Do Demand or Supply Factors Drive Bank Credit,

In Good and Crisis Times?

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Abstract

We analyze the impact of balance-sheet strength on credit availability. Bank balance sheets are weak in crisis times, but so are those of firms, and credit demand is then also weak. For identification, we exploit an administrative dataset of loan applications matched with bank and firm variables covering Spain from 2002 to 2010. Bank balance-sheet strength determines the granting of loan applications only in crisis times, while firm balance-sheet strength – notably leverage – determines strongly this granting in both good and crisis times. Our findings underscore the importance of the strength of corporate balance sheets over credit supply for credit availability.

Keywords: firm balance-sheet channel, credit demand, bank lending channel, credit supply, business cycle, credit crunch, leverage.

JEL: E44, G01, G21, G28, G32.

1. Introduction

A crucial question − yet unanswered in the literature − is whether credit availability for non-financial firms mainly depends on credit supply and/or demand factors, and how good versus crisis times differently affect the influence of credit supply and demand factors on firm credit availability. As shown theoretically by Holmstrom and Tirole (1997), bank credit is affected on the supply side by the balance-sheet strength of banks (the so-called *bank balance-sheet channel* or *lending channel*),[1] and on the demand side by the balance-sheet strength of firms (the so-called *firm balance-sheet channel*). Bank and firm net worth vary over the business cycle. Bank net worth may especially matter in financial crisis times (Gertler and Kiyotaki (2011)). At the same time, financial crises arrive after periods of high leverage (Schularick and Taylor (2012)), which may turn into debt overhang problems for non-financial firms (Myers (1977)); therefore, in crisis times the balance sheets of firms may also be weak and credit demand may be low owing to bad economic prospects (Bernanke, Gertler and Gilchrist (1996)).

While there is extant empirical work showing the importance of bank factors, there are no studies assessing the relative empirical importance of the bank (supply) versus the firm (demand) channel, which is the main question we address in this paper. This gap in the literature is mostly due to the lack of loan application level data matched with bank and firm level information, proxying for the bank (supply) and firm (demand) balance-sheet strength. Following Khwaja and Mian (2008), the large credit supply literature analyzes changes in granted credit to the same borrower

[1] See also Bernanke (2007), Bernanke and Gertler (1995) and Kashyap and Stein (2000).

in the same period by banks with different capital and liquidity.[2] This empirical strategy isolates credit supply, but does not allow to horse-race the influence of supply and demand factors on credit availability. For the analysis of this question, loan applications, in conjunction with firm and bank characteristics, are essential.

Spain, however, offers an ideal setting for identification: (i) As far as we are aware, Spain is one of only two countries where there is a credit register with loan applications that are available for all banks, including also an identifier for the lender receiving and for the borrower lodging the application.[3] Hence both bank and borrower identities are known in loan application-level data, which are crucial to identify credit availability.[4] (ii) Through the fiscal identification number, the credit application data can be matched with comprehensive supervisory bank balance-sheet data and complete administrative firm balance-sheet data, which can proxy for the strength of bank and firm balance-sheets, respectively. This information is essential to distinguish between the bank and the firm balance-sheet channels.

The data is available at a monthly frequency, starts in February 2002 and we collate it until June 2010, the time of the Greek sovereign shock. This allows us to

[2] E.g., Paravisini (2008), Ivashina and Scharfstein (2010), Schnabl (2012), Brown, Kirschenmann and Ongena (2014), Becker and Ivashina (2016), Célérier, Kick and Ongena (2016) and De Jonghe, Degryse, Jakovljevic, Mulier and Schepens (2016).

[3] Jiménez, Ongena, Peydró and Saurina (2012) and Jiménez, Ongena, Peydró and Saurina (2014) also study the Spanish loan applications, but singularly focus their studies on the impact of changes in monetary conditions through the so-called bank lending and bank risk-taking channels (see discussion below). Albertazzi, Bottero and Sene (2014) and Bofondi, Carpinelli and Sette (2014) employ Italian loan applications in their studies of information sharing and the sovereign debt crisis, respectively. Puri, Rocholl and Steffen (2011) analyse household loan applications to German saving banks before and during the recent crisis and find that banks with exposure to US subprime assets less likely grant loan applications during the crisis; our question is different than theirs as we are interested in the lenders' versus the borrowers' strength in balance sheets over the (and in firms rather than households). In addition, complementing their paper, we show that exhaustively controlling for time-varying unobserved and observed heterogeneity in non-financial borrower fundamentals (with non-financial-borrower*time or non-financial-borrower fixed effects; both sets require borrower *identity*, which the German data lack) may be essential to remove any bias in the estimates of the potency of the bank balance-sheet channel.

[4] In addition, borrower discouragement seems rather low in Spain, at the level of Germany for example (Brown, Ongena, Popov and Yeşin (2011)), making the loan application stage informative.

analyze the period before the start of the financial crisis in August 2007 which was characterized by good economic conditions (henceforth "good times"), and the banking crisis period from this date to the mid of 2010 (henceforth "crisis times"). We consider the crisis period until mid-2010, because by then the financial crisis in Europe started to metastase into a sovereign debt crisis, which compounded the financial crisis with a liquidity draught not only for the Spanish sovereign, but also for the banks and firms in Spain, and importantly because there were subsequent (from the econometrician`s perspective) disruptive policy interventions in Spain, (which include e.g. multiple bank bail-outs).

We match the loan-level data with supervisory bank-level balance sheet information and exploit bank capital, size and liquidity heterogeneity, among other bank variables. Moreover, we also match the credit data with the official balance sheet data deposited by firms to the Chamber of Commerce, as required by the Spanish law, and similarly exploit firm capital (leverage), size and liquidity heterogeneity, among other firm variables. For example, the bank and firm capital ratio are a sharp measure for both the intensity of the agency conflicts between shareholders and their financiers and the strength (net-worth) of balance sheets (Holmstrom and Tirole (1997); Bernanke (2007); Freixas and Rochet (2008)).

Analyzing first only bank balance sheet strength and loan application granting – in order to benchmark our subsequent exercises that combine the analysis of both bank and firm balance sheet channels – we find robust evidence that heterogeneity in bank balance-sheet strength does *not* determine loan granting in good times. That is, in good times, the granting of loan applications to a firm is not associated to bank capital, liquidity, size or doubtful loan ratio. However, bank balance-sheet strength does determine loan application granting in crisis times, in particular bank size,

capital, and the doubtful loan ratio. A one standard deviation increase, for example, in each of these bank characteristics changes the probability a loan application is being granted by 3.2, 5.9 and -7.9 percent (expressed as a semi-elasticity), respectively, in the specification most saturated on the firm side.

In contrast, when analyzing the effect of firm balance-sheet strength on loan granting, we find evidence that firm heterogeneity in balance-sheet strength determines the probability that a loan application is granted to the applying firm *both* in good and in crisis times. Firm balance-sheet strength, nevertheless, matters even more in crisis times than in good times, with, for example, the impact of firm capital (i.e., leverage) on loan application granting more than doubling in crisis times as compared to in good times. A one standard deviation increase in firm capital changes the probability a loan application is granted by 4.5 percent in good times and by 8.4 percent in crisis times, in the specification most saturated on the bank side.

The key contribution of our paper comprises the question we address coupled with the identification strategy we employ and the resultant estimates we obtain. The identification of the bank versus the firm balance-sheet channel is important for (i) testing theoretical models (e.g., Holmstrom and Tirole (1997), and the subsequent literature built around this path-breaking paper, which show that both bank and firm leverage matter for credit availability, but leave open the empirical question which channel matters more and when?); (ii) for public policy (i.e., should the government subsidize banks or non-financial borrowers? On this account see, e.g., the salient past debate between US central bank and government senior officials and Mian and Sufi (2014) on who to help during the crisis: Banks or non-financial borrowers (households)?); (iii) for management policy (the supply of credit matters especially in crisis times, but not overall in good times, in this latter case it is firm balance-

sheet strength that is crucial; moreover, the elasticity in crisis times is higher for firm leverage than for bank balance-sheet strength variables, hence the findings underscore the importance of the strength of corporate balance sheets over credit supply for the availability of finance).

There is a large empirical literature on the balance-sheet channels that started with a macro approach and that, to achieve better identification, moved to more micro level data (Bernanke and Gertler (1995)) both at the bank level to identify the bank balance-sheet (or lending) channel (Kashyap and Stein (2000)) and at the firm level to identify the firm balance-sheet channel (Bernanke, Gertler and Gilchrist (1996)).[5]

Bank or firm level data *per se* however does not identify credit availability. First, loan *applications* are crucial to analyze credit availability. Second, as banks with different size, net worth and risk tend to lend to firms with different size, net worth and risk, an analysis either at the bank level or at the firm level may be biased. Therefore, the analysis – including the horse-race and identification – of the bank versus the firm balance-sheet channels can only be done with loan applications matched with bank and firm identity and complete balance-sheet data for both. As far as we are aware, this paper is the first in the literature to do so, hereby relying on data from Spain.

This data moreover allows us, as we explain in detail in Section 2, to use firm*time fixed effects (which control comprehensively for the firm balance sheet channel) to identify the bank balance-sheet channel; and to use bank*time fixed

[5] A large empirical literature has investigated various manifestations of the bank- and firm-balance sheet channels independently, with the analysis done at either the bank or the firm level. On the bank side see Kashyap and Stein (2000), Kishan and Opiela (2000), Jayaratne and Morgan (2000), Ashcraft (2006), Gan (2007), Black, Hancock and Passmore (2009) and Chaney, Sraer and Thesmar (2012), among others. On the firm side, see Gertler and Gilchrist (1994), (Bernanke, Gertler and Gilchrist (1996), Chatelain *et al.* (2003), de Bondt (2004), and Ashcraft and Campello (2007), among others.

effects (which control comprehensively for the bank balance sheet channel) to identify the firm balance-sheet channel (where time is year:month level). Importantly, our analysis suggests that firm and bank fixed effects are crucial for controlling adequately for either the firm or bank channel results. The coefficients are close to the ones including either firm*time or bank*time fixed effects, and not controlling for the firm or bank balance-sheet channel with any firm or bank related fixed effects biases the estimates on the potency of the bank or firm balance-sheet channels, respectively.

Importantly we horserace firm and bank factors (in loan application granting) *both* during the last boom and also during the 2007-2010 crisis itself. We therefore contribute to historical studies by Kindleberger (1978), Bernanke (1983), Reinhart and Rogoff (2009), and Schularick and Taylor (2012) by analyzing the recent boom and bust cycle with a comprehensive and unique micro data-set that allows not only for a better identification, but also to analyze the relative importance of each balance sheet channel.

Importantly, for both theory and policy, as mentioned, we find that credit demand factors always matter, whereas supply factors only matter during a crisis. Therefore, corporate finance and macroeconomic models that do not incorporate bank credit supply frictions may work well in normal times, but poorly in bad times.[6] Moreover, our results question that only banks should be subsidized in crisis times, as debt overhang problems in non-financial borrowers are also crucial. Indeed, our findings underscore the importance of the strength of non-financial corporate balance sheets

[6] Firms could substitute in crisis times the reduction in bank credit supply by accessing market debt as shown clearly by Becker and Ivashina (2014) (with US data). However, non-financial corporate debt is tiny in Spain as compared to bank loans to firms. This number is also low in other bank-dominated countries (such as Continental Europe or emerging markets), and small and medium size firms (SMEs) are in general financially constrained, with lack of market access and strong bank dependence even in non-bank dominated countries (e.g., Allen, Chui and Maddaloni (2004)).

for the availability of financing in general. Consequently, corporate finance models that do not incorporate the supply of finance will describe the financing of firms in normal times well.

A part of the data set is also used in other papers. Jiménez, Ongena, Peydró and Saurina (2012) analyze just the bank lending channel of monetary policy until 2008 using the loan applications.[7] Our two innovations in this paper is that we analyze the potency of the (non-financial borrower) firm balance-sheet channel *versus* the bank balance-sheet channel *in general* (i.e., not confined to the banks` responsiveness to monetary policy shocks). These innovations are crucial both for testing theoretical models and for public policy and management analysis, and substantially differentiates our two papers.

Jiménez, Ongena, Peydró and Saurina (2014) also use the loan application data set but that paper assesses the relevance of the bank risk taking channel of monetary policy. Hence the focus in that paper is once more on the bank lending channel, but then on its compositional dimension (with respect to risk), and not as in this paper on a comparison of the strengths of firm and bank balance-sheet channels during boom and crisis years.[8]

The paper proceeds as follows. Section 2 discusses the data and the empirical strategy. Section 3 presents and discusses the results. Section 4 concludes by highlighting the relevant implications for theory and for public policy analysis.

[7] The *bank lending channel* (in a narrow sense) pertains to the lending response of banks to changing monetary conditions, while the *bank balance sheet channel* comprises the propensity of banks to (continue to) lend in general depending on their balance sheet strength and subject to changes in a variety of financial, monetary and macroeconomic conditions. See also Bernanke and Gertler (1987), Bernanke and Blinder (1988), Bernanke and Gertler (1989), Bernanke and Blinder (1992), Bernanke and Gertler (1995), Bernanke, Gertler and Gilchrist (1999), Bernanke (2007), Adrian and Shin (2010), and Adrian and Shin (2011).

[8] Jiménez, Ongena, Peydró and Saurina (2016) study the impact of dynamic provisioning on credit supply cycles and real effects, but the loan application data plays only a supportive role in their analysis (e.g., their Figure 4).

2. Data and Empirical Strategy

In this Section we first discuss the data we employ in our empirical work, second we present and discuss the empirical strategy highlighting the testable predictions emanating from theory. Finally, we provide the definition of the dependent and independent variables and the main econometric specification.

A. *Data*

We have access to the *Credit Register* of the *Banco de España* (CIR), which contains confidential information on all business loans granted by all banks operating in Spain (see Jiménez, Salas and Saurina (2006) for a detailed description of the CIR).

To analyze credit demand, we focus on loan applications for commercial and industrial (C&I) loans (82 percent of total loans) by non-financial publicly-limited and limited-liability companies (that account for around 95 percent of all firms) to commercial banks, savings banks and credit cooperatives (that account for more than 95 percent of the entire Spanish financial system).[9] The dataset contains loan applications from potential borrowers to banks that they are not currently borrowing from (i.e., the extensive margin of new lending). Loan applications are available since 2002:02. Though the applications can be made at any time, they are collated monthly and uniquely link borrowers with banks (see Jiménez, Ongena, Peydró and Saurina (2012) for a detailed description of this dataset).

As explained in the Introduction, we analyse the loan applications until 2010:06, the time of the start of the sovereign debt crisis in the Euro area. For each loan application between 2002:02 and 2010:06, we also observe whether the loan is accepted and granted, or not, by matching the loan application database with the CIR

[9] Delgado, Salas and Saurina (2007) explain the main features of the Spanish banking system.

database, which contains the stock of all the loans granted. Therefore, if there are applications from the same firm in the same period to multiple banks, we can infer the bank that granted the loan and the banks that did not. In case there is a loan application but the bank does not grant the loan, either the bank denied the firm credit or the firm perceived the offered conditions by the bank to be less attractive than those of the loan it eventually took. Hence, we can link loan granting for the same firm within each month to bank balance-sheet strength, and we can also analyse the granting of a loan application depending on the firm balance-sheet strength.

We therefore match the application dataset with bank and firm datasets, so that we have balance-sheet information for each bank that receives a loan application and for the firm that applies for a loan. The banks' dataset, at a monthly frequency starting in 1984, is owned by the *Banco de España* in its role as banking supervisor. The firms' dataset is available from the Spanish Mercantile Register at a yearly frequency, starts in 1992 and covers the large majority of firms. We can match 427,364 loan applications to bank balance-sheet data and 198,350 loan applications to both bank and firm balance-sheet data, which constitute our two samples of loan applications that we analyze. In case there is no balance-sheet information for a firm, there is nevertheless the firm identity, which is crucial to identify credit supply as we discuss below. The loan applications which are not matched to the firm balance-sheet data are from very small firms since CIR collects all business loans (i.e., above 6,000 euros) from all the firms in Spain, including the very small ones.

B. *Empirical Strategy*

The theory of the bank and firm balance-sheet channels that we discuss in the Introduction (e.g., the seminal paper by Holmstrom and Tirole (1997)) has the

following testable predictions: 1) Bank and firm variables that proxy for the strength of balance sheets determine loan application granting; and, 2) The impact is stronger in crisis than in good times.

Given that the main problem in the literature is to identify the channels, we emphasize more the empirical strategy and the data that is needed to test the predictions emanating from the theoretical literature. As we have access to loan applications plus the bank and firm balance-sheet characteristics that determine balance-sheet strength, we are able to better disentangle the supply from the demand for loans. Through the loan applications, loan demand for each bank is in a sense given and observed, and each bank has to decide only on the granting of each loan knowing the firm. As far as we are aware, ours is the first paper that analyzes the impact of the bank versus the firm balance-sheet channel relying on the probability loans are granted following applications from firms.

To analyze the bank and firm balance-sheet channels we exploit the cross-sectional implications of the sensitivity of credit availability in good and crisis times according to the strength of the balance sheets (see e.g. Kashyap and Stein (2000) for the bank balance-sheet (or lending) channel and Bernanke, Gertler and Gilchrist (1996) for the firm balance-sheet channel).

Following the theoretical literature (Holmstrom and Tirole (1997), Bernanke, Gertler and Gilchrist (1999), and Gertler and Kiyotaki (2011)) we focus on bank and firm capital ratios.[10] Since risk also affects net worth, we also feature for banks a non-performing ("doubtful") loan ratio and a concentration index of the bank's

[10] Off-balance sheet volumes are very small in Spain; hence, total bank assets cover most of the banks' businesses. Banks did not develop conduits and/or Structured Investment Vehicles (SIVs) because the prevailing accounting rules made banks consolidate these vehicles and set aside sufficient capital, eliminating the incentives of banks for developing such structures. See e.g. Acharya and Schnabl (2010).

credit portfolio by industry that proxies for bank diversification.[11] For firms we feature a risk measure of previous bad credit history and the age of the firm. Following Kashyap and Stein (2000) and Bernanke, Gertler and Gilchrist (1996) we also feature the bank and firm liquidity ratios and size.

We control with bank and firm fixed effects for time-invariant characteristics of banks and firms respectively, such as for example bank type (i.e., commercial, savings or cooperative) and firm legal structure, industry and location. Moreover, given that banks of different net worth may be approached by borrowers with different net worth and risk, our main regressions have firm or firm*time fixed effects to identify the bank balance-sheet channel and bank or bank*time fixed effects to identify the firm balance-sheet channel.

For example firm*time (bank*time) fixed effects are a complete set of monthly dummies (from 2002:02 to 2010:06) for *each* firm (bank), which therefore control exhaustively for all time-varying observed and unobserved firm (bank) heterogeneity. This set of effects is key to control for the demand (supply) side, and hence, to identify the bank (firm) balance-sheet channel. Given that these two comprehensive sets of fixed effects does not allow including concurrently firm or bank balance sheet variables, we also analyze specifications without these sets of fixed effects, but with firm and bank fixed effects.[12] Though we discuss the results in the next Section, it turns out that controlling for firm and bank fixed effects provide very similar qualitative and quantitative effects than controlling by firm*time and

[11] A loan is classified as doubtful when payments of interest and principal are past due by 90 days or when payments are less than 90 days overdue but there are other reasons to doubt about the performance of the contract.

[12] In addition to firm and bank fixed effects, we can also add time fixed effects. Otherwise, when there are no time fixed effects included, we control for macro factors with real GDP growth, the change in the interbank 3-month interest rate, and inflation.

bank*time fixed effects, and that firm and bank fixed effects are necessary as compared to no fixed effects.

C. *Dependent Variable, Independent Variables and Specifications*

In this subsection we provide the definition of the main dependent variable, the independent variables, and the estimated specifications.

1. Main Dependent Variable: LOAN APPLICATION IS GRANTED

Table 1 defines the dependent and independent variables employed in the first set of empirical specifications where we only analyze the bank balance-sheet channel, and Table 4 defines the second set, where we analyze both the bank and the firm balance-sheet channels.[13] Tables 1 and 4 also present their descriptive statistics for the whole period (2002:02-2010:06), for the good times (2002:02-2007:07), and for the crisis times (2007:08-2010:06). As we have stressed before, our key results are for the second subsample where we horse race bank and firm channels, but the first subsample allows to analyze a larger sample and allows to check whether controlling for firm versus firm*time fixed effects is crucial or not.

With respect to the good versus crisis times, the crisis started in August 2007 in Europe when the interbank market, which is an important source of liquidity for banks in Europe, started experiencing strong tensions – e.g., interbank spreads went significantly up and the European Central Bank had to inject large amounts of public liquidity (see Iyer, da-Rocha-Lopes, Peydró and Schoar (2014)). The onset of this liquidity crisis was an unexpected shock across all European countries and not related to the Spanish banking sector, especially as these banks were not investing in US subprime or in the US dollar market, or the bank capital regulation in Spain did

[13] As we explained above, there is no firm balance-sheet data for a significant number of loan applications but firm identity is always known and so is complete bank balance-sheet data.

not encourage setting up of off-balance sheet vehicles (Acharya and Schnabl (2010)).

The dependent variable we feature throughout the paper is LOAN APPLICATION IS GRANTED (we recurrently shorthand this as "loan granting"), which equals one if the loan application by firm *i* at time *t* is approved by bank *b* and the loan is granted in month *t* to *t+3*, and equals zero otherwise. The average value of loan granting equals 39 percent in both Tables 1 and 4 in good times and 30 percent in crisis times.

We match each loan application with its relevant bank and firm characteristics, in particular firm identity. The inclusion of firm (or firm*time) fixed effects in a logit (or probit) model naturally restricts the sample to those firms that filed at least one application that did result in a loan granted and one application that did not during the sample period (or in a month). To avoid this selection problem we employ linear probability models in the regressions.

2. Independent Variables

As independent variables we include an array of bank and firm characteristics that proxy for bank and firm balance-sheet strength. The summary statistics of Table 1 are based on the observations used in the first three Tables that include only bank characteristics (and possibly firm fixed effects or firm*time fixed effects). Bank balance-sheet data is taken at the end of the previous month *t-1*.

The bank balance-sheet variables we are foremost interested in are bank size, capital, liquidity and risk. Bank size is the log of the total assets of the bank, BANK LN(TOTAL ASSETS), its average is 17.27 in good times and 17.71 in crisis times (31 and 49 billion Euros, respectively). The BANK CAPITAL RATIO as a measure

of the bank's net worth which is defined as the ratio of core capital (total equity plus retained earnings) over total assets of the bank (as in Bernanke and Lown (1991) for example). As we use the book value of equity and assets are not risk adjusted, our measure is equivalent to a pure leverage ratio. Thus defined it has an average value of 5.47 percent in good times and 5.39 percent in crisis times. It is important to note that leverage ratios for banks were not regulated as compared to US (but with the new regulation of Basel III, banks` leverage ratios will also be regulated in Europe).

We also use a measure of banks' liquidity position. The BANK LIQUIDITY RATIO is the ratio of liquid assets held by the bank (i.e., cash and deposits with central banks and other credit institutions, and public debt with a maturity up to one year) and the total assets of the bank. Banks on average held 17.14 percent of their balance-sheet in liquid assets in good times but only 12.51 percent in crisis times.

We proxy bank risk by the doubtful loan ratio (BANK DOUBTFUL LOANS RATIO) which has an average value of 0.73 percent in good times and 2.71 in crisis times, and by the BANK CONCENTRATION IN AN INDUSTRY, the sum of shares squared of the bank's credit portfolio by industry (i.e., similar in construction to the Herfindahl–Hirschman Index measuring product market concentration), which has an average value of 27.26 in good times and 28.58 in crisis times. As a bank-firm relationship variable we include LN(1+NUMBER OF MONTHS WITH THE BANK), which is the log of one plus the number of months that the bank had a working relationship with the firm. Though the loan applications are lodged to banks that firms are not currently borrowing from, firms can have worked previously with them.

To analyze the firm balance-sheet channel we include a broad set of firm characteristics that proxy for the strength of firm balance sheets (see Table 4 for the

summary statistics). Parallel to the bank variables, as firm variables we feature: FIRM LN(TOTAL ASSETS), the log of the total assets, which has a value of 7.65 in good times and 7.74 in crisis times (2 and 2.2 million Euros, respectively); FIRM CAPITAL RATIO, which is the log of the ratio of own funds over total assets of the firm, which has an average value of 2.57 in good times and 2.84 in crisis times (13 and 17 percent, respectively); the FIRM LIQUIDITY RATIO, the current assets over total assets of the firm, which has an average value of 6.71 in good times and 7.09 in crisis times.

For firm risk we use FIRM SUBPRIME, a dummy variable that equals one if the firm had delinquent loans before the loan was requested, and equals zero otherwise. Its average value equals 10 percent in good times and 12 percent in crisis times; and FIRM LN(1+AGE), the log of one plus the age of the firm in years that has an average value of 1.96 in good times and 2.26 in crisis times (7 and 9 years, respectively).

3. Specifications

The specifications we estimate are at the loan application-level and we match the loan application outcomes (whether the loan is granted or not) with the associated bank and firm balance-sheet variables. We analyze first good times (2002:02-2007:07) and then we analyze the whole period (2002:02-2010:06) introducing a crisis dummy variable that takes the value of one after 2007:07 and its interactions with the bank and firm balance sheet variables. We provide in the next Section the exact empirical specification we discuss in each Table, but our benchmark and most general empirical specification assessing the probability a loan application is granted is structured as follows:

$$\text{LOAN APPLICATION IS GRANTED}_{bit} =$$

$$bank_{bt-1} + firm_{it-1} + \text{CRISIS}_{t-1} + \text{CRISIS}_{t-1} * bank_{bt-1} + \text{CRISIS}_{t-1} * firm_{it-1} \quad (1)$$

$$+ \textit{fixed effects} + \varepsilon_{bit},$$

where *bank* and *firm* are respectively an array of bank and firm balance-sheet variables presented above, CRISIS is the crisis dummy that takes the value of one in the sample months after 2007:07 and equals zero otherwise, CRISIS * *bank* and CRISIS * *firm* are the interactions between the dummy crisis and the firm and bank balance-sheet variables, *fixed effects* are the different specifications of bank, time and firm fixed effects we presented above, in particular bank, time, firm (and in some specifications also firm*time and bank*time) fixed effects. The theory of the bank and firm balance-sheet channels predict that bank and firm variables proxying for balance-sheet strength matter, and especially in crisis times (i.e., when the dummy variable CRISIS variable equals 1).

3. Results

We first analyze the bank balance-sheet channel with the sample composed by all loan applications (see Tables 1 to 3), and then we analyze the bank and the firm balance-sheet channels with the sample of loan applications matched to both bank and firm balance-sheet data (see Tables 4 to 6). While the latter set of tables delivers the main contribution of our paper, the first three tables provide the salient model build-up and benchmarking exercises.

A. *The Bank Balance-Sheet Channel*

Table 1, as explained in the previous Section, provides in addition to the variable definitions also the summary statistics. Table 2 provides the results for the bank balance-sheet channel for the period of good times and Table 3 for the whole period. The specifications we estimate in Table 2 are as follows:

$$\text{LOAN APPLICATION IS GRANTED}_{bit} = \\ bank_{bt-1} + controls_{bit} + fixed\ effects + \varepsilon_{bit}, \tag{2}$$

where *bank* includes BANK LN(TOTAL ASSETS), BANK CAPITAL RATIO, BANK LIQUIDITY RATIO, BANK DOUBTFUL LOANS RATIO, and BANK CONCENTRATION IN AN INDUSTRY; and *controls* include LN(1+NUMBER OF MONTHS WITH THE BANK), GDP GROWTH, CHANGE IN 3-MONTH INTEREST RATE, and INFLATION. The latter three variables drop out when we include time effects starting in Model 2.

In Table 2, when we do not control for time or firm fixed effects yet, but only include bank fixed effects (Model 1), we find that smaller banks grant loan applications with a higher probability than larger banks. The estimated coefficient equals -3.61***.[14] Given that we estimate linear probability models and given that the estimated coefficients are expressed in percent, the economic magnitude of the effect can be readily approximated. A decrease in bank asset size of one standard deviation (i.e., 1.47), increases the probability a loan application is granted by 5.2 percentage points (= 1.45 times 3.61***). This is a sizeable effect given that the probability that a loan application is accepted in good times equals 39 percent,

[14] As in the Tables, ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.

implying a semi-elasticity of 13.3 percent (the second panel in Table 2 reports this and other similarly calculated semi-elasticities).

Banks with a more diverse loan portfolio also grant loans with a higher probability, but the economic magnitude of the effect is somewhat smaller: A one standard deviation lower concentration results in a 1.3 percentage points increase (9.40 times -0.14**) in granting loans. This finding implies that in good times banks that are diversified across industries are more likely to grant loans on average. Finally, we find that banks are more likely to grant loans to firms with a longer previous relationship (but the economic relevancy is also modest) and that a one percentage point higher GDP growth implies a 2.9 percentage points higher probability of loan granting (= 1 times 2.92***).

Model 2 adds time dummies. The estimated coefficient on bank size turns statistically insignificant. In Model 3 we add firm fixed effects and bank liquidity becomes marginally statistically significant. Time and firm fixed effects control partially for firm demand fundamentals (net worth and risk) and, as the change of results suggests, they are necessary as for example banks with different size and liquidity likely have different type of borrowers.

Yet to fully control for credit demand we need to control for both time-varying observed and unobserved heterogeneity in firm balance-sheet strength. We do this in Model 4 where we add firm*time fixed effects in addition to bank fixed effects. Now only the estimated coefficients on bank concentration and the bank-firm relationship variables are now statistically significant, but as calculated earlier in Model 1 their economic relevancy is rather modest.

In sum, analyzing the effect of bank balance sheet strength on the probability a loan is granted following applications, our evidence suggests that the heterogeneity in bank balance-sheet strength (i.e., bank size, capital, liquidity, and risk) does not determine loan granting in good times.

In Table 3 we use loan applications from the whole period and, through interactions of the crisis dummy with bank balance-sheet variables, we aim to differentiate the impact of bank balance-sheet strength on lending in normal versus crisis times. As the crisis shock was unexpected, it is difficult to believe that banks already adjusted their balance sheets anticipating the crisis.[15]

The specifications we now estimate are:

$$\text{LOAN APPLICATION IS GRANTED}_{bit} = \tag{3}$$
$$\textit{bank}_{bt-1} + \text{CRISIS}_{t-1} + \text{CRISIS}_{t-1} * \textit{bank}_{bt-1} + \textit{controls}_{bit} + \textit{fixed effects} + \varepsilon_{bit},$$

where *bank* and *controls* include the same set of variables as in (2).

The crisis drastically decreases the probability a loan application is successful. Likely concurrent lower GDP growth, a higher short-term interest rate, and higher inflation also result in a lower probability of loan granting.

When analyzing the "strongest" specification, our benchmark Model 4, which is saturated with comprehensive sets of bank and firm*time fixed effects, we find that bank balance-sheet variables do not matter in normal times, but do matter in crisis times. In particular, banks that are smaller, with lower capital ratios (and thus more

[15] Our results are similar if during the crisis period we use the relevant values for bank and firm characteristics immediately prior to 2007:08.

levered), or with more doubtful loans are less likely to grant loans in crisis times. Banks also tend to grant more loan applications to firms which they had lent in the past, but this effect is not different between crisis and good times.

The economic relevancy of the estimated effects of the bank balance sheet strength is sizable. For example for a one standard deviation commensurate change in crisis times in bank size (decrease), capital (decrease), or doubtful loan ratio (increase) the probability a bank loan application is granted decreases by 1.0, 1.8 and 2.3 percentage points, respectively (-1.46 times 0.66***; -1.84 times 0.95***; 2.27 times -1.03**).[16] As the probability a loan application is granted in crisis times equals 30 percent, the semi-elasticities amount to 3.2, 5.9 and -7.9 percent, respectively.

In sum, analyzing multiple loan applications from the same borrower in the same month (firm*time fixed effects), and accounting for all time-invariant bank characteristics, banks with stronger balance-sheets grant more loan applications than banks with weaker balance-sheets in crisis times, but not in good times. Hence the results suggest that credit supply factors only matter in crisis times. Moreover, not controlling for the firm balance-sheet channel biases the estimates of the potency of the bank lending channel.

B. *The Bank and Firm Balance-Sheet Channels*

Table 4, as explained in Section 2, provides the summary statistics for the loan applications that are also matched with firm balance sheets. Table 5 provides the results for the period of good times for the bank and firm balance-sheet channels and

[16] Rochet and Vives (2004) and Vives (2011) show that low bank net worth (capital and doubtful ratio) negatively affect bank liquidity, especially during crisis times, thus leading to a reduction in bank assets, in particular new credit. See also Gale and Yorulmazer (2013).

Table 6 for the whole period. The specifications we now estimate in Table 5 take the form:

$$\text{LOAN APPLICATION IS GRANTED}_{bit} = \textit{bank}_{bt-1} + \textit{firm}_{it-1} + \textit{controls}_{bit} + \textit{fixed effects} + \varepsilon_{bit}, \quad (4)$$

where *bank* and *controls* include the same set of variables as in (2) and (3), while *firm* includes: FIRM LN(TOTAL ASSETS), FIRM CAPITAL RATIO, FIRM LIQUIDITY RATIO, FIRM SUBPRIME, and FIRM LN(1+AGE). In Tables 5 and 6 we follow the structure of the previous Tables and progressively saturate the specification with comprehensive sets of fixed effects, i.e., we introduce comprehensive sets of bank, time, firm /and/or bank*time) fixed effects.

In Models 1 and 2, without controlling for firm fixed effects, we find similar results for the bank variables as in Table 2 and we also find that smaller firms, with a lower capital ratio or that are younger have higher probability of being successful in their loan application. However, in Model 3 where we control for firm fixed effects (in addition to bank and time fixed effects that were introduced in Models 1 and 2, respectively), we now find that firms with a higher capital ratio and with a better credit history have higher loan granting probability, and we still find that smaller firms obtain higher credit granting. We also find similar results for bank variables as in Model 3 of Table 2.

In Model 4 we introduce bank*time fixed effects in addition to the firm fixed effects to control for time-varying observed and unobserved heterogeneity in bank balance-sheet strength. Given the large set of fixed effects we cannot double cluster:

Model 4 therefore provides the results with firm clustering (bank clustering yields almost the same standard errors on all estimated coefficients and is therefore not reported). We find that in good times firms with higher capital ratio and with a better credit history have a higher probability their application will be resulting in a loan being granted.

The estimated effects are also economically relevant. A one standard deviation increase in the firm capital ratio results in a 2.9 percentage points increase in the probability (1.16 times 2.56***), a semi-elasticity of 7.6 percent (2.9 divided by 39). Firms that are subprime have a 5.4 percent lower probability of getting a loan upon applying than prime firms.

Importantly as well, as in Tables 2 and 3 for the bank channel, the results imply that not controlling for firm fixed effects or bank (or bank*time) fixed effects biases the estimates of the potency of the firm balance-sheet channel, in particular the elasticity of firm capital and subprime without firm fixed effects, and of firm size or age without bank or bank*time fixed effects.

Next in Table 6 we estimate specifications of the form:

$$\text{LOAN APPLICATION IS GRANTED}_{bit} =$$

$$bank_{bt-1} + firm_{it-1} + \text{CRISIS}_{t-1} + \text{CRISIS}_{t-1} * bank_{bt-1} + \text{CRISIS}_{t-1} * firm_{it-1} \quad (5)$$

$$+ controls_{bit} + fixed\ effects + \varepsilon_{bit},$$

where *bank*, *firm* and *controls* include the same set of variables as were introduced in (2) and (3), and (5), respectively.

In the benchmark regressions including firm fixed effects in conjunction with bank fixed effects (column 3) results are similar to including bank*time fixed effects (column 4). We find that firms with a lower capital ratio are less likely to obtain credit in general, but that the effects are stronger in crisis times. A one standard deviation decrease in the firm capital ratio in good times lowers the probability by 1.7 percentage points (-1.11 times 1.51***), and a similar decrease in the capital ratio in crisis times lowers the probability by an *additional* 2.8 percentage points (-1.16 times 2.40***), implying a total semi-elasticity of 12.9 percent (= 4.5 plus 8.4 percent).

Younger firms are also less likely to obtain credit following an application in the crisis times with a similarly sized economic effect. Interestingly, subprime firms are penalized equally in crisis versus good times. Finally, and similarly as in Table 3 but differently to the firm balance-sheet channel, the bank balance-sheet strength does not matter in good times, but it does in crisis times (see Models 1 to 3).[17]

In sum, results suggest that heterogeneity in bank balance-sheet strength does not determine loan granting in good times. However, it does determine loan granting in the crisis. In consequence, the results suggest that credit supply factors only matter in crisis times.

When analyzing firm balance-sheet strength, we instead find evidence that firm heterogeneity in balance-sheet strength determines loan application granting both in good and crisis times. Firm balance-sheet strength, nevertheless, matters more in crisis than in good times, with key elasticities as firm leverage to loan application

[17] Notice that we do not control for firm*time fixed effects in Table 6 and that the coefficient on the bank doubtful loan ratio is not significant, see Table 3 Model 3 versus 4 where this coefficient was only statistically significant when we introduce firm*time fixed effects and the coefficient increases from to Model 3 to 4 by a factor of almost ten.

granting more than doubling in crisis times as compared to good times. Moreover, firm leverage has a relatively larger economic impact than bank capital in crisis times.

Finally, the results imply unequivocally that not controlling for the firm balance-sheet channel biases the estimates of the potency of the bank balance-sheet channel, and that similarly not controlling for the bank balance-sheet channel biases the estimates of the potency of the firm balance-sheet channel. As Table 6, column 3 versus 4 shows, bank versus bank*time fixed effects yield similar results.[18]

4. Conclusions and Implications for Theory and Policy

The recent crisis has resulted in massive transfers from governments and central banks to banks, through government bail-outs, recapitalizations and liquidity assistance and various central bank lender-of-last-resort actions to help banks in repairing their capital and liquidity positions. Our evidence shows that weaknesses in bank balance sheets reduces the supply of bank credit in crisis times (credit crunch) and, therefore, our estimates lend support to theories that emphasize the role of banks for the business cycle and crises (see e.g. Allen and Gale (2007); Matsuyama (2007); Shleifer and Vishny (2010a); Shleifer and Vishny (2010b); Adrian and Shin (2011); Gertler and Kiyotaki (2011); Diamond and Rajan (2011)).

However, non-financial borrower balance-sheet strength matters in general, not only in crisis times, though effects are stronger in crisis times as highlighted by our estimates of the potency of the firm-balance sheet channel (as most corporate finance models suggest and some macroeconomic models as e.g. Bernanke, Gertler and Gilchrist (1996); Bernanke, Gertler and Gilchrist (1999); Kiyotaki and Moore

[18] Results are somewhat different for Table 3, columns 3 and 4, for firm versus firm*time fixed effects for the identification of the bank balance-sheet channel.

(1997); Lorenzoni (2008); Jeanne and Korinek (2012)). In some corporate finance models, following Holmstrom and Tirole (1997), both bank and firm balance-sheet strength matter. We show empirically which specific factor matters most and when.

A crucial firm balance sheet characteristic that matters in the crisis is firm leverage, in particular high leverage, which lends support to the theories of firm debt overhang and deleveraging (see e.g. Myers (1977)). In fact the economic significance of firm leverage is higher than of any bank variable. This implies that even if the government support to banks helps bank credit availability, firms' balance-sheet strength and access to finance is also – or even more – important. Therefore, our results support some of the policies by the Federal Reserve, the Bank of England or the more recent Targeted Long Term Refinancing Operations by the ECB targeted to non-financial borrowers' access to finance.

Though our results indicate that heterogeneity in bank balance-sheet do not determine loan application granting in good times, it does not mean that banks are irrelevant for credit risk built-up in good times. Risk-taking incentives captured by changes in *composition* in credit supply could be more important in good times than overall bank credit supply (Jiménez, Ongena, Peydró and Saurina (2014), Allen and Rogoff (2011)). Finally, our findings that bank strength does significantly matter in crisis times (and not in good times) for lending policies supports current work by regulators to strengthen capital and liquidity levels at each individual bank in good times, so that when the next crisis arrives banks are in a better position to cope with it and, thus, the crisis will have an attenuated impact on credit granting, i.e., a

"softer" credit crunch (Admati and Hellwig (2013), Jiménez, Ongena, Peydró and Saurina (2016)).[19]

[19] Support in the literature for stronger regulatory requirements can also be found in Repullo, Saurina and Trucharte (2010) and Hanson, Kashyap and Stein (2011), among others. Insurance contracts contingent on average bank capital as a way to insure against systemic crises are discussed in Gersbach (2011).

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Table 1
Variable definitions and descriptive statistics for all loan applications

Variable Names	Variable Definition
LOAN APPLICATION IS GRANTED	A dummy variable which equals one if the loan application by firm i at time (i.e., month) t is approved by bank b and the loan is granted in month t to $t+3$, and equals zero otherwise
BANK LN(TOTAL ASSETS)	The log of total assets of the bank, in thousands of Euros
BANK CAPITAL RATIO	The ratio of bank equity over total assets of the bank, in percent
BANK LIQUIDITY RATIO	The ratio of liquid assets (cash and balance with central banks, and loans and advances to governments and credit institutions with up to one year in maturity) held by the bank over the total assets of the bank, in percent
BANK DOUBTFUL LOANS RATIO	The doubtful loan ratio of the bank, in percent
BANK CONCENTRATION IN AN INDUSTRY	The sum of shares squared of the bank's credit portfolio by industry
LN(1+NUMBER OF MONTHS WITH THE BANK)	The log of one plus the duration of the relationship between bank and firm, in months
CRISIS	A dummy variable which equals one in months after 2007:07 and equals zero otherwise
GDP GROWTH	Annual change of Spanish gross domestic product in real terms, in percent
CHANGE IN 3-MONTH INTEREST RATE	Annual change of Spanish 3-month interbank interest rates, in percent
INFLATION	Annual change of Spanish Consumer Price Index, in percent

Descriptive Statistics	Mean	St. Dev.	Minimum	Median	Maximum
Whole Period (2002:02-2010:06)	Number of Observations = 427,364				
LOAN APPLICATION IS GRANTED	0.35	0.48	0	0	1
BANK LN(TOTAL ASSETS)	17.49	1.47	9.60	17.66	19.94
BANK CAPITAL RATIO	5.43	2.03	0.00	4.91	87.17
BANK LIQUIDITY RATIO	14.90	7.53	0.03	14.00	92.07
BANK DOUBTFUL LOANS RATIO	1.69	1.93	0	0.82	58.61
BANK CONCENTRATION IN AN INDUSTRY	27.90	8.84	13.20	25.62	100
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.38	1.11	0	0	5.67
CRISIS	0.48	0.50	0	0	1
GDP GROWTH	1.71	2.71	-4.45	3.02	4.11
CHANGE IN 3-MONTH INTEREST RATE	-0.28	1.53	-4.38	0.09	1.41
INFLATION	2.68	1.56	-1.37	2.92	5.27
Good Times (2002:02-2007:07)	Number of Observations = 220,275				
LOAN APPLICATION IS GRANTED	0.39	0.49	0	0	1
BANK LN(TOTAL ASSETS)	17.27	1.45	9.60	17.40	19.71
BANK CAPITAL RATIO	5.47	2.20	0.00	4.91	63.10
BANK LIQUIDITY RATIO	17.14	8.10	0.03	15.40	92.07
BANK DOUBTFUL LOANS RATIO	0.73	0.66	0	0.54	28.33
BANK CONCENTRATION IN AN INDUSTRY	27.26	9.40	13.20	24.01	87.94
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.32	1.01	0	0	5.56
GDP GROWTH	3.56	0.42	2.57	3.65	4.11
CHANGE IN 3-MONTH INTEREST RATE	0.28	0.81	-1.40	0.19	1.31
INFLATION	3.11	0.62	2.13	3.15	4.19
Crisis Times (2007:08-2010:06)	Number of Observations = 207,089				
LOAN APPLICATION IS GRANTED	0.30	0.46	0	0	1
BANK LN(TOTAL ASSETS)	17.71	1.46	9.94	17.87	19.94
BANK CAPITAL RATIO	5.39	1.84	0.00	4.91	87.17
BANK LIQUIDITY RATIO	12.51	6.02	0.53	11.74	90.76
BANK DOUBTFUL LOANS RATIO	2.71	2.27	0	2.23	58.61
BANK CONCENTRATION IN AN INDUSTRY	28.58	8.15	13.65	26.89	100
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.44	1.21	0	0	5.67
GDP GROWTH	-0.27	2.73	-4.45	-0.49	3.58
CHANGE IN 3-MONTH INTEREST RATE	-0.87	1.86	-4.38	-0.50	1.41
INFLATION	2.22	2.05	-1.37	1.77	5.27

Table 2
The bank balance-sheet channel during good times (2002:02-2007:07) using all loan applications

	(1)	(2)	(3)	(4)
BANK LN(TOTAL ASSETS)	-3.61 ***	-1.74	-0.60	-0.27
	(1.38)	(1.76)	(1.85)	(1.74)
BANK CAPITAL RATIO	-0.10	-0.06	0.07	0.30
	(0.30)	(0.33)	(0.27)	(0.27)
BANK LIQUIDITY RATIO	-0.11	-0.15	-0.17 *	-0.13
	(0.13)	(0.13)	(0.10)	(0.08)
BANK DOUBTFUL LOANS RATIO	-0.22	-0.20	0.18	0.24
	(0.68)	(0.68)	(0.61)	(0.54)
BANK CONCENTRATION IN AN INDUSTRY	-0.14 **	-0.13 *	-0.14 **	-0.15 ***
	(0.07)	(0.08)	(0.06)	(0.06)
LN(1+NUMBER OF MONTHS WITH THE BANK)	1.21 ***	1.22 ***	0.99 ***	1.10 ***
	(0.16)	(0.16)	(0.20)	(0.19)
GDP GROWTH	2.92 ***			
	(1.05)			
CHANGE IN 3-MONTH INTEREST RATE	-0.13			
	(0.55)			
INFLATION	0.25			
	(0.21)			
Fixed Effects				
Bank	*Yes*	*Yes*	*Yes*	*Yes*
Time	*No*	*Yes*	*Yes*	-
Firm	*No*	*No*	*Yes*	-
*Firm*Time*	*No*	*No*	*No*	*Yes*
Number of Observations	220,275	220,275	220,275	220,275
The Impact of a One Standard Deviation Change in the Independent Variable on the Probabiltiy a LOAN APPLICATION IS GRANTED at the Mean, in Percent				
BANK LN(TOTAL ASSETS)	*-13.3*	*-6.4*	*-2.2*	*-1.0*
BANK CAPITAL RATIO	*-0.6*	*-0.4*	*0.4*	*1.7*
BANK LIQUIDITY RATIO	*-2.3*	*-3.1*	*-3.6*	*-2.7*
BANK DOUBTFUL LOANS RATIO	*-0.4*	*-0.3*	*0.3*	*0.4*
BANK CONCENTRATION IN AN INDUSTRY	*-3.3*	*-3.0*	*-3.3*	*-3.7*
LN(1+NUMBER OF MONTHS WITH THE BANK)	*3.1*	*3.1*	*2.5*	*2.8*

Notes: The table reports the estimated coefficients and robust standard errors (S.E.) in percent clustered at the bank and firm level from linear probability models estimated using least squares. The dependent variable is LOAN APPLICATION IS GRANTED. Fixed effects are included ("Yes"), not included ("No"), or comprised by the included set of fixed effects ("-"). The set of time fixed effects includes a fixed effect for every (but one) year:month during the sample period. The variable definitions and summary statistics are in Table 1. ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.

Table 3
The bank balance-sheet channel during good (2002:02-2007:07) and crisis times (2007:08-2010:06) using all loan applications

	(1)	(2)	(3)	(4)
BANK LN(TOTAL ASSETS)	0.23	0.04	-0.11	-0.10
	(2.20)	(3.49)	(2.85)	(2.19)
BANK CAPITAL RATIO	-0.30	-0.44	0.15	-0.02
	(0.38)	(0.41)	(0.34)	(0.31)
BANK LIQUIDITY RATIO	-0.08	-0.08	-0.02	-0.04
	(0.11)	(0.11)	(0.08)	(0.07)
BANK DOUBTFUL LOANS RATIO	0.26	0.15	-0.73 ***	0.35
	(0.72)	(0.73)	(0.22)	(0.46)
BANK CONCENTRATION IN AN INDUSTRY	-0.09	-0.11	-0.08	-0.09
	(0.08)	(0.09)	(0.07)	(0.05)
LN(1+NUMBER OF MONTHS WITH THE BANK)	1.22 ***	1.23 ***	0.86 ***	1.11 ***
	(0.18)	(0.17)	(0.15)	(0.19)
CRISIS	-22.23 ***			
	(7.64)			
CRISIS * BANK LN(TOTAL ASSETS)	0.75 **	0.70 **	0.01	0.66 ***
	(0.32)	(0.31)	(0.07)	(0.24)
CRISIS * BANK CAPITAL RATIO	0.99 ***	0.95 ***	0.32 ***	0.95 ***
	(0.24)	(0.26)	(0.10)	(0.17)
CRISIS * BANK LIQUIDITY RATIO	0.13	0.10	0.05	0.06
	(0.12)	(0.12)	(0.06)	(0.07)
CRISIS * BANK DOUBTFUL LOANS RATIO	-0.60	-0.76	-0.12	-1.03 **
	(0.75)	(0.78)	(0.12)	(0.47)
CRISIS * BANK CONCENTRATION IN AN INDUSTRY	-0.07	-0.07	-0.08 **	-0.07
	(0.08)	(0.08)	(0.03)	(0.05)
CRISIS * LN(1+NUMBER OF MONTHS WITH THE BANK)	0.14	0.13	0.07	-0.16
	(0.16)	(0.16)	(0.13)	(0.22)
GDP GROWTH	1.84 ***			
	(0.37)			
CHANGE IN 3-MONTH INTEREST RATE	-1.18 **			
	(0.51)			
INFLATION	-0.46 **			
	(0.20)			
Fixed Effects				
Bank	*Yes*	*Yes*	*Yes*	*Yes*
Time	*No*	*Yes*	*Yes*	-
Firm	*No*	*No*	*Yes*	-
*Firm*Time*	*No*	*No*	*No*	*Yes*
Number of Observations	427,364	427,364	427,364	427,364
The Impact of a One Standard Deviation Change in the Independent Variable for CRISIS=1 on the Probability a LOAN APPLICATION IS GRANTED at the Mean, in Percent				
BANK LN(TOTAL ASSETS)	*0.9*	*0.2*	*-0.4*	*-0.4*
BANK CAPITAL RATIO	*-1.7*	*-2.4*	*0.8*	*-0.1*
BANK LIQUIDITY RATIO	*-1.7*	*-1.7*	*-0.5*	*-0.8*
BANK DOUBTFUL LOANS RATIO	*0.4*	*0.2*	*-1.2*	*0.6*
BANK CONCENTRATION IN AN INDUSTRY	*-2.2*	*-2.7*	*-1.9*	*-2.1*
LN(1+NUMBER OF MONTHS WITH THE BANK)	*3.1*	*3.1*	*2.2*	*2.8*
CRISIS * BANK LN(TOTAL ASSETS)	*3.7*	*3.4*	*0.1*	*3.2*
CRISIS * BANK CAPITAL RATIO	*6.1*	*5.9*	*2.0*	*5.9*
CRISIS * BANK LIQUIDITY RATIO	*2.6*	*2.1*	*1.0*	*1.2*
CRISIS * BANK DOUBTFUL LOANS RATIO	*-4.6*	*-5.8*	*-0.9*	*-7.9*
CRISIS * BANK CONCENTRATION IN AN INDUSTRY	*-1.9*	*-1.9*	*-2.1*	*-2.0*
CRISIS * LN(1+NUMBER OF MONTHS WITH THE BANK)	*0.6*	*0.5*	*0.3*	*-0.7*

Notes: The table reports the estimated coefficients and robust standard errors (S.E.) in percent clustered at the bank and firm level from linear probability models estimated using least squares. The dependent variable is LOAN APPLICATION IS GRANTED. Fixed effects are included ("Yes"), not included ("No"), or comprised by the included set of fixed effects ("-"). The set of time fixed effects includes a fixed effect for every (but one) year:month during the sample period. The variable definitions and summary statistics are in Table 1. ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.

Table 4

Variable definitions and descriptive statistics for the loan applications that are also matched with firm balance sheet data

Firm Variable Names	Variable Definition
FIRM LN(TOTAL ASSETS)	The log of total assets of the firm, in thousands of Euros
FIRM CAPITAL RATIO	The log ratio of firm own funds over total assets of the firm
FIRM LIQUIDITY RATIO	The ratio of current assets over the total assets of the firm, in percent
FIRM SUBPRIME	A dummy variable which equals one if the firm was delinquent on a loan before and equals zero otherwise
FIRM LN(1+AGE)	The log of one plus the duration of the age of the firm, in years

Descriptive Statistics	Mean	St. Dev.	Minimum	Median	Maximum
Whole Period (2002:02-2010:06)	Number of Observations = 198,350				
LOAN APPLICATION IS GRANTED	0.34	0.48	0	0	1
BANK LN(TOTAL ASSETS)	17.46	1.44	9.60	17.59	19.94
BANK CAPITAL RATIO	5.39	2.06	0.00	4.87	63.10
BANK LIQUIDITY RATIO	15.13	7.73	0.03	14.15	92.07
BANK DOUBTFUL LOANS RATIO	1.75	1.96	0	0.85	28.33
BANK CONCENTRATION IN AN INDUSTRY	27.73	8.86	13.65	25.50	100
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.55	1.31	0	0	5.67
FIRM LN(TOTAL ASSETS)	7.70	1.68	1.45	7.65	15.82
FIRM CAPITAL RATIO	2.70	1.11	-5.12	2.88	4.61
FIRM LIQUIDITY RATIO	6.90	11.01	0	2.81	100
FIRM SUBPRIME	0.11	0.32	0	0	1
FIRM LN(1+AGE)	2.11	0.91	0	2.20	4.92
CRISIS	0.50	0.50	0	0	1
GDP GROWTH	1.58	2.76	-4.45	3.02	4.11
CHANGE IN 3-MONTH INTEREST RATE	-0.35	1.55	-4.38	0.06	1.41
INFLATION	2.63	1.59	-1.37	2.91	5.27
Good Times (2002:02-2007:07)	Number of Observations = 100,110				
LOAN APPLICATION IS GRANTED	0.39	0.49	0	0	1
BANK LN(TOTAL ASSETS)	17.26	1.42	9.60	17.39	19.71
BANK CAPITAL RATIO	5.44	2.28	0.00	4.90	63.10
BANK LIQUIDITY RATIO	17.68	8.30	0.03	15.82	92.07
BANK DOUBTFUL LOANS RATIO	0.72	0.64	0	0.54	28.33
BANK CONCENTRATION IN AN INDUSTRY	26.92	9.34	13.74	23.43	87.94
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.46	1.19	0	0	5.56
FIRM LN(TOTAL ASSETS)	7.65	1.72	1.48	7.59	15.06
FIRM CAPITAL RATIO	2.57	1.16	-5.12	2.75	4.61
FIRM LIQUIDITY RATIO	6.71	11.09	0	2.62	100
FIRM SUBPRIME	0.10	0.31	0	0	1
FIRM LN(1+AGE)	1.96	0.92	0	2.08	4.82
GDP GROWTH	3.54	0.43	2.57	3.64	4.11
CHANGE IN 3-MONTH INTEREST RATE	0.24	0.82	-1.40	0.11	1.31
INFLATION	3.12	0.62	2.13	3.15	4.19
Crisis Times (2007:08-2010:06)	Number of Observations = 98,240				
LOAN APPLICATION IS GRANTED	0.30	0.46	0	0	1
BANK LN(TOTAL ASSETS)	17.68	1.42	10.31	17.84	19.94
BANK CAPITAL RATIO	5.33	1.81	0.00	4.85	62.44
BANK LIQUIDITY RATIO	12.54	6.09	0.53	11.74	87.64
BANK DOUBTFUL LOANS RATIO	2.80	2.27	0	2.41	21.93
BANK CONCENTRATION IN AN INDUSTRY	28.55	8.26	13.65	27.00	100
LN(1+NUMBER OF MONTHS WITH THE BANK)	0.63	1.42	0	0	5.67
FIRM LN(TOTAL ASSETS)	7.74	1.63	1.45	7.70	15.82
FIRM CAPITAL RATIO	2.84	1.04	-4.26	3.01	4.60
FIRM LIQUIDITY RATIO	7.09	10.92	0	3.02	100
FIRM SUBPRIME	0.12	0.33	0	0	1
FIRM LN(1+AGE)	2.26	0.88	0	2.40	4.92
GDP GROWTH	-0.42	2.70	-4.45	-0.86	3.58
CHANGE IN 3-MONTH INTEREST RATE	-0.95	1.85	-4.38	-0.60	1.41
INFLATION	2.14	2.05	-1.37	1.77	5.27

Table 5

The bank and firm balance-sheet channels during good times (2002:02-2007:07) using the loan applications that are also matched with firm balance sheet data

	(1)	(2)	(3)	(4)
BANK LN(TOTAL ASSETS)	-4.45 ***	-2.12	-1.31	
	(1.60)	(2.19)	(2.58)	
BANK CAPITAL RATIO	-0.21	-0.24	-0.20	
	(0.27)	(0.28)	(0.35)	
BANK LIQUIDITY RATIO	-0.09	-0.14	-0.18 *	
	(0.14)	(0.14)	(0.10)	
BANK DOUBTFUL LOANS RATIO	0.13	0.32	0.82	
	(0.81)	(0.85)	(0.85)	
BANK CONCENTRATION IN AN INDUSTRY	-0.07	-0.07	-0.10	
	(0.08)	(0.09)	(0.09)	
LN(1+NUMBER OF MONTHS WITH THE BANK)	1.93 ***	1.95 ***	0.80 ***	0.78 ***
	(0.17)	(0.17)	(0.20)	(0.23)
FIRM LN(TOTAL ASSETS)	-1.32 ***	-1.33 ***	-1.68 *	-1.69
	(0.31)	(0.31)	(0.95)	(1.14)
FIRM CAPITAL RATIO	-0.96 ***	-0.94 ***	2.65 ***	2.56 ***
	(0.22)	(0.22)	(0.62)	(0.87)
FIRM LIQUIDITY RATIO	-0.01	-0.01	0.02	0.03
	(0.02)	(0.02)	(0.06)	(0.08)
FIRM SUBPRIME	-0.47	-0.41	-7.28 *	-6.93 *
	(0.59)	(0.59)	(3.75)	(4.01)
FIRM LN(1+AGE)	-1.10 ***	-1.09 ***	-3.67 *	-2.64
	(0.35)	(0.36)	(2.22)	(3.02)
GDP GROWTH	3.46 **			
	(1.35)			
CHANGE IN 3-MONTH INTEREST RATE	-0.35			
	(0.68)			
INFLATION	0.02			
	(0.31)			
Fixed Effects				
Bank	*Yes*	*Yes*	*Yes*	-
Time	*No*	*Yes*	*Yes*	-
Firm	*No*	*No*	*Yes*	*Yes*
*Bank*Time*	*No*	*No*	*No*	*Yes*
Number of Observations	100,110	100,110	100,110	100,110
The Impact of a One Standard Deviation Change in the Independent Variable on the Probability a LOAN APPLICATION IS GRANTED at the Mean, in Percent				
BANK LN(TOTAL ASSETS)	*-16.2*	*-7.7*	*-4.8*	
BANK CAPITAL RATIO	*-1.2*	*-1.4*	*-1.2*	
BANK LIQUIDITY RATIO	*-1.9*	*-2.9*	*-3.9*	
BANK DOUBTFUL LOANS RATIO	*0.2*	*0.5*	*1.3*	
BANK CONCENTRATION IN AN INDUSTRY	*-1.7*	*-1.6*	*-2.3*	
LN(1+NUMBER OF MONTHS WITH THE BANK)	*5.9*	*6.0*	*2.4*	*2.4*
FIRM LN(TOTAL ASSETS)	*-5.8*	*-5.8*	*-7.4*	*-7.4*
FIRM CAPITAL RATIO	*-2.9*	*-2.8*	*7.9*	*7.6*
FIRM LIQUIDITY RATIO	*-0.3*	*-0.3*	*0.5*	*0.9*
FIRM SUBPRIME	*-0.4*	*-0.3*	*-5.7*	*-5.4*
FIRM LN(1+AGE)	*-2.6*	*-2.6*	*-8.6*	*-6.2*

Notes: The table reports the estimated coefficients and robust standard errors (S.E.) in percent clustered at the bank and firm level in models 1-3 and at the firm level in model 4 from linear probability models estimated using least squares. The dependent variable is LOAN APPLICATION IS GRANTED. Fixed effects are included ("Yes"), not included ("No"), or comprised by the included set of fixed effects ("-"). The set of time fixed effects includes a fixed effect for every (but one) year:month during the sample period. The variable definitions and summary statistics are in Table 1. ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.

Table 6

The bank and firm balance-sheet channels during good (2002:02-2007:07) and crisis times (2007:08-2010:06) using the loan applications that are also matched with firm balance sheet data

	(1)	(2)	(3)	(4)
BANK LN(TOTAL ASSETS)	-0.10	0.02	-0.26	
	(2.15)	(3.58)	(3.02)	
BANK CAPITAL RATIO	-0.42	-0.55	-0.52	
	(0.42)	(0.42)	(0.40)	
BANK LIQUIDITY RATIO	-0.05	-0.06	-0.07	
	(0.11)	(0.11)	(0.08)	
BANK DOUBTFUL LOANS RATIO	0.33	0.42	0.38	
	(0.69)	(0.70)	(0.62)	
BANK CONCENTRATION IN AN INDUSTRY	-0.05	-0.08	-0.03	
	(0.09)	(0.10)	(0.08)	
LN(1+NUMBER OF MONTHS WITH THE BANK)	1.92 ***	1.94 ***	0.84 ***	0.86 ***
	(0.18)	(0.17)	(0.22)	(0.21)
FIRM LN(TOTAL ASSETS)	-1.35 ***	-1.35 ***	-2.65 ***	-2.79 ***
	(0.31)	(0.31)	(0.67)	(0.86)
FIRM CAPITAL RATIO	-0.98 ***	-0.95 ***	1.47 ***	1.51 **
	(0.22)	(0.22)	(0.51)	(0.66)
FIRM LIQUIDITY RATIO	-0.01	-0.01	-0.03	-0.03
	(0.02)	(0.02)	(0.04)	(0.06)
FIRM SUBPRIME	-0.45	-0.38	-4.88 **	-4.56 **
	(0.58)	(0.58)	(1.95)	(2.27)
FIRM LN(1+AGE)	-1.05 ***	-1.04 ***	-0.94	0.23
	(0.36)	(0.36)	(1.81)	(2.26)
CRISIS	-37.01 ***			
	(8.81)			
CRISIS * BANK LN(TOTAL ASSETS)	1.15 ***	1.10 ***	1.13 ***	
	(0.38)	(0.38)	(0.34)	
CRISIS * BANK CAPITAL RATIO	1.21 ***	1.20 ***	1.14 ***	
	(0.29)	(0.31)	(0.23)	
CRISIS * BANK LIQUIDITY RATIO	0.17	0.15	0.17 *	
	(0.13)	(0.13)	(0.09)	
CRISIS * BANK DOUBTFUL LOANS RATIO	-0.72	-0.94	-0.91	
	(0.70)	(0.73)	(0.61)	
CRISIS * BANK CONCENTRATION IN AN INDUSTRY	-0.06	-0.06	-0.10 *	
	(0.09)	(0.08)	(0.06)	
CRISIS * LN(1+NUMBER OF MONTHS WITH THE BANK)	-0.19	-0.21	-0.06	-0.13
	(0.20)	(0.19)	(0.25)	(0.27)
CRISIS * FIRM LN(TOTAL ASSETS)	-0.11	-0.11	-0.50	-0.38
	(0.32)	(0.32)	(0.41)	(0.41)
CRISIS * FIRM CAPITAL RATIO	0.97 ***	0.95 ***	2.60 ***	2.40 ***
	(0.33)	(0.32)	(0.49)	(0.60)
CRISIS * FIRM LIQUIDITY RATIO	0.00	0.00	-0.01	-0.01
	(0.02)	(0.02)	(0.06)	(0.07)
CRISIS * FIRM SUBPRIME	-0.49	-0.65	0.23	0.08
	(0.68)	(0.68)	(1.32)	(1.62)
CRISIS * FIRM LN(1+AGE)	2.20 ***	2.21 ***	1.69 **	1.86 **
	(0.37)	(0.37)	(0.71)	(0.85)
GDP GROWTH	1.74 ***			
	(0.48)			
CHANGE IN 3-MONTH INTEREST RATE	-1.04 *			
	(0.56)			
INFLATION	-0.39			
	(0.27)			
Fixed Effects				
Bank	*Yes*	*Yes*	*Yes*	-
Time	*No*	*Yes*	*Yes*	-
Firm	*No*	*No*	*Yes*	*Yes*
*Bank*Time*	*No*	*No*	*No*	*Yes*
Number of Observations	198,350	198,350	198,350	198,350
The Impact of a One Standard Deviation Change in the Independent Variable for CRISIS=1 on the Probability a LOAN APPLICATION IS GRANTED at the Mean, in Percent				
BANK LN(TOTAL ASSETS)	*-0.4*	*0.1*	*-0.9*	
BANK CAPITAL RATIO	*-2.5*	*-3.2*	*-3.0*	
BANK LIQUIDITY RATIO	*-1.1*	*-1.3*	*-1.5*	
BANK DOUBTFUL LOANS RATIO	*0.5*	*0.7*	*0.6*	
BANK CONCENTRATION IN AN INDUSTRY	*-1.2*	*-2.0*	*-0.7*	
LN(1+NUMBER OF MONTHS WITH THE BANK)	*5.9*	*5.9*	*2.6*	*2.6*
FIRM LN(TOTAL ASSETS)	*-5.9*	*-5.9*	*-11.6*	*-12.2*
FIRM CAPITAL RATIO	*-2.9*	*-2.8*	*4.4*	*4.5*
FIRM LIQUIDITY RATIO	*-0.2*	*-0.2*	*-0.9*	*-0.7*
FIRM SUBPRIME	*-0.3*	*-0.3*	*-3.8*	*-3.6*
FIRM LN(1+AGE)	*-2.5*	*-2.4*	*-2.2*	*0.5*
CRISIS * BANK LN(TOTAL ASSETS)	*5.5*	*5.2*	*5.4*	
CRISIS * BANK CAPITAL RATIO	*7.4*	*7.4*	*7.0*	
CRISIS * BANK LIQUIDITY RATIO	*3.5*	*3.1*	*3.5*	
CRISIS * BANK DOUBTFUL LOANS RATIO	*-5.5*	*-7.2*	*-7.0*	
CRISIS * BANK CONCENTRATION IN AN INDUSTRY	*-1.6*	*-1.7*	*-2.9*	
CRISIS * LN(1+NUMBER OF MONTHS WITH THE BANK)	*-0.9*	*-1.0*	*-0.3*	*-0.6*
CRISIS * FIRM LN(TOTAL ASSETS)	*-0.6*	*-0.6*	*-2.8*	*-2.1*
CRISIS * FIRM CAPITAL RATIO	*3.4*	*3.3*	*9.1*	*8.4*
CRISIS * FIRM LIQUIDITY RATIO	*0.1*	*0.1*	*-0.4*	*-0.5*
CRISIS * FIRM SUBPRIME	*-0.6*	*-0.7*	*0.3*	*0.1*
CRISIS * FIRM LN(1+AGE)	*6.6*	*6.6*	*5.0*	*5.5*

Notes: The table reports the estimated coefficients and robust standard errors (S.E.) in percent clustered at the bank and firm level in models 1-3 and at the firm level in model 4 from linear probability models estimated using least squares. The dependent variable is LOAN APPLICATION IS GRANTED. Fixed effects are included ("Yes"), not included ("No"), or comprised by the included set of fixed effects ("-"). The set of time fixed effects includes a fixed effect for every (but one) year:month during the sample period. The variable definitions and summary statistics are in Table 1. ***, **, and * indicates statistical significant at the 1, 5, and 10 percent level, respectively.