive value corresponds to a cut in interest rates, thus to an expansionary shock. In column (2) financial conditions (*Δ r*) are added as an additional explanatory variable, sector-province-year fixed effects are removed and lagged values of GDP growth and inflation rate are included as control variables. In addition, the first lag of the following variables is included as firm controls in both equations: liquidity, age, size, financial expenditures, ROA and tangibility. Standard errors clustered at firm level are reported in brackets. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Δ LnCreditD$_{it}$	Δ LnCreditD$_{it}$
	(1)	(2)
Leverage$_{it-1}$	-0.751***	-0.719***
	[0.006]	[0.006]
Leverage$_{it-1}$ * Δ r$_t$	0.060***	0.060***
	[0.003]	[0.003]
Δ r$_t$		3.790***
		[0.123]
Observations	3,201,057	3,201,057
R-squared	0.271	0.227
Firm controls	YES	YES
Firm FE	YES	YES
Sector-province-year FE	YES	NO
Adj. R-squared	0.0805	0.0641

TABLE 4. ESTIMATING CREDIT DEMAND TAKING INTO ACCOUNT CREDIT RISK

This table reports the results obtained from the estimation of equations (3), (4) and (5) in columns (1), (2) and (3), respectively. The dependent variable is *Δ Ln CreditD*, which is the annual log change of firm's demand for bank loans taking into account credit risk, as estimated by equation (6). The explanatory variable of interest in column (1) is *Leverage*, measured as the long-term liabilities-to-assets ratio. Column (2) adds as an additional explanatory variable the interaction between *Leverage* and financial conditions, captured by the change in the EONIA (*Δ r*), whose sign is normalized so that a positive value corresponds to a cut in interest rates, thus to an expansionary shock. Finally, in column (3) financial conditions (*Δ r*) are added as an additional explanatory variable and lagged values of GDP growth and inflation rate are included as control variables. The first lag of the following variables is included as firm controls in all the equations: liquidity, age, size, financial expenditures, ROA and tangibility. All regressions include firm fixed effects and sector-province-year fixed effects except column (3), in which we have removed the sector-province-year fixed effects. Standard errors clustered at the firm level are reported in brackets. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Dependent variable:	Δ Ln CreditD$_t$	Δ Ln CreditD$_t$	Δ Ln CreditD$_t$
	(1)	(2)	(3)
Leverage$_{t-1}$	-0.688***	-0.700***	-0.670***
	[0.006]	[0.006]	[0.006]
Leverage$_{it-1}$ * Δ r$_t$		0.084***	0.085***
		[0.003]	[0.003]
Δ r$_t$			2.067***
			[0.116]
Observations	3,201,057	3,201,057	3,201,057
R-squared	0.270	0.271	0.228
Firm controls	YES	YES	YES
Firm FE	YES	YES	YES
Sector-province-year FE	YES	YES	NO
Adj. R-squared	0.0797	0.0800	0.0649

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