Fourth BI-CEPR Conference on Money, Banking and Finance

CORPORATE GOVERNANCE, CAPITAL STRUCTURE AND FIRM PERFORMANCE

Rome, 2-3 October 2009

Credit Availability. Identifying Balance-Sheet Channels with Loan Applications

***José Luis Peydro-Alcalde,Gabriel Jimenez, Steven Ongena and Jesús Saurina**

CEPR is grateful to the following institution for their financial and organizational support: Banca d'Italia

Credit Availability.

Identifying Balance-Sheet Channels with Loan Applications*

Gabriel Jiménez
Banco de España

PO Box 28014, Alcalá 48, Madrid, Spain
Telephone: +34 91 3385710, Fax: +34 91 3386102
E-mail: gabriel.jimenez@bde.es

Steven Ongena
CentER - Tilburg University and *CEPR*

PO Box 90153, NL 5000 LE Tilburg, The Netherlands
Telephone: +31 13 4662417, Fax: +31 13 4662875
E-mail: steven.ongena@tilburguniversity.nl

José-Luis Peydró
European Central Bank

Kaiserstrasse 29, D 60311 Frankfurt am Main, Germany
Telephone: +49 69 13445613, Fax: +49 69 13448552
Email: jose.peydro@gmail.com and jose-luis.peydro-alcalde@ecb.europa.eu

Jesús Saurina
Banco de España

PO Box 28014, Alcalá 48, Madrid, Spain
Telephone: +34 91 3385080, Fax: +34 91 3386102
E-mail: jsaurina@bde.es

This Draft: September 2009

* We thank Andrés Almazán, Jørn I. Halvorsen, Philipp Hartmann, Manfred Kremer, Huw Pill, Jörg Rocholl, João Santos, and participants at the European Finance Association Meeting (Bergen), European Economic Association Meeting (Barcelona), HKUST-CK-IRoF Conference on Global Market Integration and Financial Crises (Hong Kong), and the ESMT (Berlin) for valuable comments. Ongena acknowledges the hospitality of the European Central Bank and the Swiss National Bank while writing this paper. Any views expressed are only those of the authors and should not be attributed to the *Banco de España*, the European Central Bank or the Eurosystem.

Abstract

To identify credit availability we analyze loan applications made during the last seven years in Spain, a bank-dominated country experiencing exogenous economic and monetary changes. Matching the applications with complete firm and bank information, we find robust evidence that both adverse economic and tight monetary conditions reduce loan granting, especially to weak firms or from weak banks (i.e., with lower capital- and liquidity-to-total-assets ratios). Responding to the *same* borrower's loan applications, weak banks less likely grant a loan. Analyzing *all* granted loans for the last seventeen years we ascertain that firms cannot offset the restrictions by turning to other banks.

Keywords: firm borrowing capacity, credit supply, business cycle, monetary policy, financial accelerator, credit channel, credit crunch, capital crunch, net worth, capital, liquidity.

JEL: E32, E44, E5, G21, G28.

Summary

We analyze a uniquely comprehensive micro-dataset that contains monthly information from 2002:M2 to 2008:M12 on firms' loan applications. We match the loan applications database with *both* firm and bank identity and balance-sheet data, including precise capital- and liquidity-to-total-assets ratios which proxy for net worth and balance-sheet strength in general. This database, therefore, helps us to distinguish the firm and bank balance-sheet channels since we can condition on the loan demand (applications) received by banks and check whether the absolute and relative importance of the bank and firm balance-sheet strength for credit availability. The dataset is from Spain, a bank-dominated country with pronounced business cycles and a fairly exogenous monetary policy, further enabling us to disentangle GDP growth from monetary policy effects.

We find four robust results: (1) Lower GDP growth or larger increases in the short-term interest rate decrease the probability that a loan application results in a loan granted. (2) A decrease in firm capital decreases the probability that a loan application results in a loan granted. (3) A decrease in bank capital or liquidity increases the probability that a loan application results in a loan granted. (4) More importantly, the negative effect of lower GDP growth or higher short-term interest rates on credit availability is stronger for both firms with low capital or liquidity and (independently) for banks with low capital or liquidity. Both the business cycle and monetary policy effects work strongly through the bank balance-sheet channel, while the level of firm capital plays a substantial role in channeling changes in GDP growth to changes in loan granting.

In addition, within the set of different applications for a loan *from the same firm in the same month* to different banks (i.e., keeping constant the quality of potential borrowers), we find that banks with low capital or liquidity grant fewer loans when GDP growth is lower or short-term interest rates are higher. Therefore, our results suggest that *under tight conditions a capital or liquidity crunch begets a credit crunch*.

Using a larger database of *all* loans granted by all banks operating in Spain for the last seventeen years matched with complete firm and bank characteristics, we show that weak firms also obtain fewer loans when economic and monetary conditions are tight. Hence, loan supply restrictions are binding and cannot be offset by firms turning to other banks. All in all, the loan application dataset allows us to better disentangle loan demand and supply and, thus, allows us to draw conclusions that are relevant for the current financial crisis. In particular, our estimates have direct bearing on the effects of the developing capital and credit crunches and on the usefulness of monetary policy, recapitalizations and liquidity injections in banks and firms to ameliorate credit supply conditions.

I. Introduction

The dramatic events unfolding in the global economy during the last two years have again highlighted the key role played by firm and bank balance sheets in determining the supply of credit. Observers and policy makers alike recurrently worry about the deleterious effects of the weakening in firm and bank balance sheets for the availability of credit. Many recapitalizations and liquidity injections later, and after an exceptionally expansionary monetary policy period, it is still unclear whether the unprecedented policies pursued by all major central banks and governments around the world have been adequate to avert a full-blown credit crunch.[1]

But do adverse economic conditions and contractive monetary policy reduce both firm borrowing capacity and bank loan supply? And does this loan reduction depend equally on firm versus bank balance-sheet strength?[2] That is, do agency problems between firms and banks and between banks and their financiers – proxied by both firm and bank capital- and liquidity-to-total-assets ratios as in Holmstrom and Tirole (1997) and Diamond and Rajan (2009) for example – make lending significantly more problematic during economic downturns or monetary contraction periods?

To convincingly answer these questions three major identification challenges need to be addressed. First, the supply of credit needs to be disentangled from its demand. Low economic growth and tight monetary conditions may lower both loan demand and supply. Demand may

---

[1] Bernanke and Lown (1991) define a credit crunch as "a significant leftward shift in the supply curve for loans, holding constant both the safe real interest rate and the quality of potential borrowers." They further relate a credit crunch to a capital crunch and provide empirical evidence on the US economic crisis in the early 1990s (see also Peek and Rosengren (1995)). Chari, Christiano and Kehoe (2008), Cohen-Cole, Duygan-Bump, Fillat and Montoriol-Garriga (2008), de Haas and van Horen (2009), Huang (2009), Ivashina and Scharfstein (2009), Puri, Rocholl and Steffen (2009), Santos (2009), and Tong and Wei (2009) provide related evidence from the recent crisis.

[2] See Stiglitz and Weiss (1981), Bernanke, Gertler and Gilchrist (1996), Kiyotaki and Moore (1997), Stein (1998), Bernanke, Gertler and Gilchrist (1999), Diamond and Rajan (2006), Matsuyama (2007), and Bernanke (2007), among others.

fall because the expectations for investment are depressed and the cost of financing is high. Supply may contract because – as already indicated – the agency costs of lending may increase. Second, borrowers may be both balance-sheet constrained and bank-dependent (Gertler and Gilchrist (1994)), and weak firms with low-quality balance sheets may borrow more from weak banks. Hence, any analysis based only on firm (or bank) level data suffers from an omitted-variables problem. Moreover, firm and bank balance-sheet channels may be interrelated as tight monetary conditions for example may decrease borrower net worth, which may have a negative impact on bank net worth. Estimating both channels simultaneously is therefore essential, and this requires an analysis at the *individual loan level* of contract information matched with *both* firm and bank characteristics. Third, if country business cycle conditions completely determine short-term interest rate changes, which is the case in many countries (through for example a Taylor (1993)-rule setting), separating the effects of monetary conditions from those of economic activity is problematic.

Our main contribution to the literature consists in meeting these three identification challenges. In particular, we analyze the effects of economic activity and monetary conditions on the availability of credit based on individual loan applications (demand) and accounting simultaneously for the strength of the firm and bank balance sheets. While we cannot identify for each possible level of firm quality what each bank wants to supply (i.e., in terms of quantity, price, and other non-price terms), we can observe the loans actually supplied by each bank in response to the set of firm loan applications it receives, and we can relate this supply of loans to the firm and bank balance-sheet strength.

The empirical micro literature (we review later) was confined by the unavailability of comprehensive loan-level data and has mainly addressed these questions at the firm or bank level. We, instead, use a rich and comprehensive dataset of bank loan applications and loans granted, matched with extensive firm and bank identity and accounting information, from a

country where most firms are bank dependent and where monetary policy has been fairly exogenous.

The *Credit Register* of the *Banco de España* (CIR) has recorded during the last seven years all monthly information requests by banks following loan applications from firms that are currently not borrowing from them. In total there are more than 2,350,000 information requests on record. This is a unique dataset we use to better disentangle loan demand and supply.

Moreover, the CIR database also contains detailed monthly information on all, new and outstanding, loans (over 6,000 Euros) to non-financial firms granted by all credit institutions operating in Spain during the last seventeen years. We use this information to perform further robustness tests: The more than fifty million granted loans on record avert any concerns about unobserved changes in bank lending and will further be used to deal with the non-randomness in bank information requests.

Finally, the CIR contains loan conditions and tracks key firm and bank characteristics, including identity. Therefore, both datasets can be augmented with complete accounting information – including accurate measures of capital and liquidity – that are recorded monthly for banks and yearly for firms.

The resultant richness of the data allows us to meet the three identification challenges. First, to separate bank loan supply from demand we rely on the loan-application stage information, i.e., we study the received loan applications from the borrowers and we analyze whether economic and monetary conditions and firm and bank balance-sheet strength affect the loan granting probability. In addition, we also employ theoretically motivated interactions between economic and monetary conditions on the one hand and balance-sheet strength variables on the other (Bernanke, Gertler and Gilchrist (1996), Kashyap and Stein (2000)). Our precise capital- and liquidity-to-total-assets ratios – for both firms and banks – closely follow the

theoretical literature that attributes a prominent role to net worth and balance-sheet strength in general. The correspondence with the theoretical models sharpens the interpretation of the interactions of economic and monetary conditions with these ratios that further serve to identify supply.

Second, to disentangle firm and bank balance-sheet channels we study micro-data (as strongly advocated by Kashyap, Stein and Wilcox (1996)) but at *the individual loan level* and matched with *both* complete firm and bank information. In addition, not only do we control for both firm and bank variables, but also exploit all relevant interactions.

To tackle the first and second identification challenges jointly, we further focus on the set of multiple loan applications that are made in one month by the same borrower to multiple banks of varying balance-sheet strengths. Within such a set of loan applications, for which the quality of potential borrowers is constant as in the definition by Bernanke and Lown (1991), we study how bank capital and liquidity affect the granting of loans.

Third, to distinguish between the impact of real activity and monetary conditions, we rely on the observation that monetary policy in Spain has been fairly exogenous during the last twenty years. It was basically "set in Frankfurt", first by the *Bundesbank* and then by the European Central Bank. Their mandates focused on price stability and the correlation of GDP growth between Germany (Euro Area) and Spain has never been strong. Moreover, the recession that is taking place during the sample period was partially triggered and/or worsened by financial and economic conditions from abroad.

We analyze this uniquely comprehensive dataset from a bank-dominated country with a fairly exogenous monetary policy and find four robust results: (1) Lower GDP growth or larger short-term interest rate hikes reduce the probability that a loan application results in a loan granted. (2) A decrease in firm capital decreases the probability that a loan application is granted, but firm liquidity does not matter. (3) A decrease in bank capital or liquidity has a

positive effect on the probability that a loan application is granted. (4) More importantly, the negative effect of lower GDP growth or higher short-term interest rate on the probability that a loan application is granted is (statistically) stronger both for firms with low capital or liquidity and (independently) from banks with low capital or liquidity. Firm capital plays an economically relevant role when channeling changes in GDP growth to loan granting. Bank capital and liquidity matter in the case of both GDP growth and changes in the short-term interest rate for the probability that an individual loan application is granted, and whether any loans were observably granted.

All findings are robust to the inclusion of firm, bank and month fixed effects in different combinations. *Within* all the loan applications received by a bank in a month we find that firms with low capital or liquidity are less likely to get a loan when GDP growth is lower or short-term interest rate changes are higher.

Within the set of applications made in the same month by the same firm to different banks, and *within* the set of different applications made for the same granted loan, we find that banks with low capital or liquidity grant fewer loans when GDP growth is lower or short-term interest rate changes are higher. Our results, therefore, suggest that under tight economic or monetary conditions a bank capital or liquidity crunch begets a credit crunch (Bernanke and Lown (1991)). As far as we know, we are the first to identify and document in such a clear-cut way the occurrence of a credit crunch.

Finally, given that the bank information requests are not random (i.e., these requests follow loan applications by firms that are currently not borrowing from the bank) and because these requests were recorded only during the last seven years, we also analyze the records on *all* granted loans for the extended 1992 to 2008 period. This period comprises two economic recessions. We find that lower GDP growth or higher short-term interest rate increases *similarly* reduce both the probability that a firm with low capital or liquidity obtains new loans

and that a bank with low capital or liquidity grants new loans. These results, moreover, imply that weak firms not only face a higher likelihood of being rejected but also obtain fewer loans when economic and monetary conditions are tight. Hence, the loan supply restriction is binding and seemingly cannot be offset by firms turning to other banks.

Our sharpened identification of loan supply allows us to draw conclusions that are immediately relevant for the current financial crisis. In particular, our estimates have a direct bearing on the effects of the developing capital and credit crunches and on the usefulness of monetary policy, recapitalizations and liquidity injections in banks and firms to ameliorate supply conditions.

The rest of the paper proceeds as follows. Section II provides a brief review of the literature highlighting the testable hypotheses from theory and the identification challenges from the empirical studies. Section III presents the database and the empirical strategy. Section IV explains the data in detail, and presents and discusses the results. Section V concludes and discusses the policy implications.

II. Theory, Testable Hypotheses, and Empirical Work

This Section provides a brief review of the literature highlighting both the testable hypotheses from theory and the identification challenges present in the empirical studies (for an excellent pointed literature review see Bernanke (2007)).

A. Theory

In standard models of lending with asymmetric information and/or incomplete contracting, the external finance premium depends inversely on the borrowers' net worth (see Freixas and Rochet (2008) for a review). When borrowers have little wealth to contribute to the financing of their projects, the potential divergence of interests between the borrower and the suppliers

of external funds is larger, increasing agency costs. In equilibrium, lenders must be compensated. As borrower net worth is pro-cyclical (because profits and asset prices are pro-cyclical), the external finance premium is countercyclical, amplifying the changes in credit availability and thus in investment, spending, and production (Bernanke, Gertler and Gilchrist (1999), Matsuyama (2007)). In Holmstrom and Tirole (1997) the agency problems depend on the capital-to-total-assets ratio, in Bernanke, Gertler and Gilchrist (1999) net worth is also associated with the liquidity of the assets.

Since banks not only face agency problems with their borrowers (firms), but banks themselves are also borrowing funds from their depositors and other financiers, bank net worth may determine their own agency costs of borrowing (Bernanke (2007)). The capital-to-total-assets ratio of the bank determines its own stake and incentive to exert effort to monitor in Holmstrom and Tirole (1997). Hence, higher bank capital implies easier access to finance for banks thus allowing more lending to firms.

On the other hand, higher bank capital implies lower short-term debt for banks, tightening their hard-budget constraint and decreasing their ability to provide liquidity and hence credit (Diamond and Rajan (2000)). In addition, higher banks' net worth or charter value also makes a "gambling for resurrection" strategy – possibly involving excessive lending to riskier clients – less attractive (Kane (1989), Hellman, Murdock and Stiglitz (2000)). However – and especially during bad times – banks with less capital and more illiquid assets have an incentive to increase their capital and liquidity, and restrict lending due to their fear of liquidity shocks, their own needs for future liquidity, and/or the potential use of liquidity for buying distressed assets in the market (Diamond and Rajan (2009)).[3]

[3] During bad times lower bank capital constrains lending because: (1) Wholesale depositors and bank investors demand higher levels of capital as a buffer for losses and to reduce bank moral hazard problems, (2) bank incentives to monitor and screen new borrowers are lower, and (3) capital levels get closer to the regulatory limits. During normal times bank equity is considerably more expensive than bank short-term debt. During bad

Finally, higher levels of short-term interest rates reduce borrowers' net worth in turn worsening the agency problems between lenders and their borrowers (Bernanke and Gertler (1995)), both between firms and their banks, and also between banks and their financiers (Bernanke (2007)).[4]

B. Testable Hypotheses

Consequently, one can distinguish the effects of business cycle and monetary policy on credit availability depending on firm and bank-balance sheet strength, i.e., through the so-called firm and bank balance-sheet channels (the latter is also known as the bank lending channel). Given the agency costs on both sides of the bank, the sketched framework exhibits a "financial accelerator": Endogenous developments in credit markets work to propagate and amplify economic and monetary shocks to the macroeconomy.[5] In sum, the testable hypotheses based derived from the aforementioned theory are:

(1) Loan supply is reduced by lower GDP growth and/or higher short-term interest rates.

(2) Lower firm capital reduces firm borrowing capacity.

(3) Lower bank capital has an ambiguous effect on loan supply.

(4) The negative impact of lower GDP growth and/or higher short-term interest rates on loan supply is stronger for firms with low capital or liquidity, and for banks with low capital or liquidity.

---

times the situation worsens, hence it may not be optimal or feasible for bank shareholders to raise bank equity then. Banks with low levels of liquid assets similarly may try to increase their holdings of liquid assets during bad times, thus reducing new lending.

[4] Short-term interest rates may not only affect banks' incentives for lending but also for risk-taking (Jiménez, Ongena, Peydró and Saurina (2008), Ioannidou, Ongena and Peydró (2009)).

[5] See also Stiglitz and Weiss (1981), Bernanke (1983), Bernanke and Gertler (1989), Bernanke and Blinder (1988), Stein (1998), Stiglitz and Greenwald (2003) and Diamond and Rajan (2006).

C. Empirical Work

Due to the unavailability of comprehensive loan-level data, a large empirical literature mostly has investigated the firm and bank-balance sheet channels independently, with the analysis done at either the firm or the bank level. We briefly review this literature here.

Lang and Nakamura (1995) and Bernanke, Gertler and Gilchrist (1996) analyze changes in borrowing across firms in response to changes in business cycle and monetary conditions. Both studies use size as a proxy for borrower quality and find that output or monetary contractions result in more borrowing by higher-quality firms. Bernanke and Blinder (1992) focus on the bank side. They find that a monetary contraction is followed by a significant decline in aggregate bank lending.

To better control for loan demand, Kashyap and Stein (2000) analyze whether there are also important cross-sectional differences in the way that banks respond to monetary policy shocks. They find that, following a monetary contraction, small banks with liquid balance sheets cut their lending less than other small banks. Similarly, Kishan and Opiela (2000), Jayaratne and Morgan (2000), Ashcraft (2006) and Black, Hancock and Passmore (2009) examine the differentiation across bank capitalization, core deposits, bank holding company status and bank business strategies, respectively.[6]

However, as far as we are aware no paper has employed loan applications to investigate the effects of economic and monetary conditions through both the firm and bank-balance sheet channels simultaneously. This is potentially a problem if borrowers are balance-sheet

[6] Khwaja and Mian (2008) for example examine the drop in lending by different banks to similar firms following shocks to banks' liquidity that are induced by unanticipated nuclear tests in Pakistan. They find that in this context banks pass their liquidity shortages to firms. But large firms, i.e., those with strong business or political ties, can turn to alternative sources in the credit market. Small firms are unable to do so. See also Gan (2007).

constrained and bank-dependent (Gertler and Gilchrist (1994)), and weak banks with low-quality balance sheets lend more to weak firms.[7]

III. Data

In the previous two Sections we have discussed the three main identification challenges when analyzing whether – and through which channels – economic and monetary conditions affect loan supply. In this Section we discuss the data we will employ in our empirical work to address these identification challenges.

A. Loan Applications

All banks in Spain automatically receive monthly updated information on the total current credit exposures and (possible) loan defaults – vis-à-vis all other banks in Spain – of their own current borrowers. This information is extracted from the *Credit Register* of the *Banco de España* (CIR). Any bank can also request this information on potential borrowers, which are defined as "any firm that seriously approaches the bank to obtain credit". The monetary cost of requesting this information is zero. But a Law stipulates that a bank cannot ask for the information without consent by the potential borrower, indicating a seriousness of intent regarding the "financial relationship between bank and firm."

We observe *all* requests for information on potential borrowers between 2002:M02 and 2008:M12. Though the requests can be made at any time, they are collated monthly, pairing borrowers and banks. Requests for information on firms that are completely new to the CIR, i.e., firms that never borrowed from any bank reporting to the CIR, yield no information.

[7] Peek and Rosengren (2005) and Caballero, Hoshi and Kashyap (2008) for example argue that during the Japanese financial crisis banks with capital ratios closer to the minimum binding levels lent more to zombie firms. Hence, the quality of the banks' balance-sheets was positively correlated with the quality of the borrowing firms' balance-sheets.

Requests for information on firms that are currently borrowing from the requesting bank would yield information that is already known to this bank. In the same vein, requests for information on firms that were until very recently borrowing from the requesting bank would only update information. Consequently, requesting information from the CIR is especially useful if the firm has never before received a loan from the bank (that is requesting the information) or when the relationship between the firm and the bank ended a long time ago. Nevertheless, even for the former group one sixth of the loans are granted without any information request on record.[8]

Between 2002:M02 to 2008:M12 we observe more than 2,350,000 bank requests for information. For each request we also observe whether the loan is accepted and granted, or not. Therefore, if multiple banks request information on a particular borrower in the same month, we can infer the bank that granted the loan and the banks that did not (in contrast Brown, Kirschenmann and Ongena (2009) and Puri, Rocholl and Steffen (2009) observe a loan approval or denial for only one bank per application). In case a bank requests information but 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 a month to bank balance-sheet strength.

We match the application dataset with firm and bank datasets, so that we have balance-sheet information for each firm that applies for a loan and for each bank that receives a loan application and/or grants a loan. We can match more than 800,000 loan applications. As we

[8] This statistic shows that while the monetary cost of requesting the information is zero, other non-pecuniary costs may not be. An information request may slight borrowers (whose consent is required), involves waiting, uses management time processing the information, and/or may result in a loss of reputation vis-à-vis the *Banco de España* if prospects turn idle. Especially for the very good or connected borrowers that don't take a "check-and-wait" for an answer or during economic expansions when capacity constraints at the bank become binding these non- pecuniary costs may be relevant.

have the loan applications plus firm and bank characteristics, in particular their capital and liquidity ratios as measures of their balance sheet strength, we are able to better disentangle the demand from the supply of loans. Through the loan applications, loan demand for each bank is in a sense given and observable, and each bank has to decide only on the granting of each loan – "its loan supply" – knowing the firm characteristics. To absorb variation in loan demand and supply quality over the business and monetary policy cycles, we include a wide array of firm and bank characteristics, including their identity (fixed effect), capital, liquidity, assets, age, and profitability for example. As far as we are aware ours is the first paper that analyzes the impact of business cycle and monetary conditions on the probability of loans being granted following applications.

Then, as in Bernanke, Gertler and Gilchrist (1996) and Kashyap and Stein (2000), we exploit the cross-sectional implications of the sensitivity of credit availability to economic and monetary conditions according to the strength of the firm and bank balance sheets. Motivated by the theoretical literature we focus on net worth and liquidity. Because of lack of data, most other studies had to rely on size or debt as a proxy for net worth. Following Holmstrom and Tirole (1997) we define net worth – both for firms and for banks – as the capital-to-total-assets ratio.[9] Following Bernanke and Gertler (1995), Bernanke, Gertler and Gilchrist (1999), Bernanke (2007) and Diamond and Rajan (2009) we – again both for firms and for banks – feature a liquidity measure. The 100,000 firms and 200 banks active in the loan application dataset provide ample cross-sectional variation in both measures.

Weak banks likely lend to weak firms (Gertler and Gilchrist (1994)). This is indeed the case in Spain. For example, the median capital ratio of the banks lending to the lowest quartile of

[9] Off-balance sheet volumes are very small in Spain. Hence, total bank assets cover most of the banks' business. Banks did not develop conduits or Special Investment Vehicles (SIVs) because the prevailing accounting rules make banks consolidate these items and set aside adequate capital.

firms according to this ratio is 17 basis points lower than the median capital ratio for the banks lending to firms in the highest capital ratio quartile (5.57% versus 5.74% respectively). Disentangling the firm from the bank balance-sheet channel by assessing them simultaneously seems therefore imperative to avoid an omitted-variables problem.

We control for the quality of applicants by including firm fixed effects and, in some regressions, bank and month fixed effects. To identify loan supply contractions (Bernanke and Lown (1991)), we analyze the success of the loan applications made in the same month by the same firm to multiple banks that differ in capital and liquidity and within all loan applications received for the same loan by multiple banks. We also analyze variation within all loan applications received in the same month by the same bank to assess how firm capital and liquidity affects bank loan granting following changes in economic and monetary conditions.

B. All Loans Granted

We also analyze the records on *all* granted loans for the extended 1992:Q1 to 2008:Q4 period because: (1) Bank information requests are not random (i.e., these requests follow loan applications by firms that are currently not borrowing from the bank), (2) these requests are recorded for only seven years, and (3) firms may shift their applications between banks of different balance sheet strengths possibly neutralizing the supply effect measured with loan applications.

For these purposes, we employ the information in the CIR which contains confidential and very detailed information at the loan level on virtually *all* commercial and industrial (C&I) loans granted to all non-financial publicly limited and limited liability companies (that account for around 95% of all firms) by all commercial banks, savings banks and credit cooperatives (that account for more than 95% of the entire Spanish financial system) operating in Spain during a twenty-five year period. The CIR is *almost* comprehensive, as the reporting threshold

for a loan is only 6,000 Euros. This very low threshold, especially as we only consider C&I loans, alleviates any concerns about unobservable changes in bank credit to small and medium sized enterprises (which may be more influenced by changes in business cycle and monetary policy under the credit channel theory for example).[10]

We also match CIR compiled data at a quarterly frequency with complete firm and bank balance sheets. These are available at a yearly frequency starting in 1992 for firms and at a monthly frequency starting in 1984 for banks (as the *Banco de España* is the banking regulator and supervisor in Spain it enjoys privileged access to bank balance sheets). We further match the CIR with the loan application database to find out if the loan application was accepted or rejected.

C. Economic and Monetary Conditions

Separating the effects of economic activity from monetary conditions on bank lending is generally difficult as short-term interest rate changes are determined by the business cycle (as in a Taylor-rule setting for example). We start from the observation that monetary policy in Spain has been fairly exogenous during the last twenty years (see Banco de España (1997) and Jiménez, Ongena, Peydró and Saurina (2008)). Spain formally joined the European Monetary Mechanism in 1989, after joining the European Union in 1986. Monetary conditions consequently became basically "set in Frankfurt", first through the fixed exchange rate policy with the *Deutsche Mark* and as of January 1, 1999, within the Eurosystem.

---

[10] See e.g. Gertler and Gilchrist (1993), Gertler and Gilchrist (1994), Bernanke and Gertler (1995) and Bernanke, Gertler and Gilchrist (1996). The Credit Register contains more than 2,400,000 loans in the last month of 2008. Commercial and financial loans, i.e., the loans we study in this paper, represent 82.6% of the total loans that are granted (excluding leasing, factoring and other specialized loans). Incomplete coverage of the widely used U.S. (National) Survey of Small Business Finances or Loan Pricing Corporation datasets for example may complicate any analysis of bank credit provision.

In addition, GDP growth in Germany and Spain were only weakly synchronized during the last twenty years. During the period 2002-2005 for example short-term interest rates were low given the slow economic growth in Germany, Italy and France (the three larger euro area economies). But potentially these rates were less fitting Spain's much higher economic growth rates. Consequently, there is some exogenous variation in short-term interest rates allowing us to disentangle its effects from those of economic activity.

In addition, the current recession in Spain was partly initiated by the financial crisis abroad, providing a modicum of exogeneity to its start. The European Central Bank also did not decrease its policy rates as much as the Federal Reserve, partly because its main mandate is to ensure price stability. However, the current economic contraction in Spain is very severe. In less than two years time Spain's unemployment rate for example more than doubled, from eight to more than seventeen percent (2007:Q2 to 2009:Q1).

To complete our specifications we include inflation as an important economic determinant of short-term interest rates in all specifications. Robustness exercises feature month, bank-month and firm-month fixed effects to control for other macroeconomic factors.

IV. Dependent Variable, Independent Variables and Results

A. Main Dependent Variable: LOAN APPLICATION IS GRANTED

Table 1 defines the dependent and independent variables employed in the first set of empirical specifications (reported in Tables 2 to 3) as well as their descriptive statistics. The dependent variable we feature first 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 (results are unaffected if the loan is granted in *t* to *t+1* or in *t* to *t+2*). We also match each loan

application with its relevant firm and bank characteristics. In the main regressions we include firm fixed effects, naturally restricting the sample to firms that face at least one rejection and one approval during the sample period (with an average value equal to 43.0 percent, see Table 1). In robustness we will analyze all loan applications and the dependent variable then equals one for all firm – month combinations with one or more granted loans and equals zero otherwise.

[Table 1 around here]

B. Independent Variables

As independent variables we include an array of macroeconomic conditions and firm / bank characteristics to control for changes in the propensity during the business cycle of different type of firms to apply for loans to a potentially varying set of banks that request information and approve the loans.

1. Macroeconomic Conditions

As macroeconomic conditions we include annual GDP growth, a short-term interest rate measure of the annual changes in monetary policy conditions and the inflation rate. According to Hypothesis 1 we expect the coefficient on GDP growth to be positive and the coefficient on the interest rate to be negative.

GDP growth, ΔGDP, is available only quarterly, while both the interest rate changes and the inflation rate are measured monthly. Hence to be consistent with the other macroeconomic measures we interpolate GDP growth for all intermediary months (results are unaffected if we do not interpolate). Thus defined, GDP growth averages 3.1 percent and varies between -0.9 and 3.8 percent.

Our measure for the changes in monetary policy conditions, ΔIR, is the change in the Spanish 3-month interbank interest rate during the last year. The average change in the 3-month

interest rate during the sample period was 0.2 percent, ranging between -1.6 and 1.0 percent. The use of variations in the short-term interest rate as a measure of the stance of monetary policy is fully in line with the literature analyzing the credit channel at the micro level.[11] Our main results are unaffected if we employ the level rather than the changes in this interest rate. The use of a 3-month interest rate is in line with many articles in Kashyap, Mojon and Angeloni (2003) for example that also use European data. Using the changes in the overnight interbank interest rate yields very similar results, not surprisingly as the correlation between the two series equals 0.95. Finally, the average inflation rate, ΔCPI, during the sample period was 3.3 percent.

2. *Firm Characteristics*

The composition of the pool of borrowers may change over time and different firms may have different degrees of success in obtaining loans from banks. To control for these demand-side effects, we include a broad set of firm characteristics, in most specifications also firm fixed effects, in robustness replaced by all-encompassing firm-month and loan fixed effects. The summary statistics of Table 1 are based on the observations used in the regressions with firm fixed effects. All firm characteristics are taken at-the-end-of or over the previous year (*t-1*).[12]

The key firm balance-sheet variables are the CAPITAL RATIO measuring the firm's net worth and the LIQUIDITY RATIO capturing its liquidity position (to distinguish them clearly

---

[11] See Jayaratne and Morgan (2000), Kashyap and Stein (2000), Kishan and Opiela (2000), Ashcraft (2006) and Black, Hancock and Passmore (2009) among others. On the other hand, Bernanke and Blinder (1992) and Christiano, Eichenbaum and Evans (1996) use vector auto regressions to identify monetary policy shocks. But Kashyap and Stein (2000) find very similar results using either the variation in the federal funds rate, the Boschen and Mills (1995) index or the Bernanke and Mihov (1998) measure.

[12] We employ lagged values as economic and monetary conditions may determine the capital and liquidity ratios firms and banks optimally choose. In this paper we study how changes in economic and monetary conditions affect the availability of credit along these predetermined firm and bank capital and liquidity positions. In future work we also want to analyze how exogenously induced changes in capital and liquidity affect the availability of credit.

from their corresponding bank ratios in later exercises we add FIRM in their label). According to Hypothesis 2 we expect the sign of the coefficients of both variables to be positive. The capital ratio is defined as the ratio of own funds over total assets of the firm and has an average value of 22.5 percent. Given the skewness of its distribution we employ the natural logarithm of the ratio in all regressions, but assess its economic relevancy in levels. The liquidity ratio is the current assets over total assets of the firm. It has an average value of 6.7 percent.

As other firm characteristics we include controls for firm risk, in particular: Ln(TOTAL ASSETS), the log of the total assets of the firm in 2008 Euros; Ln(1+AGE), the log of one plus the age of the firm in years; ROA, the return on assets of the firm; I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST), a dummy variable that equals one if the firm had doubtful loans the previous months to the month before the loan was requested, and equals zero otherwise; I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST), a dummy variable that equals one if the firm had doubtful loans prior to the month the loan was requested, and equals zero otherwise; Ln(1+No. MONTHS WITH THE BANK), the log of one plus the number of months that the firm had a working relationship with the bank (i.e., has outstanding loans with the bank and/or obtains other banking services there); and Ln(1+NUMBER OF BANK RELATIONSHIPS), the log of the number of bank relationships of the firm.[13]

As an industry characteristic we include INDUSTRY DOUBTFUL LOANS RATIO, which is the doubtful loan ratio of the industry in which the firm operates and which controls for the probability of loan rejections over the business cycle in the industry of the firm. As a province characteristic we include Ln(No. BANKS) which is the log of the number of banks in the

[13] The maximum of firm assets indicates that banks either do not request information or do not grant regular loans to the largest firms in Spain.

province where the firm is located. Many firms borrow from local banks (Petersen and Rajan (2002), Degryse and Ongena (2005)) so this variable controls for the number of banks that a firm may approach. The variable also partially captures the intensity of local bank competition.

3. Bank Characteristics

Lending behavior may vary across banks, hence we control for bank variables that may affect bank lending and, for robustness, we also control for bank fixed effects. Key balance-sheet variables again include the bank's CAPITAL RATIO as a measure of the bank's net worth and the LIQUIDITY RATIO as a measure of its' liquidity position. The capital ratio is defined as the ratio of bank equity (core-capital) over total assets of the bank (as in Bernanke and Lown (1991) for example). Core-capital ratio is defined as total equity plus retained earnings over total assets. 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 5.4 percent. Unlike in the US there is no regulated minimum leverage ratio in Spain, hence its minimum equals zero. As with firm capital we take its natural logarithm but results are similar without this transformation. The 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 almost 17 percent of their balance-sheet in liquid assets.

Other bank variables we include are: Ln(TOTAL ASSETS), the log of the total assets of the bank in 2008 euro; ROA, the return on assets of the bank; DOUBTFUL LOANS RATIO, the doubtful loan ratio of the bank; and the HERFINDAHL BY INDUSTRY, the Herfindahl-Hirschman index of the bank's credit portfolio by industry.

C. Results

Our empirical exercises are structured as follows: We first focus on the impact of economic and monetary conditions (ΔGDP and ΔIR) and, second, and more importantly, on the interactions between the economic and monetary conditions and the strength of the firm and bank balance sheets (proxied by CAPITAL RATIO and LIQUIDITY RATIO). The regressions are at the loan application level and we match the loan application outcomes with the associated macroeconomic, firm, industry, province, and bank information.

We do not simply compare loan application outcomes across different firms and banks, but we also control – and exploit – the strength of the balance sheets of both the firms and the banks associated with each loan application. In addition, firm fixed effects allow us to compare lending to the same firm under different economic and monetary conditions and for different bank strength. This is important since the pool of borrowers may change over the business cycle and across banks.

Finally, we take a step further in identification by comparing loan granting within the set of applications made by: (a) different firms in the same month to the same bank; (b) the same firm in the same month to different banks; and (c) the same firm for the same loan to different banks. In (a) the quality of the lending banks is held constant, whereas in (b) and (c) the quality of the potential pool of borrowers is held constant.

1. *Economic and Monetary Conditions*

Table 2 reports the estimated coefficients, the standard errors between parentheses, and the significance levels of the baseline conditional logit model (i.e., a logit that controls for firm fixed effects). Standard errors are clustered at the firm level.[14]

[Table 2 around here]

We start analyzing the direct effects of economic and monetary conditions on the probability that the LOAN APPLICATION IS GRANTED. Following Hypothesis 1 we expect the estimated coefficient on ΔGDP to be positive as loan granting (corresponding improving firm and bank balance-sheet strength) increases with GDP growth. And following higher short-term interest rate increases we expect loan granting to decrease as agency costs of lending would increase. Hence we expect the coefficient on ΔIR to be negative.

In Table 2 we indeed find that GDP growth spurs loan granting while short-term interest rate hikes reduces loan granting. The semi-elasticity column indicates that both effects are also economically relevant.[15] At the mean of all variables, a one standard deviation increase in GDP growth (from 3.14 to 4.07 percent), for example, increases the loan granting probability by almost 12 percent (from 43 to 48 percent), while a one standard deviation increase in the short-term interest rate (from 0.23 to 1.05 percent) decreases the loan granting probability by three and a quarter percent (from 43 to 41 percent).

We note that the estimated coefficients on GDP growth and the change in the interest rate are obtained in specifications that include a comprehensive set of firm and bank characteristics,

---

[14] The reported McFadden (1974) pseudo R2 does not account for the included fixed effects and as usual should be interpreted cautiously as only a relative measure of uncertainty reduction.

[15] The semi-elasticity ε of a change in a regressor x_j in a logit model equals its marginal effect divided by the conditional probability p that the dependent variable equals one. For $p = \Pr[y = 1 | \mathbf{x}]$ and $\Lambda(\mathbf{x}'\beta) = \frac{e^{\mathbf{x}'\beta}}{1 + e^{\mathbf{x}'\beta}}$, the semi-elasticity is $\varepsilon = \left(\frac{\partial p}{\partial x_j} \right) / p = \left\{ \Lambda(\mathbf{x}'\beta)[1 - \Lambda(\mathbf{x}'\beta)]\beta_j \right\} / p$.

and firm fixed effects. These variables absorb changes in loan demand quality over the business cycle, i.e., changes in the pool of applicant firms that apply for and obtain loans from different banks, and changes in the balance sheet strength of banks. We also add the number of loan applications to key specifications. Its growth rate declines over the sample period and during the recession, but results are virtually unaffected (in addition, the month, bank-month, firm-month, or loan fixed effects added later will also absorb variation in the propensity to apply).

In sum, controlling for firm and bank characteristics, we find that loan granting increases in good times, i.e., when GDP growth is higher and the cost of financing (short-term interest rate) is lower. Theory of the firm and bank balance-sheet channels predict the effects we have found so far, but also predict that these effects will work mainly through the strength of balance-sheet of firms and banks respectively. However we first now discuss the coefficients on the firm and bank characteristics once and then turn back to the focus of our study which are the effects of the changes in economic (and monetary) conditions through the strength of the balance sheets of firms (and banks) on loan granting.

2. Firm and Bank Characteristics

The estimated coefficients on the firm characteristics are overall and across all specifications statistically significant, economically relevant, stable and in line with straightforward priors. These results suggest therefore that these controls are at once needed and relevant. Applications from firms with a higher capital ratio are more likely to be successful. Therefore, we find clear support for Hypothesis 2. The coefficient on firm liquidity is not significant, but it becomes significant in models where liquidity is also interacted with economic and monetary conditions. This indicates liquidity matters especially for firms that lack it when growth is low and short-term interest rates are high.

Loan applications from larger, older and more profitable firms, from firms with fewer doubtful loans at or prior to the loan application or from an industry with a lower doubtful loan ratio, and from firms with longer and fewer bank relationships located in a province with many banks are also more successful. Hence, *ceteris paribus* more transparent firms with a stronger balance-sheet and with a longer and more impeccable track record can rely more on external financing (as in Jensen and Meckling (1976)), as so can firms with stronger and bilateral relationships in competitive banking markets (see Freixas and Rochet (2008) and Degryse, Kim and Ongena (2009) for reviews of theory and empirical evidence).

Regarding bank characteristics, more solvent and liquid banks are less prone to lend to new borrowers. Larger and also riskier banks (i.e., with higher NPL ratios and more industry concentrated loan portfolios) also have a higher probability of granting loans to new borrowers. These results are further robust to the inclusion of firm-month or loan application fixed effects for example (unreported).

Therefore, either using capital and liquidity ratios or other measures of bank strength, we find a clear negative sign when assessing Hypothesis 3. This result potential hints to a type of behavior where lowly capitalized banks may have larger incentives to take more risk.

Overall, we find these estimated coefficients in line with standard priors and their statistical significance and stability reassuring for our investigation of the different credit channels (as the working of these channels require the imperfect substitutability between external and internal financing that is especially acute for small and opaque firms and for small banks).

3. Firm and Bank Balance Sheet Channels

Table 3 analyzes the impact of *both* economic and monetary conditions on loan granting through *both* firm and bank balance sheet channels. As argued before the simultaneous assessment of both channels is necessary to avoid an omitted-variables problem. Table 3

therefore includes the interactions of both GDP growth and the change in the short-term interest rate with firm and bank capital and liquidity ratios.[16]

Model I in Table 3 contains our benchmark regression. As explained in the previous Sections, GDP growth and interest rate changes are not highly correlated in Spain because of the relatively low level of synchronization of economic activity in Spain vis-à-vis the largest euro area countries since 1999. This allows us to exploit simultaneously the variation in output and monetary conditions interacted with firm and bank capital and liquidity.

[Table 3 around here]

The estimates in Model I suggest that the negative effect of lower GDP growth or larger increases in the short-term interest rate on the probability that a LOAN APPLICATION IS GRANTED is stronger for firms with low capital or liquidity and (independently) for banks with low capital or liquidity.[17] To put it differently, "weaker" firms or banks are more pro-cyclical (in GDP or interest rate) in terms of loan granting than stronger ones. For zero changes in GDP and the interest rate, the probability that a LOAN APPLICATION IS GRANTED is lower for firms with low capital or liquidity and from banks with low capital or liquidity.[18] In unreported specifications we also add interactions of firm with bank capital and firm with bank liquidity, and in addition interact also those two terms with GDP growth and

[16] In unreported specifications we exclude various combinations of economic and/or monetary conditions and firm and/or bank capital and liquidity (and their interactions). Results are mostly unaffected in terms of statistical significance though not always in terms of the economic relevance.

[17] The ordinarily reported standard errors and marginal effects of interacted variables in non-linear models require corrections (Ai and Norton (2003), Norton, Wang and Ai (2004)). However, when the average probability of the dependent variable is close to 0.5, which is the case for our dependent variable, the logistic function is almost linear and the required corrections tend to be small. For the benchmark model we calculate the corrected standard errors and marginal effects based on the above papers, and alternatively we linearize the benchmark model and estimate it using ordinary linear squares. As in both cases the results are very similar to the standard (i.e., non-corrected) non-linear model's estimates, we report the latter.

[18] The coefficient on bank liquidity is not statistically significant however. If bank capital is pro-cyclical, we may underestimate the total impact of current economic and monetary conditions on lending since adverse economic and tight monetary conditions by reducing bank capital may further decrease credit availability. See also Adrian and Shin (2009), Brunnermeier, Crockett, Goodhart, Persaud and Shin (2009) and Shin (2009) for example on the importance of overnight rates for bank liquidity and behavior.

interest rate changes respectively. None of the estimated coefficients on the latter four interactive terms is statistically significant however, suggesting that when conditions are tight weaker banks cut lending more across the board, but do not reallocate along firm strength.

In Figure 1 we further explore the economic relevancy of these estimated effects. The figure plots the percentage change in the probability that a LOAN APPLICATION IS GRANTED for a one standard deviation increase in GDP growth (ΔGDP) or in the change in the short-term interest rate (ΔIR) for values in the 25th to 75th percentile ranges of the FIRM and BANK CAPITAL RATIO (the values of both ratios are displayed in levels in the Figure).

[Figure 1 around here]

The effect of a one standard deviation increase in GDP growth on the probability that a LOAN APPLICATION IS GRANTED is always sizeable and around 12 percent, but fairly equal across the changes in firm and bank capital ratios, although the effect of firm capital ratio on GDP growth is slightly higher. When both firm and bank capital ratios are high (75th percentile) the effect equals 9 percent, when both are low (25th percentile) the effect equals 16 percent.

The effect of a one standard deviation increase in the change in the short-term interest rate, on the other hand, depends mostly on the bank capital ratio. At the 25th percentile of the firm capital ratio for example, the effect varies between -3.5 percent for highly capitalized banks (75th percentile) and -7.5 percent for lowly capitalized banks. This finding suggests that – in contrast to changes in GDP growth that work through both firm and bank balance sheet channels – monetary policy changes work predominantly through the banking lending channel.

Findings for FIRM and BANK LIQUIDITY are similarly depicted in Figure 2. Both GDP growth and interest rate changes now work only through the bank channel, highlighting the important role played by bank liquidity and the bank balance sheet channel in general.

[Figure 2 around here]

The robustness checks we mentioned before in the text (but did not tabulate) so far include time windows shorter than three months during which loans can be granted following an application, the use of the overnight interest rate instead of the three-month interest rate, the use of levels of short-term rates instead of changes, the use of non-interpolated quarterly variables, and the inclusion of the monthly number of loan applications at the firm level as an independent variable.

4. Various Effects Models

We now present the estimates of various fixed effects models in the rest of Table 3. In Model II we start by dropping the firm fixed effects. Firm fixed effects absorb firm heterogeneity that is fixed over time and that may determine firm capital and liquidity for example if it is not accounted for by other controls. But including firm effects removes all firms with loan applications that were always or never granted within the sample period from the sample. By dropping the firm effects these firms re-enter the sample and the number of loan applications in this sample increases to 813,612. However, the estimated coefficients on the interactions remain very similar, except for the coefficient on the interaction term between the interest rate changes and firm capital which is no longer statistically significant (but was already economically speaking small in Model I).

In Model III we again feature firm fixed effects, but now add bank and month fixed effects. Bank fixed effects captures the still-unaccounted-for bank heterogeneity that is fixed over time yet that may determine loan granting. Month fixed effects capture the changes in economy-wide conditions, such as current and future expectations of GDP growth, inflation and interest rates and general shocks affecting the economy. Hence, all variables at the country level are dropped from the empirical model and the identification entirely comes from the interactions. Again, the estimated coefficients are similar to those in Model I, except for the coefficient on

the interaction between the interest rate changes and firm liquidity which is no longer statistically significant (but this interaction was also economically not very relevant in Model I) and the coefficient on the interaction between the interest rate changes and bank capital which reduces in absolute size. The latter finding is not entirely surprising as the largest part of variation of bank capital is *between* but not *within* banks.

Model IV features bank-month fixed effects on top of firm fixed effects, i.e., it is equivalent to Model III but instead of adding up bank and time fixed effects we multiply them. We find that within a bank and a month, banks more often reject weaker firms, but do so especially during downturns or periods of higher short-term interest rates. *Within* all the loan applications received by a bank in a month we further find that firms with low capital or liquidity are less likely to be granted a loan when GDP growth is lower or short-term interest rate changes are higher.

In Model V we include firm-month fixed effects (but no other effects). A firm-month fixed effects model accounts for the impact on loan granting of all time-varying macroeconomic conditions, and both time-varying *observable* firm characteristics (e.g., firm size and credit rating) and potentially correlated time-varying *unobservable* firm characteristics such as the strength of the firm's bank relationships, access to market finance, and political connections (Petersen and Rajan (1994), Faccio (2006), among others). Hence all the independent firm characteristics and macro variables and their interactions have to be dropped from the model. In addition, to be included in the regression a firm must have filed more than one loan application in the same month, reducing in turn the number of observations to 155,167. All estimated coefficients are similar to Model I, except for the coefficient on the interaction between GDP growth and bank liquidity which is no longer statistically significant.

In Model VI we present estimates from a loan fixed effects model, where the 134,445 loan applications are included that resulted in a granted loan and for which multiple applications were filed.[19] Again, results are very similar to both Models I and V.

In sum, Models V and VI show that *within* the set of applications made in the same month by the same firm to different banks and resulting in at least one granted loan, and *within* the set of different applications made for the same granted loan, banks with low capital grant fewer loans when GDP growth is lower or short-term interest rate increases are larger.

Assuming that the very small changes in firm quality that occur during each month are not correlated with the quality of the approached banks – which is the case for example if firm quality is constant within each month – our results imply that under tight conditions (i.e., a recession or very tight monetary policy) a capital crunch begets a credit crunch. This is a key result since Bernanke and Lown (1991) define credit crunch as "a significant leftward shift in the supply curve for loans, *holding constant both the safe real interest rate and the quality of potential borrowers*" (italics are ours). As far as we are aware we are the first to identify and document in such a clear-cut way (i.e., it is the *same firm* that applies *at the same time* or for *the same loan* to several banks) the occurrence of a credit crunch.

5. Granted Loans

The set of loan applications we have used so far are loan applications during the period 2002:M02 – 2008:M12 to banks that ask the *Banco de España* for information about firms that try to borrow from them and which are currently not customers. We therefore now extend the analysis to the set of *all* granted loans for the period 1992 to 2008 during which there were two economic recessions (results employing all granted loans are very similar for the 2002 –

[19] As indicated before we match bank information requests with loans on the basis of borrower identity and date (three-month window). A loan application with the current lender most likely does not trigger an information request. In robustness we therefore also use one- and two-month windows. Results are unaffected.

2008 sub-period that corresponds to the loan application sample). We can match the granted loans with firm and bank balance sheets and income statements culled from the Business Register and the monthly bank reports maintained by the *Banco de España*.

This extended sample offers a worse environment in disentangling loan supply from demand. Firms may not have new loans in a quarter either because they did not borrow, or because they tried to borrow but their loan applications were all rejected, or the loan conditions offered by the banks were not attractive enough. In consequence, there is an identification problem between loan supply and demand and, hence, a positive (negative) coefficient of GDP (interest rates) on granted loans may be due to either higher loan supply or higher loan demand, or both.

The identification problem is, however, much less severe than in other empirical work (see Section II), since our analysis is at the firm level controlling for firm characteristics that determine loan demand, like for example identity (which controls for industry, province, and constant unobserved characteristics), capital, liquidity, size, profits and others. Moreover, we are more interested in exploiting the interactions between GDP or the short-term interest rate with firm and bank capital and liquidity, which further alleviates the supply identification problem.

While we can condition on the characteristics of the banks the firm currently borrows from, we cannot condition on the characteristics of the banks the firm did not get a loan from. As argued before, for this group of firms, the relevant bank conditions are most likely correlated with those of the banks located close by. Hence, the banks in the firm's *province* are most likely the set of banks a firm can obtain a new loan from, and their capital and liquidity ratios are reasonably the relevant characteristics to include. While there are 50 provinces, results are very similar if we use the characteristics of the average bank at the *country* level in the relevant period.

Table 4 presents the summary statistics of the dependent and independent variables employed in the sample of granted loans. The dependent variable FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR *t* equals one if the firm *i* obtained at least a loan by the set of banks *b* during year *t* and equals zero otherwise. Its average value is 0.51, which is very similar to the earlier main dependent variable LOAN APPLICATION IS GRANTED (see Table 1).

[Table 4 around here]

As independent variables in the models we include as much as possible the same macroeconomic conditions, firm and bank characteristics as in the main sample with loan applications. But as we do not have all firm and bank information for the entire period, we rerun the earlier loan application regressions also with this slightly more limited set of variables. Results are unaffected.

ΔGDP has an average value of 3.4 percent, the average ΔIR is -0.2 percent, and the average ΔCPI is 3.2 percent. The average FIRM CAPITAL RATIO is 38.4 percent and the average FIRM LIQUIDITY RATIO equals 14.6 percent. The equivalent averages for banks are 6.0 and 23.4 percent, respectively.

Table 5 presents the estimated conditional logit models. The first column shows similar results to Table 2: Higher GDP growth or lower short term interest rates imply more granted loans. Despite all our firm and bank controls, the results could still be due to both higher loan demand and/or higher loan supply. Hence, to further control for loan demand and to disentangle firm and bank balance-sheet channels, we introduce in Models II and III interactions of economic and monetary conditions with firm and bank capital and liquidity. In Model III we also introduce time fixed effects to fully control for aggregate shocks and identify supply effects from the interactions. Results are very similar to those of the sample of loan applications (that were presented in Table 3), except for the interaction between short-

term rates and bank liquidity which is not significant. We find a negative impact of lower GDP growth or higher short-term interest rates on granted loans is stronger for both firms with low capital or liquidity and (independently) for banks with low capital or liquidity.

[Table 5 around here]

Figure 3 again plots the percentage change in the loan granting probability (i.e., FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR t) for a one standard deviation increase in GDP growth (ΔGDP) or in the change in the short-term interest rate (ΔIR) for values in the 25^{th} to 75^{th} percentile ranges of the FIRM and BANK CAPITAL RATIO (the values of both ratios are again displayed in levels in the Figure).

[Figure 3 around here]

The effects for GDP growth and the change in the short-term interest rate are now very similar in magnitude and in the role played by the bank balance sheet channel. In both cases the effects are much larger in absolute value for lowly capitalized banks (25^{th} percentile) than for highly capitalized banks (75^{th} percentile). For the firm capital ratios set equal to their 25^{th} percentile, for example, the effect of GDP growth ranges from close to 2 percent to almost 7 percent. The effect of the interest rate ranges from close to minus 10 to minus 5 percent. The firm balance sheet channel, though statistically significant, plays in both cases economically speaking a minor role. The same is true for the effects of GDP growth and the change in the short-term interest rate across FIRM and BANK LIQUIDITY (see Figure 4).

[Figure 4 around here]

Remember that estimates in Table 3 show that engagements between firms and banks with low capital or liquidity are more likely to result in a loan rejection, especially during adverse economic and monetary conditions. Table 4 and Figures 3 and 4 similarly show that, during adverse economic and monetary conditions, firms and banks with low capital or liquidity are less likely to engage in a credit transaction.

In non-reported regressions we also feature as dependent variables the number of loans and the total volume of credit that was granted. We find that weak firms or banks involve fewer loans but also lower loan volumes. Hence, the restrictions on the availability of credit identified through the loan application analysis are binding and have "net" effects in the sense that: (i) Weak firms that face a higher likelihood of a loan rejection cannot simply apply more to other banks and obtain loans there; (ii) Weak banks that reject more loan applications do not end up granting more loans as the number of applications to them increases.

In sum, our results suggest that it is not the case that in a capital and liquidity crunch, weak firms (with less capital and liquidity) can compensate their limited borrowing capacity with more loan applications or that reduced lending by weak banks is compensated by more lending from strong banks, especially not in times with worse economic and monetary conditions.

V. Conclusions and Policy Implications

Do the business cycle and the stance of monetary policy affect credit supply? And, if so, how relevant are the firm versus the bank balance-sheet channel both for the business cycle and for monetary policy?

These questions are not only key for macroeconomics in general but also for handling of the current crisis in particular. However, to answer these questions there are three main identification challenges: (1) An economic downturn and/or high cost of short-term financing may reduce both loan supply and demand. (2) Separating firm from bank balance-sheet channels, through which both business cycle and monetary policy may affect the availability of credit, creates an identification challenge since firms with low quality of balance-sheet strength that are more bank dependent may borrow more from banks with low quality of balance-sheet strength (Gertler and Gilchrist (1994)). Therefore, analyzing the questions at the

firm, or the bank, level may imply an omitted-variables problem which may bias the results. Hence, these matching issues make it necessary – for identification – to analyze the questions *at the individual loan level*, matched with *both* firm and bank complete information. (3) Separating the effects of economic activity and monetary conditions is also problematic as short-term interest rate changes may completely be determined by the business cycle (as for example in a Taylor- rule setting).

Our contribution to the literature lies in meeting these three identification challenges. We use a uniquely and comprehensive micro-dataset that contains for the last seven years all monthly information requests by banks following loan applications from firms that are currently not borrowing from them and, for the last seventeen years, information on all granted loans to non-financial firms by all credit institutions. Both loan applications and granted loans are matched with both firm and bank identity and complete balance-sheet data, including precise measures of capital and liquidity which proxy for the quality of the balance sheets. This dataset helps us to separate loan supply from demand, and firm from bank balance-sheet channels. The dataset is from Spain, a bank-dominated country with pronounced business cycles (including a severe contraction under way) and a fairly exogenous monetary policy allowing us to disentangle output from monetary policy effects.

We find robust evidence that: (1) Lower GDP growth or a larger increase in the short-term interest rate reduces loan supply. (2) Firm capital and liquidity matter for the availability of credit; and so do (3) bank capital and liquidity. (4) The GDP and interest rate effects on bank loan supply are stronger for firms with low capital or liquidity and (independently) from banks with low capital or liquidity. Though both the business cycle and monetary policy effects work strongly through the bank balance-sheet channel, firm balance sheets may also play a substantial role in channeling changes in GDP growth.

In addition, within the set of different applications to different banks from the *same* firm in the *same* month or for the *same* loan, we find that banks with low capital or liquidity grant fewer loans when GDP growth is lower or short-term interest rates are higher. Our results therefore suggest that under tight conditions low bank capital and liquidity leads to a credit crunch, i.e., a reduction of the loan supply to potential borrowers with the *same* quality. Moreover, the results we find suggest that loan supply restrictions are binding and cannot be offset by firms by turning to other banks.

Improved identification makes the interpretation of the reduced-form coefficients more reliable. Our policy conclusions also have an immediate bearing on the current financial and economic crisis. First, the contracting effects of a slowdown in economic activity or a tightening of monetary policy on the supply of bank loans may be amplified by low firm and bank capital. Capital crunch (eventually) begets credit crunch. Second, for the easing monetary policy to soften the credit crunch, especially bank capital matters; only to a lesser extent does firm capital matter. Moreover, in a credit crunch and with weakly capitalized banks it is more difficult for monetary policy to "exit" from a low level of the short-term interest rate as loan supply reductions may be severe! Finally, firm and bank recapitalizations and liquidity injections will in principle increase the supply of bank loans. But the way in which this balance sheet strengthening is executed (e.g., seasoned equity offering or interbank market liquidity versus government or central bank assistance) may affect the credit expansion (we leave this conjecture for future research).

References

Adrian, T., and H. S. Shin, 2009, Money, Liquidity and Monetary Policy, *American Economic Review Papers and Proceedings* 600-605.

Ai, C., and E. C. Norton, 2003, Interaction Terms in Logit and Probit Models, *Economics Letters* 80, 123-129.

Ashcraft, A., 2006, New Evidence on the Lending Channel, *Journal of Money, Credit and Banking* 38, 751-775.

Banco de España, 1997. *La Politica Monetaria y la Inflation en España (Monetary Policy and Inflation in Spain)* (Alianza Editorial, Madrid).

Bernanke, B. S., 1983, Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression, *American Economic Review* 73, 257-276.

Bernanke, B. S., 2007, The Financial Accelerator and the Credit Channel, (Board of Governors of the US Federal Reserve System, Washington DC), Remarks - Credit Channel of Monetary Policy in the Twenty-first Century

Bernanke, B. S., and A. S. Blinder, 1988, Money, Credit and Aggregate Demand, *American Economic Review* 82, 901-921.

Bernanke, B. S., and A. S. Blinder, 1992, The Federal Funds Rate and the Channels of Monetary Transmission, *American Economic Review* 82, 901-921.

Bernanke, B. S., and M. Gertler, 1989, Agency Costs, Net Worth, and Business Fluctuations, *American Economic Review* 79, 14-31.

Bernanke, B. S., and M. Gertler, 1995, Inside the Black Box: The Credit Channel of Monetary Policy Transmission, *Journal of Economic Perspectives* 9, 27-48.

Bernanke, B. S., M. Gertler, and S. Gilchrist, 1996, The Financial Accelerator and the Flight to Quality, *Review of Economics and Statistics* 78, 1-15.

Bernanke, B. S., M. Gertler, and S. Gilchrist, 1999, The Financial Accelerator in a Quantitative Business Cycle Framework, in John Taylor, and Michael Woodford, eds.: *Handbook of Macroeconomics* (Elsevier, Amsterdam).

Bernanke, B. S., and C. S. Lown, 1991, The Credit Crunch, *Brookings Papers on Economic Activity* 205-239.

Bernanke, B. S., and I. Mihov, 1998, Measuring Monetary Policy, *Quarterly Journal of Economics* 113, 869-902.

Black, L., D. Hancock, and W. Passmore, 2009, Core Deposit Funding of Subprime Mortgages and the Effect of Monetary Policy, (Board of Governors of the Federal Reserve System, Washington DC), Mimeo.

Boschen, J. F., and L. O. Mills, 1995, The Relation between Narrative and Money Market Indicators of Monetary Policy, *Economic Inquiry* 33, 24-44.

Brown, M., K. Kirschenmann, and S. Ongena, 2009, Foreign Currency Lending - Borrower or Bank Driven?, (Swiss National Bank, Zurich), Mimeo.

Brunnermeier, M., A. Crockett, C. A. E. Goodhart, A. Persaud, and H. S. Shin, 2009, The Fundamental Principles of Financial Regulation, (Geneva), Geneva Report 11.

Caballero, R. J., T. Hoshi, and A. K. Kashyap, 2008, Zombie Lending and Depressed Restructuring in Japan, *American Economic Review* 98, 1943-1977.

Chari, V. V., L. J. Christiano, and P. J. Kehoe, 2008, Facts and Myths about the Financial Crisis of 2008, (Federal Reserve Bank of Minneapolis, Minneapolis), Working Paper

Christiano, L. J., M. Eichenbaum, and C. Evans, 1996, The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds, *Review of Economics and Statistics* 78, 16-34.

Cohen-Cole, E., B. Duygan-Bump, J. Fillat, and J. Montoriol-Garriga, 2008, Looking Behind the Aggregates: A Reply to "Facts and Myths about the Financial Crisis of 2008", (Federal Reserve Bank of Boston, Boston), Quantitative Analysis Unit Working Paper 5.

de Haas, R., and N. van Horen, 2009, The Crisis as a Wake-up Call. Do Banks Tighten Lending Standards during a Financial Crisis?, (European Bank for Reconstruction and Development, London), Mimeo.

Degryse, H., M. Kim, and S. Ongena, 2009. *Microeconometrics of Banking: Methods, Applications and Results* (Oxford University Press).

Degryse, H., and S. Ongena, 2005, Distance, Lending Relationships, and Competition, *Journal of Finance* 60, 231-266.

Diamond, D. W., and R. G. Rajan, 2000, A Theory of Bank Capital, *Journal of Finance* 55, 2431-2465.

Diamond, D. W., and R. G. Rajan, 2006, Money in a Theory of Banking, *American Economic Review* 96, 30-53.

Diamond, D. W., and R. G. Rajan, 2009, Fear of Fire sales and the Credit Freeze, (Booth School of Business, Chicago), Mimeo.

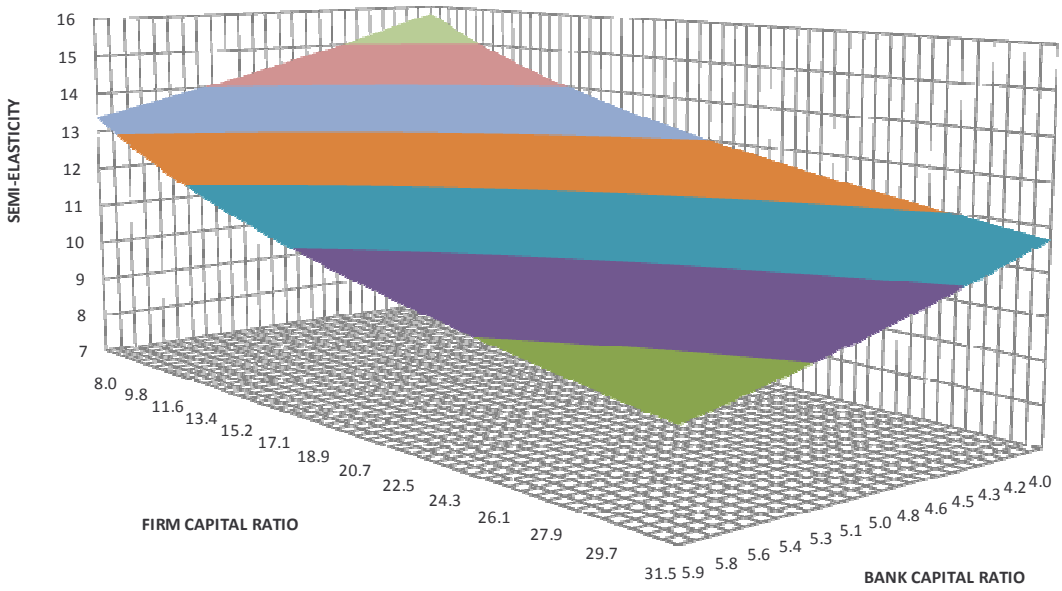
Faccio, M., 2006, Politically Connected Firms, *American Economic Review* 96, 369-386.
Freixas, X., and J. C. Rochet, 2008. *Microeconomics of Banking* (MIT Press, Cambridge MA).
Gan, J., 2007, The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel, *Review of Financial Studies* 20, 1941-1973.
Gertler, M., and S. Gilchrist, 1993, The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence, *Scandinavian Journal of Economics* 95, 43-64.
Gertler, M., and S. Gilchrist, 1994, Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms, *Quarterly Journal of Economics* 109, 309-340.
Hellman, T. F., K. C. Murdock, and J. E. Stiglitz, 2000, Liberalization, Moral Hazard in Banking and Prudential Regulation: Are Capital Controls Enough?, *American Economic Review* 90, 147-165.
Holmstrom, B., and J. Tirole, 1997, Financial Intermediation, Loanable Funds, and the Real Sector, *Quarterly Journal of Economics* 112, 663-691.
Huang, R., 2009, How Committed Are Bank Lines of Credit? Evidence from the Subprime Mortgage Crisis, (Federal Reserve Bank of Philadelphia, Philadelphia PA), Mimeo.
Ioannidou, V. P., S. Ongena, and J. L. Peydró, 2009, Monetary Policy, Risk-Taking and Pricing: Evidence from a Quasi-Natural Experiment, (CentER - Tilburg University / European Central Bank, Tilburg), Mimeo.
Ivashina, V., and D. S. Scharfstein, 2009, Bank Lending During the Financial Crisis of 2008, (Harvard University, Cambridge MA), Mimeo.
Jayaratne, J., and D. P. Morgan, 2000, Capital Market Frictions and Deposit Constraints at Banks, *Journal of Money, Credit and Banking* 32, 74-92.
Jensen, M. C., and W. H. Meckling, 1976, Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure, *Journal of Financial Economics* 3, 305-360.
Jiménez, G., S. Ongena, J. L. Peydró, and J. Saurina, 2008, Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say about the Effects of Monetary Policy on Credit Risk?, (Banco de España, Madrid), Documentos de Trabajo 833.
Kane, E. J., 1989. *The S&L Insurance Mess: How Did it Happen?* (MIT Press, Cambridge MA).
Kashyap, A. K., B. Mojon, and I. Angeloni, 2003. *Monetary Policy Transmission In The Euro Area: A Study By The Eurosystem Monetary Transmission Network* (Cambridge University Press, Cambridge).
Kashyap, A. K., and J. C. Stein, 2000, What Do A Million Observations on Banks Say About the Transmission of Monetary Policy?, *American Economic Review* 90, 407-428.
Kashyap, A. K., J. C. Stein, and D. W. Wilcox, 1996, Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance: Reply, *American Economic Review* 86, 310-314.
Khwaja, A., and A. Mian, 2008, Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market, *American Economic Review* 98, 1413-1442.
Kishan, R., and T. Opiela, 2000, Bank Size, Bank Capital, and the Bank Lending Channel, *Journal of Money, Credit and Banking* 32.
Kiyotaki, N., and J. Moore, 1997, Credit Cycles, *Journal of Political Economy* 105, 211-248.
Lang, W. W., and L. I. Nakamura, 1995, 'Flight to Quality' in Banking and Economic Activity, *Journal of Monetary Economics* 36, 145-164.
Matsuyama, K., 2007, Credit Traps and Credit Cycles, *American Economic Review* 97, 503-516.
McFadden, D., 1974, Conditional Logit Analysis of Qualitative Choice Behavior, in *Frontiers of Econometrics* (Academic Press, New York NY).
Norton, E. C., H. Wang, and C. Ai, 2004, Computing Interaction Effects and Standard Errors in Logit and Probit Models, *Stata Joumal* 4, 154-167.
Peek, J., and E. S. Rosengren, 1995, The Capital Crunch: Neither a Borrower nor a Lender Be, *Journal of Money, Credit, and Banking* 27, 625-638.
Peek, J., and E. S. Rosengren, 2005, Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan, *American Economic Review* 95, 1144-1166.
Petersen, M. A., and R. G. Rajan, 1994, The Benefits of Lending Relationships: Evidence from Small Business Data, *Journal of Finance* 49, 3-37.
Petersen, M. A., and R. G. Rajan, 2002, Does Distance Still Matter? The Information Revolution in Small Business Lending, *Journal of Finance* 57, 2533-2570.
Puri, M., J. Rocholl, and S. Steffen, 2009, The Impact of the U.S. Financial Crisis on Global Retail Lending, (Fuqua School of Business Duke University, Durham NC), Mimeo.
Santos, J. A. C., 2009, Bank Corporate Loan pricing Following the Subprime Crisis, (Federal Reserve Bank of New York, New York NY), Mimeo.
Shin, H. S., 2009. *2008 Clarendon Lectures in Finance on Risk and Liquidity* (Oxford University Press, Oxford).

Stein, J. C., 1998, An Adverse-Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy, *RAND Journal of Economics* 29, 466-486.
Stiglitz, J. E., and B. Greenwald, 2003. *Towards a New Paradigm in Monetary Economics* (Cambridge University Press).
Stiglitz, J. E., and A. Weiss, 1981, Credit Rationing in Markets with Imperfect Information, *American Economic Review* 71, 393-410.
Taylor, J. B., 1993, Discretion versus Policy Rules in Practice, *Carnegie-Rochester Conference Series on Public Policy* 39, 195-214.
Tong, H., and S.-J. Wei, 2009, The Misfortune of Non-financial Firms in a Financial Crisis: Disentangling Finance and Demand Shocks, (CEPR, London), Discussion Paper 7208.

FIGURE 1. CAPITAL RATIO AND LOAN APPLICATION IS GRANTED

The figure plots the percentage change in the probability that a LOAN APPLICATION IS GRANTED for a one standard deviation increase in GDP growth (ΔGDP) or a one standard deviation increase in the change in the short-term interest rate (ΔIR) for values in the 25th to 75th percentile range of firm and bank CAPITAL RATIO, based on the estimates in Table 3 Model I. All variables are otherwise set equal to their mean. The sample period equals 2002:M2 – 2008:M12.

ΔGDP



ΔIR

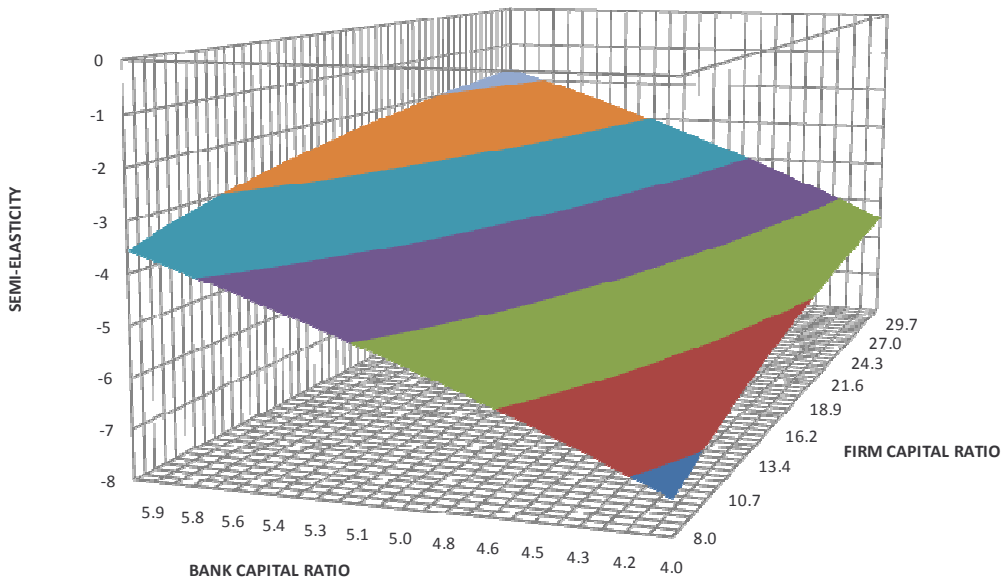
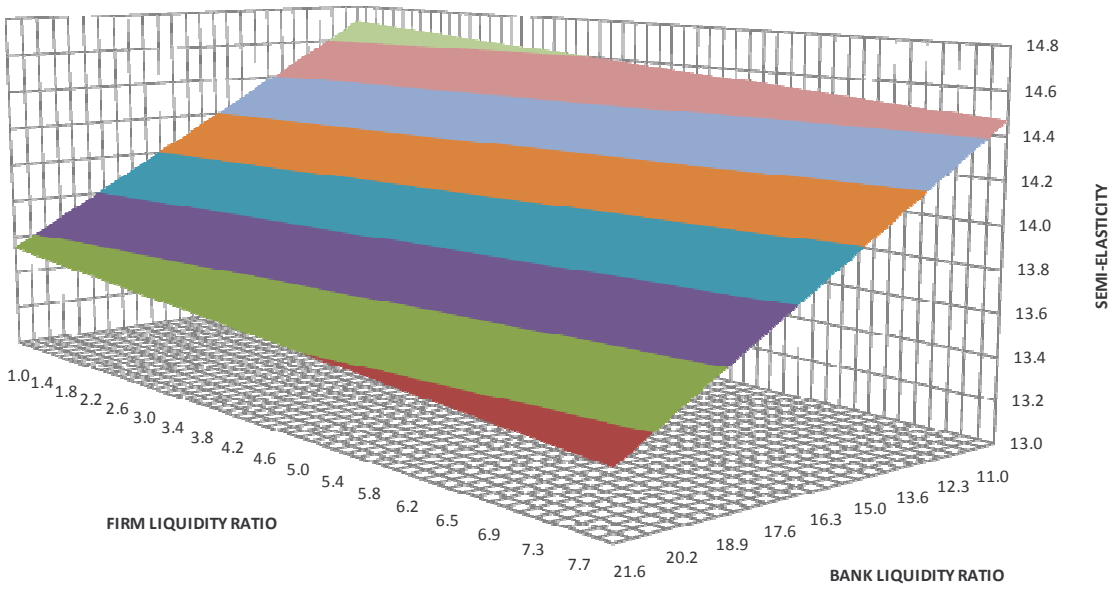


FIGURE 2. LIQUIDITY RATIO AND LOAN APPLICATION IS GRANTED

The figure plots the percentage change in the probability that a LOAN APPLICATION IS GRANTED for a one standard deviation increase in GDP growth (ΔGDP) or a one standard deviation increase in the change in the short-term interest rate (ΔIR) for values in the 25th to 75th percentile range of firm and bank LIQUIDITY RATIO, based on the estimates in Table 3 Model I. All variables are otherwise set equal to their mean. The sample period equals 2002:M2 – 2008:M12.

ΔGDP



ΔIR

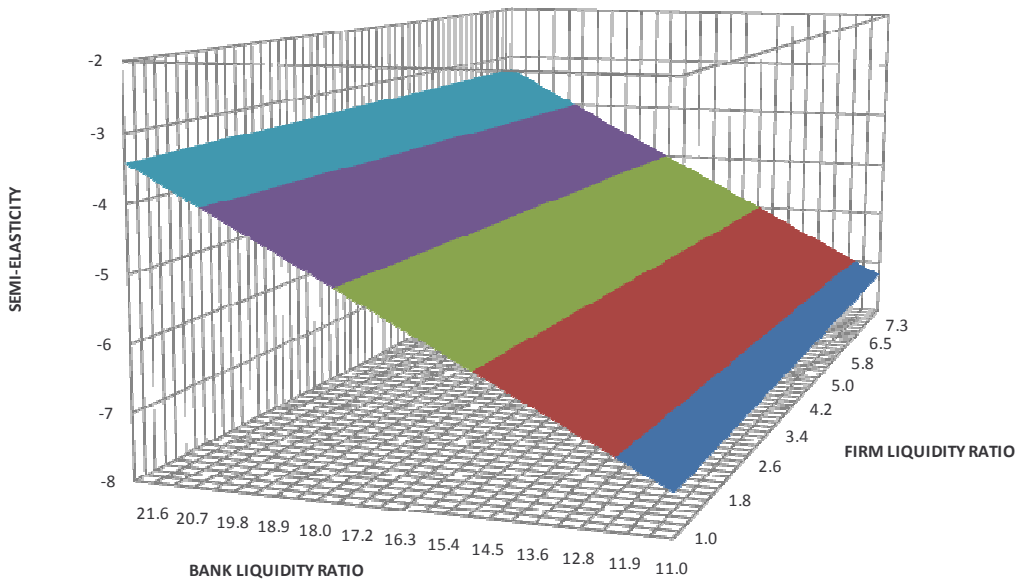
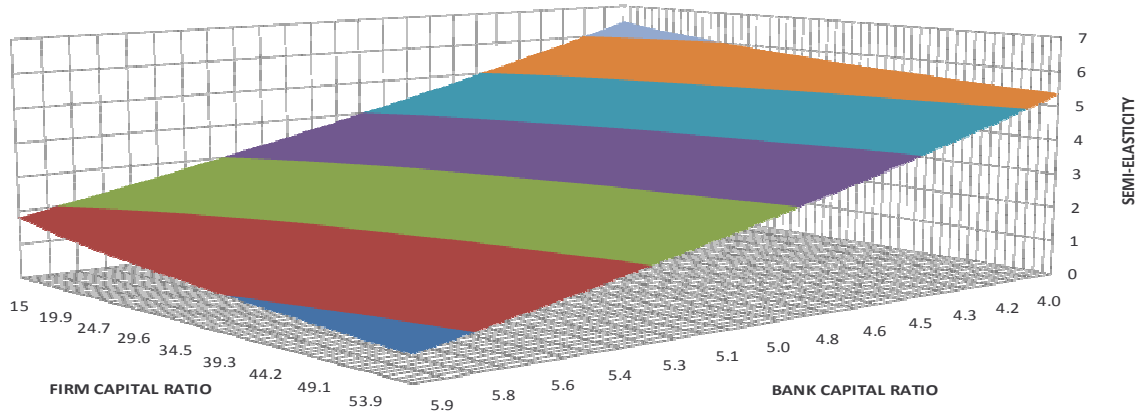


FIGURE 3. CAPITAL RATIO AND FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR T

The figure plots the percentage change in the probability that the FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR t for a one standard deviation increase in GDP growth (ΔGDP) or a one standard deviation increase in the change in the short-term interest rate (ΔIR) for values in the 25th to 75th percentile range of firm and bank CAPITAL RATIO, based on the estimates in Table 5 Model II. All variables are otherwise set equal to their mean. The sample period equals 1992 – 2008.

ΔGDP



ΔIR

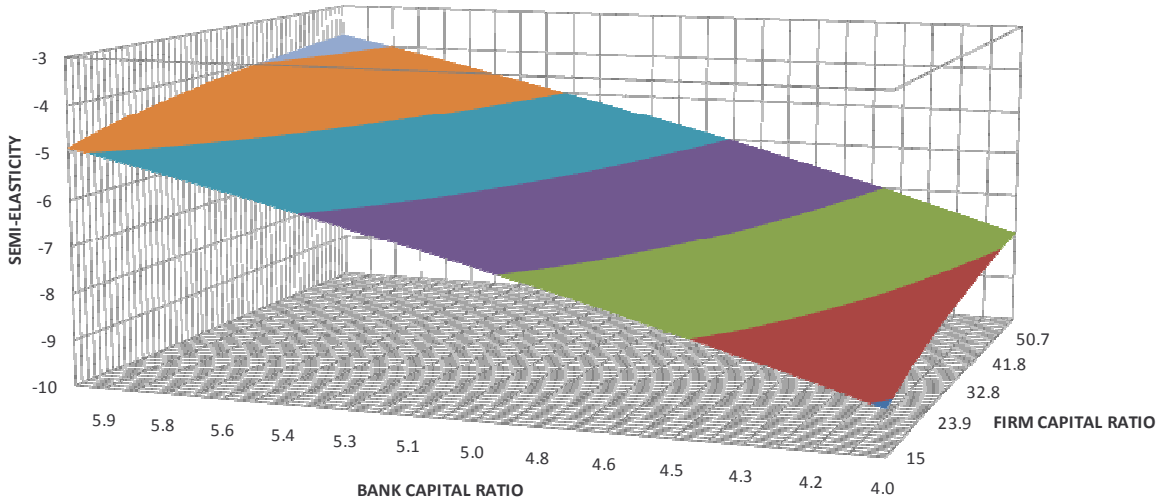
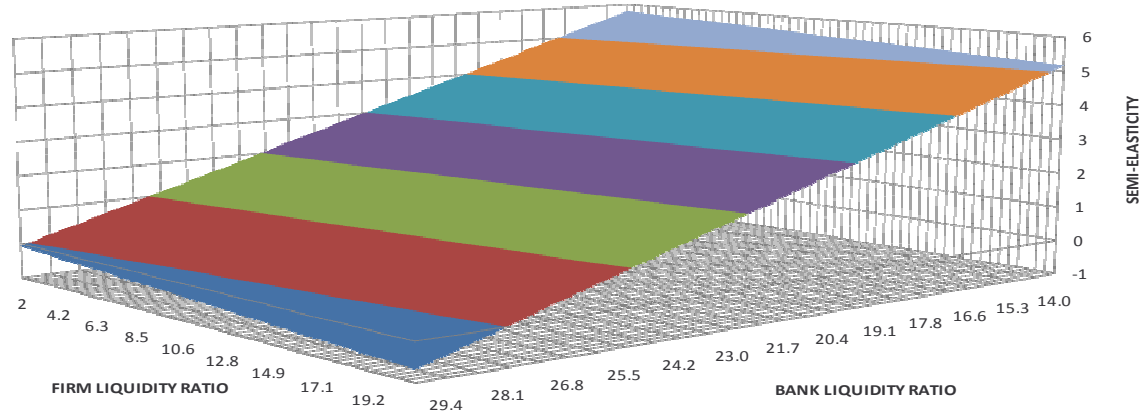


FIGURE 4. LIQUIDITY RATIO AND FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR T

The figure plots the percentage change in the probability that the FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR t for a one standard deviation increase in GDP growth (ΔGDP) or a one standard deviation increase in the change in the short-term interest rate (ΔIR) for values in the 25th to 75th percentile range of firm and bank LIQUIDITY RATIO, based on the estimates in Table 5 Model II. All variables are otherwise set equal to their mean. The sample period equals 1992 – 2008.

ΔGDP



ΔIR

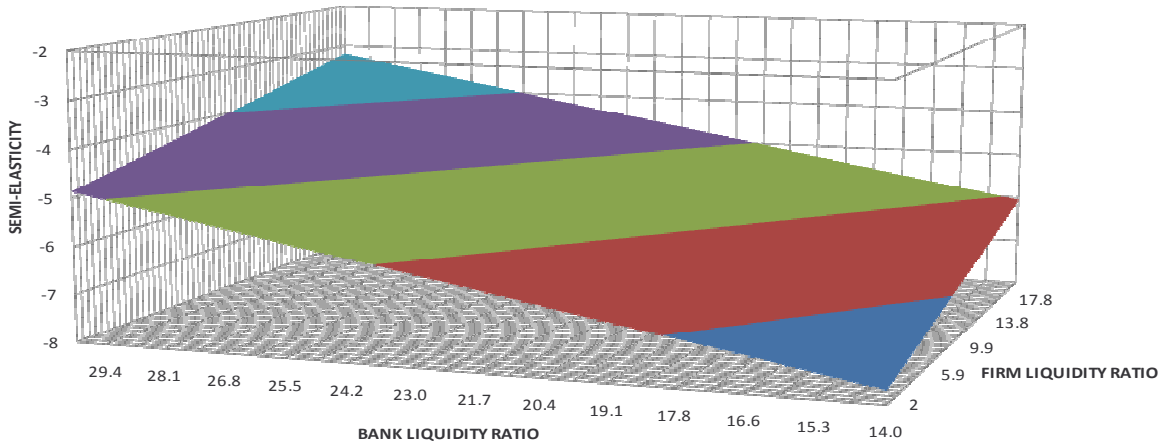


TABLE 1. DESCRIPTIVE STATISTICS

The table lists the variables employed in the first set of empirical specifications and provides their unit, definition, mean, standard deviation, minimum, 25th, 50th, and 75th percentiles and maximum. The number of observations equals 560,020 for all variables. The sample period equals 2002:M2 – 2008:M12. All monetary amounts are in thousands of 2008 Euros (000 EUR).

	Units	Definition	Mean	SD	Min	P25	Median	P75	Max
Dependent variable									
LOAN APPLICATION IS GRANTED$_{ibt}$	0/1	=1 if the loan application by a firm is approved and the loan is granted by a bank, =0 otherwise	0.43	0.50	0	0	0	1	1
Macroeconomic conditions (t)									
ΔGDP_t	%	Annual change of Spanish gross domestic product in real terms	3.14	0.93	-0.85	2.95	3.42	3.78	3.98
ΔIR_t	%	Annual change of Spanish 3-month interbank interest rates	0.23	0.82	-1.56	-0.40	0.28	1.04	1.41
ΔCPI_t	%	Annual change of Spanish Consumer Price Index	3.33	0.78	1.43	2.67	3.40	3.93	5.27
Firm characteristics (i)									
Ln(FIRM CAPITAL RATIO$_{it-1}$)	-	The log of the ratio of own funds over total assets of the firm	2.68	1.08	-5.79	2.09	2.85	3.46	4.61
FIRM CAPITAL RATIO$_{it-1}$	%	The ratio of own funds over total assets of the firm	22.51	18.82	0	8.06	17.35	31.85	100
FIRM LIQUIDITY RATIO$_{it-1}$	%	The ratio of current assets over total assets of the firm	41.60	26.30	0	19.34	39.03	61.19	100
Ln(TOTAL ASSETS$_{it-1}$)	-	The log of the total assets of the firm	7.53	1.55	0.88	6.49	7.46	8.49	15.50
TOTAL ASSETS$_{it-1}$	000 EUR	The total assets of the firm	7,771	41,573	2	657	1,736	4,881	5,392,372
Ln(1+AGE$_{it-1}$)	-	The log of one plus the age of the firm	2.14	0.84	0	1.61	2.20	2.77	4.89
AGE$_{it-1}$	years	The age of the firm	10.62	9.41	0	4	8	15	132
ROA$_{it-1}$	%	The return on assets of the firm	6.32	8.87	-36.07	2.39	4.92	8.77	63.16
I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST$_{it-1}$)	0/1	=1 if the firm had doubtful loans the month before the loan was requested, =0 otherwise	0.01	0.09	0	0	0	0	1
I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST$_{it-1}$)	0/1	=1 if the firm had doubtful loans before the previous month to the loan was requested, =0 otherwise	0.10	0.30	0	0	0	0	1
Ln(1+No. MONTHS WITH THE BANK$_{ibt-1}$)	-	The log of one plus the duration of the relationship between firm and bank	0.63	1.37	0	0	0	0	5.63
No. MONTHS WITH THE BANK$_{ibt-1}$	months	The duration of the relationship between firm and bank	7.93	23.67	0	0	0	0	278
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	-	The log of the number of bank relationships of the firm	1.50	0.63	0	1.10	1.39	1.95	4.63
NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$	-	The number of bank relationships of the firm	4.49	3.84	0	2	3	6	102

Industry characteristics (s)									
INDUSTRY DOUBTFUL LOANS RATIO$_{st}$	%	The doubtful loan ratio of the industry in which the firm operates	0.91	0.60	0.06	0.43	0.73	1.31	4.91
Province characteristics (p)									
Ln(No. BANKS$_{pt}$)	-	The log of the number of banks in the province where the firm is located	4.72	0.29	2.40	4.51	4.72	5.00	5.19
No. BANKS$_{pt}$	-	The number of banks in the province where the firm is located	116.94	32.45	11	91	112	148	179
Bank characteristics (b)									
Ln(BANK CAPITAL RATIO$_{bt}$)	-	The log of the ratio of bank equity over total assets of the bank	1.61	0.46	-9.71	1.39	1.57	1.80	4.15
BANK CAPITAL RATIO$_{bt}$	%	The ratio of bank equity over total assets of the bank	5.35	2.09	0.00	4.00	4.82	6.02	63.15
BANK LIQUIDITY RATIO$_{bt}$	%	The ratio of liquid assets (cash and balance with central banks, and loans and advances to governments and credit institutions) held by the bank over the total assets of the bank	16.93	8.07	0.04	11.02	15.74	21.84	92.07
Ln(TOTAL ASSETS$_{bt}$)	-	The log of the total assets of the bank	17.35	1.45	9.57	16.40	17.55	18.51	19.90
TOTAL ASSETS$_{bt}$	000 EUR	The total assets of the bank	17.35	1.45	9.57	16.4	17.55	18.51	19.9
ROA$_{bt}$	%	The return on assets of the bank	0.94	0.55	-8.93	0.67	0.90	1.12	11.92
DOUBTFUL LOANS RATIO$_{bt}$	%	The doubtful loan ratio of the bank	0.84	0.85	0.00	0.34	0.57	0.97	31.24
HERFINDAHL BY INDUSTRY$_{bt}$	%	The Herfindahl-Hirschman index of the bank's credit portfolio by industry	26.70	9.01	12.77	20.11	23.51	31.40	87.94

TABLE 2. CONDITIONS AND THE APPROVAL OF LOAN APPLICATIONS

The estimates this table lists are based on a conditional logit model. The dependent variable is LOAN APPLICATION IS GRANTED$_{ibt}$ which equals one if the loan application in month *t* by firm *i* is approved by bank *b* and the loan is granted, and equals zero otherwise. The definition of the other variables can be found in Table 1. Subscripts indicate the time of measurement of each variable. The sample period equals 2002:M2 – 2008:M12. The coefficients are listed in the first column and standard errors clustered at the firm level are between parentheses in the second column. Significance levels are in the third column. *** Significant at 1%, ** significant at 5%, * significant at 10%. The semi-elasticity column reports the percentage change in the probability when the variable of interest increases by one standard deviation.

	Coefficient	S.E.	Semi-elasticity
Macroeconomic conditions (t)			
ΔGDP_t	22.465	0.622 ***	11.91
ΔIR_t	-6.978	0.742 ***	-3.25
ΔCPI_t	-0.064	0.440	-0.03
Firm characteristics (i)			
Ln(FIRM CAPITAL RATIO$_{it-1}$)	0.256	0.038 ***	2.64
FIRM LIQUIDITY RATIO$_{it-1}$	-0.024	0.029	-0.14
Ln(TOTAL ASSETS$_{it-1}$)	0.023	0.011 **	7.14
Ln(1+AGE$_{it-1}$)	0.078	0.022 ***	3.95
ROA$_{it-1}$	0.315	0.056 ***	1.59
I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST$_{it-1}$)	-0.452	0.051 ***	-25.73
I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST$_{it-1}$)	-0.173	0.039 ***	-9.86
LN(1+No. MONTHS WITH THE BANK$_{ibt-1}$)	0.029	0.003 ***	4.86
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	-0.747	0.016 ***	-36.37
Industry characteristics (s)			
INDUSTRY DOUBTFUL LOANS RATIO$_{st-1}$	-5.495	1.047 ***	-1.88
Province characteristics (p)			
LN(No. BANKS$_{pt-1}$)	0.511	0.069 ***	8.07
Characteristics of the bank (b)			
Ln(BANK CAPITAL RATIO$_{bt-1}$)	-0.474	0.036 ***	-2.29
BANK LIQUIDITY RATIO$_{bt-1}$	-0.296	0.047 ***	-1.36
LN(TOTAL ASSETS$_{bt-1}$)	0.011	0.003 ***	0.70
ROA$_{bt-1}$	0.699	0.594	0.22
DOUBTFUL LOANS RATIO$_{bt-1}$	1.364	0.500 ***	0.66
HERFINDAHL BY INDUSTRY$_{bt-1}$	0.227	0.048 ***	1.17
Firm Fixed Effects	yes		
No. Observations	562,020		
No. of Clusters and Level of Clustering	106,466 Firms		
Sample Period	2002.M2-2008.M12		
Pseudo R2	2.03%		
Log pseudolikelihood	-236,579.05		

TABLE 3. CONDITIONS, CAPITAL AND LIQUIDITY, AND THE APPROVAL OF LOAN APPLICATIONS

The estimates this table lists are based on conditional logit models. The dependent variable is LOAN APPLICATION IS GRANTED$_{ibt}$ which equals one if the loan application in month *t* by firm *i* is approved by bank *b* and the loan is granted, and equals zero otherwise. The definition of the other variables can be found in Table 1. Subscripts indicate the time of measurement of each variable. The sample period equals 2002:M2 – 2008:M12. For each model coefficients are listed in the first column and standard errors clustered at the firm (I to III), firm-month (IV), loan (V) or bank-month (VI) are between parentheses in the second column. Significance levels are in the third column. *** Significant at 1%, ** significant at 5%, * significant at 10%.

	I		II		III		IV		V		VI	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Macroeconomic conditions (t)												
ΔGDP_t	62.851	2.365 ***	59.948	1.753 ***								
ΔGDP_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)	-24.483	3.559 ***	-17.615	1.365 ***	-26.116	2.252 ***	-20.196	1.886 ***				
ΔGDP_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)	-54.424	3.742 ***	-50.510	3.217 ***	-23.991	4.272 ***			-50.290	5.550 ***	-53.827	5.915 ***
ΔGDP_t*FIRM LIQUIDITY RATIO$_{it-1}$	-6.503	1.756 ***	-3.292	1.147 ***	-6.382	1.743 ***	-4.249	1.511 ***				
ΔGDP_t*BANK LIQUIDITY RATIO$_{bt-1}$	-20.748	6.045 ***	-21.272	4.786 ***	-19.533	6.632 ***			-11.000	9.122	-11.037	9.846
ΔIR_t	-64.210	2.868 ***	-60.833	1.952 ***								
ΔIR_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)	12.865	2.743 ***	0.057	1.349	13.653	2.446 ***	5.216	1.730 ***				
ΔIR_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)	92.856	5.941 ***	88.181	3.800 ***	17.871	6.142 ***			91.555	9.207 ***	89.109	9.841 ***
ΔIR_t*FIRM LIQUIDITY RATIO$_{it-1}$	4.316	1.973 **	2.019	1.206 *	2.632	1.989	3.227	1.484 **				
ΔIR_t*BANK LIQUIDITY RATIO$_{bt-1}$	77.687	6.728 ***	73.499	4.269 ***	49.428	6.991 ***			64.552	10.314 ***	60.917	11.040 ***
ΔCPI_t	0.372	0.441	1.875	0.333 ***								

Firm characteristics (i)																		
Ln(FIRM CAPITAL RATIO$_{it-1}$)	1.075	0.081	***	0.651	0.044	***	1.116	0.083	***	0.694	0.061	***						
FIRM LIQUIDITY RATIO$_{it-1}$	0.175	0.061	***	0.278	0.037	***	0.184	0.062	***	0.290	0.049	***						
Ln(TOTAL ASSETS$_{it-1}$)	0.029	0.011	***	-0.214	0.002	***	0.041	0.011	***	-0.120	0.003	***						
Ln(1+AGE$_{it-1}$)	0.080	0.022	***	-0.016	0.004	***	0.144	0.024	***	-0.007	0.004							
ROA$_{it-1}$	0.335	0.056	***	0.059	0.027	**	0.336	0.056	***	0.218	0.033	***						
I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST$_{it-1}$)	-0.437	0.051	***	-0.603	0.032	***	-0.438	0.051	***	-0.433	0.032	***						
I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST$_{it-1}$)	-0.156	0.039	***	-0.101	0.010	***	-0.135	0.039	***	-0.038	0.010	***						
Ln(1+No. MONTHS WITH THE BANK$_{ibt-1}$)	0.031	0.003	***	0.080	0.002	***	0.033	0.003	***	0.048	0.003	***	0.048	0.006	***	0.052	0.006	***
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	-0.744	0.016	***	0.244	0.006	***	-0.725	0.016	***	0.103	0.007	***						
Industry characteristics (s)																		
INDUSTRY DOUBTFUL LOANS RATIO$_{st-1}$	-5.275	1.048	***	3.434	0.513	***	-6.674	1.111	***	2.672	0.658	***						
Province characteristics (p)																		
Ln(No. BANKS$_{pt-1}$)	0.542	0.069	***	-0.204	0.009	***	0.504	0.071	***	-0.069	0.012	***						
Bank characteristics (b)																		
ln(BANK CAPITAL RATIO$_{bt-1}$)	0.512	0.106	***	0.542	0.097	***	0.469	0.131	***				0.422	0.156	***	0.506	0.166	***
BANK LIQUIDITY RATIO$_{bt-1}$	0.245	0.201		0.303	0.158	*	0.483	0.233	**				-0.303	0.296		-0.223	0.321	
Ln(TOTAL ASSETS$_{bt-1}$)	0.000	0.003		-0.012	0.002	***	-0.120	0.037	***				-0.005	0.004		-0.012	0.005	***
ROA$_{bt-1}$	2.746	0.608	***	3.397	0.468	***	-0.316	0.868					6.577	1.064	***	6.681	1.138	***
DOUBTFUL LOANS RATIO$_{bt-1}$	2.128	0.511	***	2.322	0.386	***	0.131	0.719					1.137	0.777		0.976	0.834	
HERFINDAHL BY INDUSTRY$_{bt-1}$	0.274	0.049	***	0.252	0.037	***	-0.274	0.118	**				0.121	0.076		0.124	0.082	
Constant	no			yes			no			no			no			no		
Firm Fixed Effects	yes			no			yes			yes			no			no		
Bank Fixed Effects	no			no			yes			no			no			no		
Month Fixed Effects	no			no			yes			no			no			no		
Bank-Month Fixed Effects	no			no			no			yes			no			no		
Firm-Month Fixed Effects	no			no			no			no			yes			no		
Loan Fixed Effects	no			no			no			no			no			yes		
No. Observations	562,020			813,612			562,020			558,259			155,167			134,445		
No. of Clusters and Level of Clustering	106,466	Firm		265,080	Firm		106,466	Firm		7,732	Bank - Mon		68,228	Firm-Month		62,483	Loan	
Sample Period	2002:M2-2008:M12			2002:M2-2008:M12			2002:M2-2008:M12			2002:M2-2008:M12			2002:M2-2008:M12			2002:M2-2008:M12		
Pseudo R2	2.20%			2.64%			3.91%			0.65%			0.31%			0.33%		
Log pseudolikelihood	-236,186			-540,444			-232,060			-353,216			-54,898			-46,735		

TABLE 4. DESCRIPTIVE STATISTICS

The table lists the variables employed in the second set of empirical specifications and provides their mean, standard deviation, minimum, 25th, 50th, and 75th percentiles, and maximum. Units and definition are provided in Table 1. The number of observations equals 1,081,911 for all variables. The sample period equals 1992 – 2008.

	Mean	SD	Min	P25	Median	P75	Max
Dependent variable							
FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR t	0.51	0.50	0	0	1	1	1
Macroeconomic conditions (t)							
ΔGDP_t	3.40	0.94	-1.03	3.10	3.62	3.89	5.05
ΔIR_t	-0.22	1.15	-4.46	-1.22	0.07	0.46	1.99
ΔCPI_t	3.24	0.82	1.41	2.67	3.23	4.00	5.35
Firm characteristics (i)							
Ln(FIRM CAPITAL RATIO$_{it-1}$)	3.30	0.98	-5.78	2.76	3.52	4.06	4.61
FIRM LIQUIDITY RATIO$_{it-1}$	14.57	16.92	0	2.25	8.43	20.84	100
Ln(TOTAL ASSETS$_{it-1}$)	6.29	1.45	0.19	5.30	6.18	7.15	16.65
Ln(1+AGE$_{it-1}$)	2.15	0.78	0	1.61	2.20	2.71	4.85
ROA$_{it-1}$	7.07	10.64	-39.22	1.67	5.12	10.94	64.53
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	0.22	0.42	0	0	0	0	3.97
Characteristics of the mean bank (b)							
Ln(BANK CAPITAL RATIO$_{bt-1}$)	1.74	0.32	-5.04	1.56	1.73	1.89	4.60
BANK LIQUIDITY RATIO$_{bt-1}$	23.42	11.30	0.17	14.61	21.93	30.13	97.34
Ln(TOTAL ASSETS$_{bt-1}$)	17.39	1.39	2.63	16.55	17.66	18.35	19.86
ROA$_{bt-1}$	1.02	0.54	-16.38	0.77	0.94	1.17	9.42

TABLE 5. CONDITIONS, CAPITAL AND LIQUIDITY, AND THE GRANTING OF LOANS

The estimates this table lists are based on conditional logit models. The dependent variable is FIRM WAS GRANTED AT LEAST ONE LOAN IN YEAR t_{it} which equals one if the firm *i* was granted at least one loan in year *t*, and equals zero otherwise. The definition of the other variables can be found in Table 1, their descriptive statistics are in Table 4. Subscripts indicate the time of measurement of each variable. The sample period equals 1992 – 2008. For each model coefficients are listed in the first column and the standard errors clustered at the firm level between parentheses are in the second column. The significance levels are in the third column. *** Significant at 1%, ** significant at 5%, * significant at 10%. The semi-elasticity column reports the percentage change in the probability when the variable of interest increases by one standard deviation.

	I			II		III	
	Coefficient	S.E.	Semi-elasticity	Coefficient	S.E.	Coefficient	S.E.
Macroeconomic conditions (t)							
ΔGDP_t	6.874	0.313 ***	3.14	73.356	1.998 ***		
ΔGDP_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)				-8.141	1.243 ***	-12.301	1.266 ***
ΔGDP_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)				-115.101	4.219 ***	-111.109	5.055 ***
ΔGDP_t*FIRM LIQUIDITY RATIO$_{it-1}$				-6.913	1.601 ***	-5.475	1.612 ***
ΔGDP_t*BANK LIQUIDITY RATIO$_{bt-1}$				-79.634	2.259 ***	-60.176	4.335 ***
ΔIR_t	-6.977	0.224 ***	-3.92	-55.558	2.213 ***		
ΔIR_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)				7.134	0.996 ***	11.126	1.012 ***
ΔIR_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)				83.577	5.288 ***	73.516	4.907 ***
ΔIR_t*FIRM LIQUIDITY RATIO$_{it-1}$				15.447	1.358 ***	14.602	1.303 ***
ΔIR_t*BANK LIQUIDITY RATIO$_{bt-1}$				31.634	1.886 ***	-1.795	3.154
ΔCPI_t	-1.249	0.318 ***	-0.50	-3.633	0.328 ***		
Firm characteristics (i)							
Ln(FIRM CAPITAL RATIO$_{it-1}$)	-0.211	0.025 ***	-58.85	0.103	0.051 **	0.304	0.052 ***
FIRM LIQUIDITY RATIO$_{it-1}$	-0.678	0.021 ***	-5.58	-0.423	0.059 ***	-0.468	0.059 ***
Ln(TOTAL ASSETS$_{it-1}$)	0.310	0.007 ***	260.43	0.308	0.007 ***	0.327	0.007 ***
Ln(1+AGE$_{it-1}$)	-0.060	0.009 ***	-2.42	-0.003	0.009	0.107	0.011 ***
ROA$_{it-1}$	0.247	0.027 ***	1.28	0.248	0.027 ***	0.206	0.028 ***
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	0.702	0.009 ***	79.66	0.710	0.009 ***	0.708	0.009 ***
Characteristics of the mean bank (b)							
Ln(BANK CAPITAL RATIO$_{bt-1}$)	-3.423	0.083 ***	-82.20	0.452	0.169 ***	-0.073	0.184
BANK LIQUIDITY RATIO$_{bt-1}$	-0.569	0.041 ***	-3.12	2.331	0.091 ***	1.031	0.164 ***
LN(TOTAL ASSETS$_{bt-1}$)	-0.140	0.003 ***	-7.27	-0.144	0.003 ***	-0.126	0.004 ***
ROA$_{bt-1}$	47.050	0.810 ***	12.33	51.571	0.832 ***	57.325	0.898 ***
Firm Fixed Effects	yes			yes		yes	
Year Fixed Effects	no			no		yes	
No. Observations	1,081,911			1,081,911		1,081,911	
No. of Clusters and Level of Clustering	198,884	Firms		198,884	Firms	198,884	Firms
Sample Period	1992-2008			1992-2008		1992-2008	
Pseudo R2	4.33%			4.71%		5.24%	
Log pseudolikelihood	-403,738			-402,142		-399,883	