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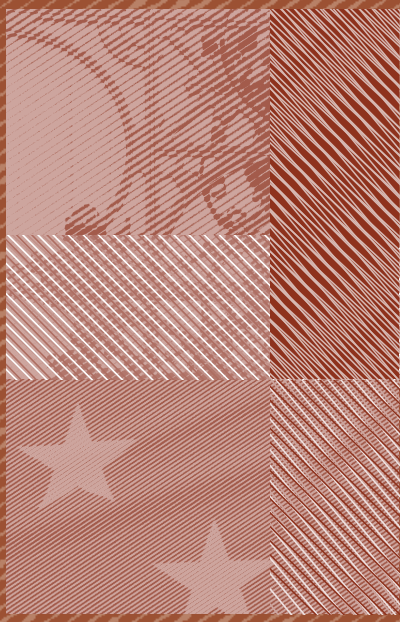

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Abstract

To identify credit availability we analyze the extensive and intensive margins of lending with loan applications and all loans granted in Spain. We find that during the period analyzed both worse economic and tighter monetary conditions reduce loan granting, especially to firms or from banks with lower capital or liquidity ratios. Moreover, responding to applications for the same loan, weak banks are less likely to grant the loan. Our results suggest that firms cannot offset the resultant credit restriction by turning to other banks. Importantly the bank-lending channel is notably stronger when we account for unobserved time-varying firm heterogeneity in loan demand and quality.

Keywords: non-financial and financial borrower balance-sheet channels, financial accelerator, firm borrowing capacity, credit supply, business cycle, monetary policy, credit channel, net worth, capital, liquidity, 2007-09 crisis.

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

Summary

To identify credit availability, we analyze a uniquely comprehensive micro-dataset that contains monthly information from 2002:M2 to 2008:M12 on firms' loan applications to their non-current banks. This dataset allows us to study the extension of credit to new clients (i.e., the extensive margin). We also analyze all business loans granted by all banks operating in Spain during the 1988:Q2 to 2008:Q4 period and study the change in loan volume to old clients (i.e., the intensive margin). To identify the impact of both non-financial and financial borrower balance-sheet channels, we match the loans with both firm and bank identity and complete balance-sheet data, including precise capital- and liquidity-to-total-assets ratios. These variables capture net worth and balance-sheet strength that determine the agency costs of borrowing for both firms and banks. The dataset is from Spain, a bank-dominated country with pronounced business cycles where the correlation between GDP growth and short-term interest rate changes is not strong, further enabling us to disentangle economic from monetary policy effects.

On the extensive margin we find the following results: (1) Lower GDP growth or positive short-term interest rate changes reduce loan granting. (2) A decrease in firm capital reduces loan granting, but a decrease in bank capital or liquidity increases loan granting. (3) 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) from banks with low capital or liquidity. Both the business cycle and monetary policy effects work strongly through the bank lending channel, while the level of firm capital plays a substantial role in channeling changes in GDP growth to changes in loan granting. Moreover, 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.

To analyze credit substitution by firms, we match – at the firm-time level – the loan applications with all the granted loans. We find that – conditioning on a firm's need for funds – weak firms, and also average firms associated with banks with weaker capital or liquidity, have a higher probability of obtaining zero granted loans when economic and monetary conditions are tighter. Hence, the results suggest that loan supply restrictions are binding and cannot be fully offset by firms turning to other (stronger) banks.

Finally, we analyze the intensive margin employing all the granted business loans in Spain during the last 20 years. This is important for several reasons. The intensive margin may be economically more significant than the extensive one, we can cover two business cycles, and using all granted loans may be better to analyze credit substitution by firms across different banks. To account for unobserved time-varying firm loan demand and quality shocks, we saturate the econometric model with firm-quarter fixed effects as in Khwaja and Mian (2008). Not only do we find evidence for the existence of a bank lending channel, we also show that the bank-lending channel is stronger if we account for unobserved time-varying firm heterogeneity in loan demand and quality. These findings suggest that an empirical analysis of the bank lending channel done at the bank level, as Kashyap and Stein (2000), significantly underestimate the strength of the bank lending channel.

The datasets and empirical setting allow us to better disentangle loan demand and supply and firm and bank balance-sheet channels, thus allowing us to draw policy 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 supply and on the usefulness of monetary policy, recapitalizations and liquidity injections in banks and firms to ameliorate credit supply conditions, thus suggesting that exit strategies need to be carefully assessed.

1 Introduction

The dramatic events unfolding in the global economy during the last few years have again highlighted the key role played by financial frictions for business cycle fluctuations. Observers and policy makers alike recurrently worry about weakening firm and bank balance sheets that may worsen the contractive impact of adverse economic and tight monetary conditions on the supply 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 soften the credit crunch.[1]

But do adverse economic conditions and contractive monetary policy reduce both firm borrowing capacity and bank loan supply? And does the reduction in credit availability depend equally on firm versus bank balance-sheet strength [Bernanke and Blinder (1988), Bernanke and Gertler (1989), Bernanke et al. (1996)]?[2] That is, do agency costs of borrowing 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, "borrowers may be both balance-sheet constrained and bank-dependent" [Gertler and Gilchrist (1994)], and weak firms with low-quality balance sheets may therefore borrow more from weak banks.[3] 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 directly interrelated as tight monetary conditions 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 coupled with *both* firm and bank characteristics.

Second, the supply of credit needs to be disentangled from its demand [see Bernanke and Gertler (1995) and Bernanke, Gertler and Gilchrist (1996)]. Low economic growth and tight monetary conditions may lower both loan demand and supply. Demand may fall because the expectations for investment are depressed and the cost of financing is high.

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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. [also Peek and Rosengren (1995)]. Chari et al. (2008), Cohen-Cole et al. (2008), Huang (2009), Ivashina and Scharfstein (2009), and Puri et al. (2009), among others, provide related evidence from the recent crisis.

2. See also Stiglitz and Weiss (1981), Bernanke (1983), Bernanke and Gertler (1987), Kiyotaki and Moore (1997), Stein (1998), Diamond and Rajan (2006), Matsuyama (2007), among others. Bernanke (2007) suggests that the bank lending channel is the (borrower) balance-sheet channel of Bernanke, Gertler and Gilchrist (1996) and Bernanke et al. (1999) for banks that obtain funds from depositors, other debt-holders and equity holders. Hence, not only the agency problems between banks and their borrowers (firms and households) but also the agency problems between banks and their providers of funds matter. Gertler and Kiyotaki (2009) formalize the bank balance-sheet channel modeling financial intermediation as in Gertler and Karadi (2009) but include liquidity risk as in Kiyotaki and Moore (2008).

3. In theory firm and bank balance-sheet strengths could be correlated: the higher the agency problems between firms and banks due to the firms' moral hazard, the more fragile the banks will be [Diamond and Rajan (2001)]. Peek and Rosengren (2005) and Caballero et al. (2008) *document that, during the Japanese financial crisis, banks with capital ratios closer to the minimum binding levels lent more to zombie firms. Hence, the strength of the lending banks' balance-sheets was positively correlated with those of the borrowing firms.*

Supply may contract because – as already indicated – the agency costs of borrowing may increase.

Third, if country business cycle conditions completely determine short-term interest rate changes, which may be the case in many countries [e.g., through a Taylor (1993)-rule], separating the effects of monetary conditions from those of economic activity is problematic.

Our main contribution to the literature consists in taking additional but crucial steps in addressing all three identification challenges at once. In particular, we analyze the effects of economic activity and monetary conditions on the availability of credit and account *simultaneously* for the strength of the firm and bank balance sheets. We use individual loan records on *all* granted business loans, including *loan application* records, from Spain, a country where most firms are bank dependent and where the correlation between GDP growth and short-term interest rate changes is not strong, further enabling us to disentangle economic from monetary policy effects.

The empirical micro literature, which we review later, has been constrained by the unavailability of comprehensive loan-level data and, thus, has mainly addressed these challenges at the firm or bank level using credit aggregates [e.g., Gertler and Gilchrist (1994) for firms and Kashyap and Stein (2000) for banks]. In contrast we tackle these fundamental research questions at the loan level and rely on three unique features of the *Credit Register* of the *Banco de España* (CIR) to attain identification. First, the CIR database 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 since 1984. The more than fifty million granted loans on record avert any concerns about unobserved changes in bank lending, which is important since economic or monetary conditions may influence bank lending to smaller firms for example [Lang and Nakamura (1995), Bernanke, Gertler and Gilchrist (1996)]. We analyze this dataset to study the changes in the volume of lending to *all* clients, including those *currently* borrowing from the bank (i.e., the intensive margin).

Loan applications are the CIR's second unique feature. During the last seven years the CIR recorded all information requests lodged by banks. In total more than 2,350,000 requests were filed. Because banks monthly receive information on all outstanding loans and defaults of their current borrowers, they will only file information requests following loan applications from firms that are currently not borrowing from them, in particular we observe each loan that is actually granted by a bank with the set of corresponding loan applications (i.e., the extensive margin). The loans granted to *noncurrent* borrowers surely do not involve simply the renewal or even evergreening of outstanding loans.

Third, the CIR uniquely contains loan conditions and tracks key firm and bank characteristics, including *identity*. Therefore, both the granted loan and loan application datasets can be augmented with complete accounting information, including accurate measures of capital and liquidity. These are recorded monthly for banks since 1984 and yearly for firms since 1992. This feature of the CIR allows us to simultaneously control for and exploit firm and bank identity and accounting information, and relate the approval and granting of loans with firm and bank balance-sheet strength.

The three unique features of the CIR allow us to improve identification. First, to disentangle firm and bank balance-sheet channels we study micro-data at *the individual loan level* matched with *both* complete firm and bank information [a course of action strongly

advocated by Kashyap et al. (1996)]. Not only do we control for both firm and bank variables, but also exploit theoretically motivated interactions between economic and monetary conditions on the one hand and firm and bank balance-sheet strength variables on the other to identify supply [Bernanke, Gertler and Gilchrist (1996), Kashyap and Stein (2000)]. The definition of the capital- and liquidity-to-total-assets ratios we employ closely follows the theoretical literature that attributes a prominent role to net worth in reducing the agency costs of borrowing, which sharpens the interpretation of the coefficients on their interactions with economic and monetary conditions.[4]

Second, to separate bank loan supply from demand we study the extensive margin with loan applications and analyze whether economic and monetary conditions interacted with firm and bank balance-sheet strength affects the probability a loan is granted. Tackling 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 (by including in the specifications firm-month or alternatively loan fixed effects). Within such a set of loan applications, for which the (observed and unobserved) quality of potential borrowers is constant as in the credit crunch definition by Bernanke and Lown (1991), we study how bank capital and liquidity affect the granting of loans. In addition, we analyze whether firms that get rejected in their initial loan application can undo the resultant reduction in credit availability by successfully applying to other banks.

To identify loan supply when analyzing the intensive margin with all granted loans, we account for unobserved time-varying firm heterogeneity in loan quality and demand, by saturating the specification with firm-quarter fixed effects [as in Khwaja and Mian (2008)]. We identify the causal impact of the bank lending channel by showing that for the *same* firm borrowing from at least two different banks in the *same* quarter the amount borrowed from the weaker bank declines more when monetary and economic conditions are tighter.

Third, to distinguish between the impact of real activity and monetary conditions, we rely on the observation that – since mid 1988 – the correlation between GDP growth and short-term interest rate changes has not been strong, further enabling us to disentangle economic from monetary policy effects. The monetary policy was basically coming first by the *Bundesbank* and then by the European Central Bank. Their mandates focused on price stability and the correlation of GDP growth (or Taylor-rule implied rates) between Germany (Euro Area) and Spain has never been strong. Moreover, the current recession that is taking place was partially triggered and/or worsened by financial and economic conditions abroad. The 1993 recession similarly came after a recession in the US and a significantly raise of monetary policy rates by the *Bundesbank* (which the *Banco de España* followed).

In sum, our study is the first in the financial accelerator literature – as far as we are aware – to analyze loan applications (also matched with firm and bank information), to account for unobserved time-varying firm loan demand and quality, and to study a country with fairly exogenous monetary policy. Our study yields the following robust results. On the extensive margin using loan applications we find that: (1) lower GDP growth or positive short-term interest rate changes reduce the probability that a loan is granted. (2) A decrease

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4. The agency problem in Gertler and Kiyotaki (2009) for example depends on the level of capital over the total assets "as a borrower's percentage stake in the outcome of an investment project increases, his or her incentive to deviate from the interests of lenders' declines." See also Holmstrom and Tirole (1997) and Holmstrom and Tirole (1998). By definition capital and liquidity ratios are liability- and asset-based respectively and are relevant for both firms and banks, in contrast to asset tangibility or wholesale to retail deposit ratios for example that are only relevant for either firms or banks, respectively.

in firm capital reduces loan granting, firm liquidity does not matter, while a decrease in bank capital or liquidity has a positive effect on loan granting. (3) The negative effect of lower GDP growth or higher short-term interest rate on loan granting is statistically stronger both for firms with low capital or liquidity and (independently) from banks with low capital or liquidity.

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. Moreover, *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. The first evidence – we think – that clearly identifies that, under tighter economic or monetary conditions, bank capital and/or liquidity have a significant impact on credit supply [Bernanke and Lown (1991)].

However, loan applications have been available only during the last seven years and may not be fully representative in terms of the actual borrowing that takes place if firms end up borrowing from their current banks if their applications elsewhere (i.e., the ones we observe) fail. Three sets of exercises thoroughly address these potential limitations of the loan application dataset. First, we study only firms that are noncurrent for all banks, i.e., firms that do not have any bank loan outstanding at the time of the loan application. We find similar results. Second, we match the loan application dataset to the dataset of *all* loans granted in Spain and study only those firms that applied for loans and, hence, are in need of financing. We find that weaker firms and firms associated with weaker banks face a higher probability of obtaining *no* bank loans at all when economic and monetary conditions are tighter. The loan supply restriction is therefore binding and firms cannot offset it by turning to other banks where the acceptance probability may be lower in any case or by leaning more on their current banks.

Finally, we analyze the impact of monetary and economic conditions on the intensive margin by employing all granted business loans in Spain during the 1988:Q2-2008:Q4 period. We find that the bank lending channel is both operative and potent. The channel is even stronger if we include firm-quarter fixed effects that account for unobserved time-varying firm loan demand and quality. This last finding suggests that an empirical analysis done at the bank level [as in Kashyap and Stein (2000)] significantly underestimates the relevancy of the bank lending channel, explaining why in contrast to most existing literature [Romer and Romer (1990), Ramey (1993), Bernanke and Gertler (1995), and Angeloni et al. (2003) for example] our analysis documents its existence and potency.

In sum, our results suggest that: (1) the strength of firm and bank balance-sheets plays an economically relevant role in channeling changes in GDP and short-term interest rates to credit availability; and (2) analyzing the bank lending channel at the bank level may crucially underestimate its importance because firm loan demand and quality are correlated with bank balance-sheet strength.

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 discusses the empirical

strategy. Section IV explains the variables in detail, and presents and discusses the results. Section V concludes and discusses the policy implications.

2 Theory, Testable Hypotheses, and Empirical Work

We first very briefly review the literature highlighting both the testable hypotheses emanating from theory and the identification challenges faced by the empirical studies [for recent literature reviews see Bernanke (2007) and Boivin et al. (2009)]. 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, 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), Gertler and Kiyotaki (2009)]. 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 for example. On the other hand, higher bank capital mechanically implies lower (short-term) debt for banks, softening their hard-budget constraint and decreasing their ability to provide liquidity and hence credit [Diamond and Rajan (2000)].[5]

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)].[6]

In sum, the testable hypotheses present in the aforementioned theory are:

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5. 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 et al. (2000)]. However, banks with less capital and more illiquid assets have especially during bad times 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)]. 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 (see Iyer and Peydró (2009) for evidence), (2) bank incentives to monitor and screen new borrowers are lower [Holmstrom and Tirole (1997)], 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 times the situation worsens, hence it may not be optimal or feasible for current 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.

6. Short-term interest rates may not only affect banks' incentives for lending but also for risk-taking [Jiménez et al. (2008), Ioannidou et al. (2009), Adrian and Shin (2010)]. Angeloni and Faia (2009) integrate Diamond and Rajan (2000)-type banks that are exposed to runs into a standard DSGE model. They show that monetary contractions may reduce bank leverage and risk.

(H1) Loan supply is reduced by lower GDP growth and/or higher short-term interest rates.[7]

(H2) Lower firm capital reduces firm borrowing capacity. Lower bank capital has an ambiguous effect on loan supply.

(H3) 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 from banks with low capital or liquidity.

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. Moreover, the literature has tried to control for loan demand through some observed firm characteristics like industry or by interactions between economic/monetary conditions and firm/bank characteristics.[8] However, as far as we are aware, and probably due to unavailability of data, no paper has so far employed comprehensive loan level data, has investigated simultaneously the effects of economic and monetary conditions working through both firm and bank-balance sheet channels, has analyzed loan applications, and has accounted for unobserved time-varying firm loan demand and quality by including firm-time fixed effects. In particular the usage of loan applications and firm-time fixed effects are crucial when identifying loan supply from demand.

7. The testable implications emanating from a financial accelerator model are especially relevant during economic recessions or periods with a tightened monetary policy stance, but credit availability can also be linearly dependent on economic and monetary conditions. We test the latter implication without loss of generality.

8. Gertler and Gilchrist (1993) and Oliner and Rudebusch (1996) for example find that, following the dates of monetary contractions identified in Romer and Romer (1989), the ratio of bank loans to small versus large manufacturing firms falls. Gertler and Gilchrist (1994) show that, even after controlling for differences in sales between these firms, the differences in the behavior of small and large firm debt remain. See also Lang and Nakamura (1995) and Bernanke, Gertler and Gilchrist (1996). 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. See also Kishan and Opiela (2000), Jayaratne and Morgan (2000), Ashcraft (2006) and Black et al. (2009), among others. Khwaja and Mian (2008) 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. Banks pass their liquidity shortages to firms, but firms with strong business or political ties can turn to alternative sources in the credit market [see also Gan (2007)].

3 Data and Empirical Strategy

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 employ in our empirical work to tackle 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 (before 2002 the requests were not stored). Though the requests can be made at any time, they are collated monthly and uniquely link borrowers with banks. Requests for information on firms that are currently borrowing from the requesting bank would yield information that is already known to this bank. 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 before. In this way, the information requests focus our analysis on a key category of borrowers that do not simply renew or even evergreen existing loans at their current bank, but that seek new loans from another bank (i.e., the extensive margin).[9]

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, by matching the loan application database with the CIR database, which contains the stock of all loans granted. 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 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.

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9. Since we cannot observe firm loan applications to their current banks, we later on also study only firms that do not have any bank loan outstanding at the time of the loan application. These firms are noncurrent for all banks and hence we have the loan applications from all the banks. Notice that approximately one fifth of the loans to borrowers entirely new to the bank are granted without any information request on record during the last sample quarter. This statistic shows that while the monetary cost of requesting the information is zero, non-pecuniary costs may not be. For example, 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. Banks may further not request information about the largest firms for example because these firms deal with many banks, are well-known, and/or do not seek regular loans. For all these reasons and for completeness we also study *all* the actual loans granted to *all* firms when analyzing the intensive margin.

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. The firms' dataset is available from the Spanish Mercantile Register at a yearly frequency starting in 1992. The banks' dataset, at a monthly frequency starting in 1984, is owned by the *Banco de España* in its role as banking supervisor. We can match more than 800,000 loan applications. As we 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 observed, 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. Following 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.[10] Following Bernanke and Gertler (1995) and Gertler and Kiyotaki (2009) we also feature a liquidity measure for both firms and banks. The 100,000 firms and 200 banks active in the loan application dataset provide ample cross-sectional variation in both measures.

We control for time-invariant differences in the quality of applicants by including firm fixed effects and, in some regressions, we also control for differences across banks and time periods by including 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 affect bank loan granting following changes in economic and monetary conditions.

Finally, since firms may shift their applications between banks of different balance sheet strengths possibly neutralizing the supply effect measured with loan applications, we match the loan application dataset to the dataset that contains *all* loans granted in Spain (see below) and – at the firm level – study only those firms that applied for loans and hence are in need of financing. We then analyze whether weaker firms face different likelihood of obtaining bank loans at all when economic and monetary conditions are tighter.

10. Off-balance sheet volumes are very small in Spain. Hence, total bank assets cover most of the banks' businesses. Banks did not develop conduits or Structured Investment Vehicles (SIVs) because the prevailing accounting rules made banks consolidate these items and set aside sufficient capital.

B. All Loans Granted

We also analyze the records on *all* granted business loans for the extended 1988:Q2 to 2008:Q4 period because with the loan application dataset we can only analyze the extensive margin, i.e., the information requests follow loan applications by firms that are currently not borrowing from the bank. Loan applications are also only recorded since 2002.

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. The CIR is *almost* comprehensive, as the reporting threshold for a loan is only 6,000 Euros. Given that we consider only C&I loans, this threshold is very low which alleviates any concerns about unobserved 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).[11] As before, we match CIR data compiled at a quarterly frequency with complete bank balance-sheet variables and exploit relevant interactions between business cycle conditions and bank balance-sheet strength.[12]

To account for unobserved time-varying firm loan demand and quality shocks we saturate the specification with firm-year:quarter (which we shorthand as *firm-quarter)* fixed effects as in Khwaja and Mian (2008). As explained in the Introduction, our identification therefore entirely comes from firms that at least once in their history borrow from two different banks during the same quarter. Not only do we want to test the existence of the bank lending channel, but also whether it is *correlated* with firm demand and balance-sheet channels. This is a key test to shed light on whether it is possible to investigate the credit channels at the firm or bank level [as in Gertler and Gilchrist (1994) and Kashyap and Stein (2000)], or if it is imperative to test them at the *loan* level.

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). We start from the observation that – since mid 1988 – the correlation between GDP growth and short-term interest rate changes has not been strong in Spain, which enables to disentangle economic from monetary policy effects [see Banco de España (1997) and Jiménez, Ongena, Peydró and Saurina (2008)]. Spain formally joined the European Monetary Mechanism in 1989, informally in mid 1988, after joining the European Union in 1986. Monetary conditions consequently became basically set first through the fixed exchange rate policy with the *Deutsche Mark* and as of January 1, 1999, within the Eurosystem.

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11. 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. The commercial and financial loans we study in this paper represent 82.6% of all 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.

12. Before 1992 we can match each loan to selected firm characteristics, i.e., identity, industry, location, the level of credit and default. For loans to households, in all time periods, a very limited set of characteristics is available. Given the focus of our paper, we therefore study only the loans that were granted to firms.

Moreover, GDP growth in Germany and Spain were only weakly synchronized during the last twenty years. For example, during the period 2002-2005 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 a significant exogenous variation in short-term interest rates allowing us to disentangle its effects from those of local Spanish economic activity. [13]

The current recession in Spain, in addition, 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 economic contraction in Spain has been severe. In less than two years time Spain's unemployment rate for example more than doubled, from eight to almost twenty percent (2007:Q2 to 2009:Q3).

As explained above, given the previous paragraphs and that our purpose in this paper is to control better for loan demand and analyze the credit channel, we use simple measures of economic and monetary conditions: GDP growth and short-term interest rate changes. In addition, 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 or firm-month fixed effects to control for other macroeconomic factors.

13. Since 1999, monetary policy is set for the euro area as a whole, with Spain being a part of the euro area, but entering only with its relative weight (less than 15% of the euro area output).

4 Dependent Variable, Independent Variables and Results

We first analyze in detail the extensive margin with the set of business loan applications introducing all loan, firm, bank and macro variables, and then analyze the intensive margin with the dataset on all granted business loans.

A. The Extensive Margin with Loan Applications

1. 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 filed at least one application that did not result in a loan and one application that did 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.

2. Independent Variables

As independent variables we include an array of macroeconomic conditions and firm/bank characteristics to control for changes in the quality and 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.

a) 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 (H1) 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 3.14 percent and varies between -0.85 and 3.98 percent.

Our measure for the changes in monetary 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 0.23 percent, ranging between -1.56 and 1.41 percent. The use of variations in the short-term interest rate as a measure that proxies the change in the stance of monetary policy is fully in line with the literature analyzing the credit channel at the micro level.[14] Our main results are unaffected if we employ the level

14. 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 et al. (1996) use vector auto regressions to identify monetary policy shocks. But Kashyap and Stein (2000) find very

rather than the changes in this interest rate. The use of a 3-month interest rate is in line with many articles in Angeloni, Kashyap and Mojon (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 3.33 percent, with the minimum and maximum were 1.43 and 5.27 respectively.

b) 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 to control for time-invariant unobservable firm characteristics, in robustness replaced by all-encompassing firm-month and loan fixed effects to control for time-variant unobservable firm characteristics. The summary statistics of Table 1 are based on the observations used in the regressions with firm fixed effects. Firm balance-sheet data is taken at the end of the previous year *(t-1)* and firm credit related information over the previous year. We employ lagged values as economic and monetary conditions may determine the capital and liquidity ratios firms and banks optimally choose.

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 from their corresponding bank ratios in later exercises we add FIRM in their label). According to Hypothesis 2 (H2) 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 41.6 percent.

As other firm characteristics we include controls for firm risk: 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 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 any time previous to the month before 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; though the firm currently does not borrow from the bank as we are analyzing borrowing from new banks, the firm may have previously borrowed from the bank); and Ln(1+NUMBER OF BANK RELATIONSHIPS), the log of the number of bank relationships of the firm.

As an industry characteristic we include INDUSTRY DOUBTFUL LOANS RATIO, which is the doubtful loan ratio of the industry in which the firm operates to control 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 province where the firm is located (a province in Spain roughly corresponds to a Metropolitan

similar results using either the variation in the federal funds rate, the Boschen and Mills (1995) index or the Bernanke and Mihov (1998) measure.

Statistical Area in the United States). 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.

c) Bank Characteristics

The key bank balance-sheet variables we are interested are 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 core capital over total assets of the bank [as in Bernanke and Lown (1991) for example]. Core capital is defined as total equity plus retained earnings. 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 is very low. 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.

Lending behavior may vary across banks, hence we control for bank variables that may affect bank lending and in robustness also feature bank fixed effects. We therefore include: 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.

3. Results

Our empirical exercises assessing the extensive margin of lending 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 (whether the loan is granted or not) with the associated macroeconomic, firm, industry, province, and bank information.

We control – and exploit – the strength of the balance sheets of both the firms and the banks associated with each loan application. Firm fixed effects allow us to compare lending to the same firm under different economic and monetary conditions and for different bank strength. Taking an additional step towards identification we compare 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.

a) Economic and Monetary Conditions

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

We start analyzing the direct effects of economic and monetary conditions on the probability that the LOAN APPLICATION IS GRANTED. Following Hypothesis 1 (H1) 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 positive short-term interest rate changes 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 reduce loan granting. The semi-elasticity column indicates that both effects are also economically relevant. 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 variation (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, 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 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).[15]

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.

b) 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 (H2). The coefficient on firm liquidity is not significant, but it becomes significant in models where liquidity is also interacted with economic and

15, During periods of adverse economic or monetary conditions the firms' propensity to apply may decrease in response to tightening bank lending standards [Dell'Ariccia et al. (2008)]. Weaker firms likely anticipate an even lower probability of loan approval during these periods. Consequently weaker firms may apply less, the pool of applicants may become better and therefore our estimates should be conservative.

monetary conditions (Tables 3 and 4). 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 et al. (2009) for reviews of theory and empirical evidence].

Regarding bank characteristics, more solvent and liquid banks are less prone to lend to new borrowers. Riskier banks (i.e., with higher NPL ratios and more industry concentrated loan portfolios) 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 2 (H2). This result potentially hints to a type of behavior where lowly capitalized banks may have larger incentives to take more risk (see again the aforementioned reviews).

Overall, we find these estimated coefficients in line with theory 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).

c) 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 suggested by Hypothesis 3 (H3).[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, even after 1999 [Giannone et al. (2008)]. This allows us to exploit simultaneously the variation in output and monetary conditions interacted with firm and bank capital and liquidity.

The estimates in Model I suggest that the negative effect of lower GDP growth or positive changes 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

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 their 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 et al. (2004)]. For the benchmark model we calculate the corrected standard errors and marginal effects based on the above papers, and alternatively linearize the benchmark model and estimate it using ordinary linear squares. In both cases the results are very similar to the standard (i.e., non-corrected) non-linear

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] Hence overall H3 is confirmed.

In Figure 1 we further explore the economic relevance of these estimated effects. We plot 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). 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 is 9 percent, when both are low (25th percentile) the effect is 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, the effect varies between -3.5 percent for highly capitalized banks 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 similar (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.

d) Various Effects Models

We now present the estimates of various fixed effects models in the rest of Table 3.[19] In Model II we add bank and month fixed effects to the firm fixed effects. Bank fixed effects capture the still-unaccounted-for bank heterogeneity that is fixed over time. 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. The estimated coefficients are similar to those in Model I, except for the coefficient on the interaction between the interest

model estimates, not surprising as the mean of the dependent variable is close to 0.5. Hence we report the ordinarily reported non-linear estimates.

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 et al. (2009) and Shin (2009) for example on the importance of overnight rates for bank liquidity and behavior. 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 interest rate changes respectively. None of the estimated coefficients on the latter four interactive terms is statistically significant however, suggesting that, when economic and monetary conditions are tight, weaker banks cut lending across the board, including lending to strong firms.

19. In an unreported specification we replace in Model I the firm by region and industry fixed effects. Firm fixed effects absorb unobservable 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 816,852. The estimated coefficients on firm size, age and number of bank relationships reverse sign (from Model I) demonstrating the importance of controlling for time-invariant unobserved firm heterogeneity (see also Model III). 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 it was already small economically speaking in Model I).

rate changes and firm liquidity which is no longer statistically significant (this interaction was 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 surprising as the largest part of variation of bank capital is *between* but not *within* banks.

Model III drops firm fixed effects and saturates the model with bank-month fixed effects, i.e., and instead of adding up bank and month fixed effects we multiply them. We replace the firm by region and industry effects to make estimation possible. The firms with loan applications that were always or never granted therefore re-enter the sample and the number of loan applications increases to 813,115. We find that, *within* all the loan applications received by a bank in a month, firms with low capital or liquidity are less likely to be granted a loan when GDP growth is lower.

In Model IV 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 *observed* time-varying firm characteristics (e.g., firm size and credit rating) and *unobserved* time-varying firm characteristics such as firm risk, quality, investment opportunities, the strength of the firm's bank relationships, and access to market finance [Petersen and Rajan (1994), 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. In addition, in Model V 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. Again, results are very similar to both Models I and IV.

In sum, Models IV and V 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 or liquidity grant fewer loans when GDP growth is lower or short-term interest rate increases are larger.[20] 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 tight monetary policy) a lower capital level has an impact on credit supply. 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*" (our italicizing). 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 *do apply at the same time* or for *the same loan* to several banks) the occurrence of this phenomenon.

e) Loan Applications from Current Borrowers

Our estimations so far focused on the probability that loan applications from noncurrent borrowers get approved (i.e., the extensive margin). However, firms may initially apply to banks they currently don't borrow from, but if their applications fail return to their current lenders to obtain new loans there. These "applications of last resort" with current lenders will not trigger information requests because lenders automatically obtain monthly information

20. The coefficient on the interaction between GDP growth and bank liquidity is no longer statistically significant at standard levels.

from the CIR on all their current borrowers. Not including such applications may bias our findings. To address this potential problem, Model VI studies lending to all borrowers without any outstanding bank debt (hence borrowers without any current lender) and Table 4 analyzes *all* lending to all borrowers that applied for a loan, key to assess potential credit substitution by firms that get rejected by some banks.

The estimation in Model VI is based on 33,345 firms that have no bank debt outstanding at *t-1*. The number of firm-month observations equals only 42,029, suggesting that most firms are without bank debt for only one month (these are therefore most likely new firms). Firm fixed effects are therefore impossible, so we include region and industry fixed effects. The coefficients on the interaction terms confirm the existence of a bank balance sheet channel.

f) Credit Substitution: Loan Applications and All Granted Loans

Matching the loan application dataset to all granted loans in Spain, Table 4 presents estimates of conditional logit models of whether a firm gets (a) loan(s), conditioning on the firm having applied for (a) loan(s) reflecting its need for financing. The dependent variable is now AT LEAST ONE LOAN APPLICATION IS GRANTED which equals one if firm *i* applies for at least a loan at time *t* and one or more loans are granted from any bank in month *t* to *t+3*, and equals zero if firm *i* applies for at least a loan at time *t* but did not obtain any loans from any bank in *t* to *t+3*.

This new dependent variable defined as granted loans *per* applying firm and month in effect "expands" the previous dependent variable LOAN APPLICATION IS GRANTED that was confined to loan applications *per firm – mont – bank*. Moreover, the granted loans to the firm can now come from either their non-current banks, which request information from the CIR when the firm applies, or from their current banks, which do not request any. The mean for this new dependent variable is higher than for the variable employed in Table 1 (61% versus 43%), because some firms that did not obtain loans from the non-current banks can obtain them from their current banks.

The independent variables in Table 4 are the same as those in Table 3, with one exception: bank characteristics are now those of the average bank the firm either borrows from or gets rejected by (including the current banks). Table 4 displays three representative models: one without interactions, one with interactions, and one with interactions and month fixed effects (we also include firm fixed effects in all models).

Overall, and despite the use of the average bank characteristics, results are quite similar to those in Tables 2 and 3. Conditioning on their need for financing, firms with low capital or liquidity that try to borrow from non-current banks or are associated with current banks with low capital or liquidity ratios have a lower probability of obtaining loans during tighter economic or monetary times. Hence, even average firms associated to weak banks have a higher probability of *not obtaining a single* granted loan despite their need for funds. Hence, the results suggest that loan supply restrictions are binding and cannot be fully offset by firms turning to other banks.

B. The Intensive Margin with All Granted Loans

The set of loan applications we have used so far are loan applications during the period 2002:M02 – 2008:M12 to banks from firms that try to borrow from them and which are currently not customers (i.e., the extensive margin of lending). We now extend the analysis

to the set of *all* granted loans for the period 1988:Q2 to 2008:Q4 (during which there were two economic recessions) and study the intensive margin of lending to account for changes in loan amounts and maturities. We match the granted loans with bank balance sheets and income statements culled from the monthly bank reports collected by the *Banco de España*.[21]

This extended sample offers a worse environment for 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 because the loan conditions offered by the banks were not attractive enough. Consequently there is a problem identifying loan supply from demand and a positive (negative) coefficient of GDP (interest rates) on granted loans may be due to a higher loan demand or a higher loan supply, or both.

However, we identify loan supply through a difference-in-difference exercise. Since the firm channel and loan demand is a firm-level shock, we do the analysis at the loan level, using all granted loans, controlling for *unobserved time-varying firm loan demand and quality shocks* by including firm-quarter fixed effects as in Khwaja and Mian (2008). In this way identification is possible by comparing changes in credit for the *same* firm in the *same* quarter by banks with different levels of capital and liquidity ratios over the business cycle. If for example a firm that borrows from at least two banks starts obtaining less credit from the weaker vis-à-vis the stronger bank(s) when monetary and economic conditions are tighter, then such a result would suggest that it is the bank lending channel and not the firm loan demand or quality (channel) that is causing the changes in credit. Since we have access to *all* granted loans, we can perform this exercise.

Not only do we want to test the existence of the bank lending channel, but also whether the bank-lending channel is *correlated* with firm demand and balance-sheet channels. We can do this by comparing the results on the bank lending channel between the models with and without firm-quarter fixed effects. This is a key test to shed light on whether the credit channel should be tested at the *firm* or *bank* level or if one needs to test for the presence of the bank lending channel employing *loan* level data.

Table 5 presents the summary statistics of the dependent and independent variables employed in the sample of granted loans (representing 20% of all loans and randomly drawn on the basis of tax identification numbers to steer clear of computational constraints). The dependent variable ΔLN(LOAN CREDIT) is the change in outstanding credit of firm *i* granted by bank *b* during quarter *t*. Its average value equals -0.01, with a standard deviation equal to 0.48. As independent variables in the models we include as much as possible the same macroeconomic conditions and bank characteristics we employed when analyzing loan applications. ΔGDP has an average value of 3.28 percent, the average ΔIR is -0.36 percent, and the average ΔCPI is 3.64 percent. The average BANK CAPITAL RATIO is 6.10 percent and the average BANK LIQUIDITY RATIO is 25.93 percent.

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21. Starting in 1992 we can match loan contracts with complete firm characteristics. Non-reported regressions that include all firm variables that were also employed in the loan application exercises corroborate the relevance of both firm and bank balance sheet channels for loan granting. Because Spanish monetary policy basically became decided in Frankfurt in 1988 [see Jiménez, Ongena, Peydró and Saurina (2008)] and because an important economic recession started in Spain in 1992, we only present the estimates from the longer 1988-2008 time-period. As firm-quarter fixed effects will absorb the impact of firm balance-sheet and loan demand channels, we can still identify loan supply (the bank lending channel) and, in addition, we can test whether the firm channel is correlated or not with the bank lending channel (i.e., whether an analysis done at the bank level under- or overestimates the potency of the bank lending channel).

Table 6 presents the estimated models. Given our focus on the interaction between business cycle and bank balance-sheet strength variables, we cluster the errors in bank-time. We present four models: Model I does not feature any fixed effect, while Models II, III and IV include *quarter*, *firm*, and *firm-quarter* fixed effects, respectively. Model IV fully accounts for unobserved time-varying firm loan demand and quality shocks, i.e., the firm loan demand and balance sheet channels.[22]

The first column shows results similar to those on the extensive margin in Table 2. Higher GDP growth or lower short term interest rates imply more granted loans. These results could still be due to both higher loan demand and/or higher loan supply. In addition, we find that the effects of economic and monetary conditions are stronger for banks with lower capital and liquidity ratios, similar to the results we reported in Table 3. In Model II we control for firm fixed effects to account for *time-invariant* firm loan demand and quality shocks. We find statistically similar but economically *stronger* results as compared to Model I. Hence controlling for loan demand strengthens the bank lending channel. However, as explained above, loan demand volume and firm net worth may react to the business cycle.

In Model III we introduce time fixed effects to focus on the micro interactions. We find that bank capital still channels output and monetary changes. But, more importantly, when we control for firm-quarter fixed effects in Model IV (and hence account for all *time-varying* firm loan demand and quality shocks) the estimated coefficients on bank capital significantly increase in absolute size. Hence, not only do we *identify* the existence of a bank channel but its economic significance *increases* when we control for firm loan demand and balance-sheet channels.

In sum, we find evidence for the existence of a strong bank lending channel. The bank-lending channel strengthens if we control for firm-quarter fixed effects that account for unobserved time-varying firm loan demand and quality. This last result implies that empirical analysis of the bank lending channel done at the bank level [following the seminal paper by Kashyap and Stein (2000)] may significantly underestimate the strength of the bank lending channel. This may explain why in contrast to most of the literature we find evidence for the existence of a strong bank-lending channel.

22. Regressions that include firm-quarter fixed effects require that firms that at least once in their history borrow from two different banks during the same quarter. Given our focus on Model 4, we employ this set of firms in Models I to III as well. However, the bank lending channel similarly exists if we study the universe of all loans with these three specifications (to conserve space we choose not to report these results).

5 Conclusions and Policy Implications

Do business cycle fluctuations and the stance of monetary policy affect credit supply? And, if so, how relevant are the firm versus the bank balance-sheet channels 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 creates an identification challenge since firms with low balance-sheet strength that are more bank dependent may borrow more from banks with low balance-sheet strength. (3) Separating the effects of economic activity and monetary conditions is also problematic as short-term interest rate changes may be completely determined by the business cycle.

Our contribution to the literature lies in meeting these three identification challenges. We use a uniquely and comprehensive micro-dataset on loans that contains: (1) for the last seven years all monthly information requests by banks following loan applications from firms that are currently not borrowing from them; and (2) for the last twenty years, information on all granted loans to non-financial firms by all credit institutions. 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 and a fairly exogenous monetary policy.

We analyze the extensive margin of lending with loan applications and find the following results: (1) Lower GDP growth or positive short-term interest rate changes reduce loan granting. (2) A decrease in firm capital reduces loan granting, but a decrease in bank capital or liquidity increases loan granting. (3) 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) from banks with low capital or liquidity. Both the business cycle and monetary policy effects work strongly through the bank lending channel, while the level of firm capital plays a substantial role in channeling changes in GDP growth to changes in loan granting.

Moreover, 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.

To analyze possible credit substitution by firms we match the loan level application data with all granted loans. We find that weak firms in need of funds, and also average firms associated with banks with weaker capital or liquidity, have a lower probability of obtaining a loan when economic and monetary conditions are tighter. Loan supply restrictions, our results therefore suggest, are binding and cannot be fully offset by firms turning to other banks.

Finally, we analyze the intensive margin of lending by using all business loans that were granted in Spain during the last 20 years. To account for both *observed and unobserved time-varying firm loan demand and quality shocks* we saturate the specification with firm-quarter fixed effects. Not only do we find a significant bank lending channel, but we

also find that the bank-lending channel is *stronger* if firm-quarter fixed effects are included. Our results therefore suggest that any empirical analysis of the bank lending channel done at the bank level may significantly underestimate the strength of the bank lending channel.

In sum, our results suggest that the levels of firm and bank balance-sheet strength play an economically relevant role when channeling changes in GDP and short-term interest rates to credit availability, and that one may underestimate the potency of the bank lending channel when analyzing it *at the bank level* because firm loan demand and quality are *correlated* with the bank balance-sheet strength.

Improved identification makes the interpretation of the reduced-form coefficients more reliable. Our policy conclusions further 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. Second, for the easing monetary policy to increase credit availability, especially bank capital matters. Frictions between banks and their financiers may have further gained in prominence as banks increasingly turned from core deposit to wholesale funding. In a low credit supply environment and with weakly capitalized banks it is therefore more difficult and risky than ever 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., central bank lending to banks) may affect the credit expansion. We leave this conjecture for future research.

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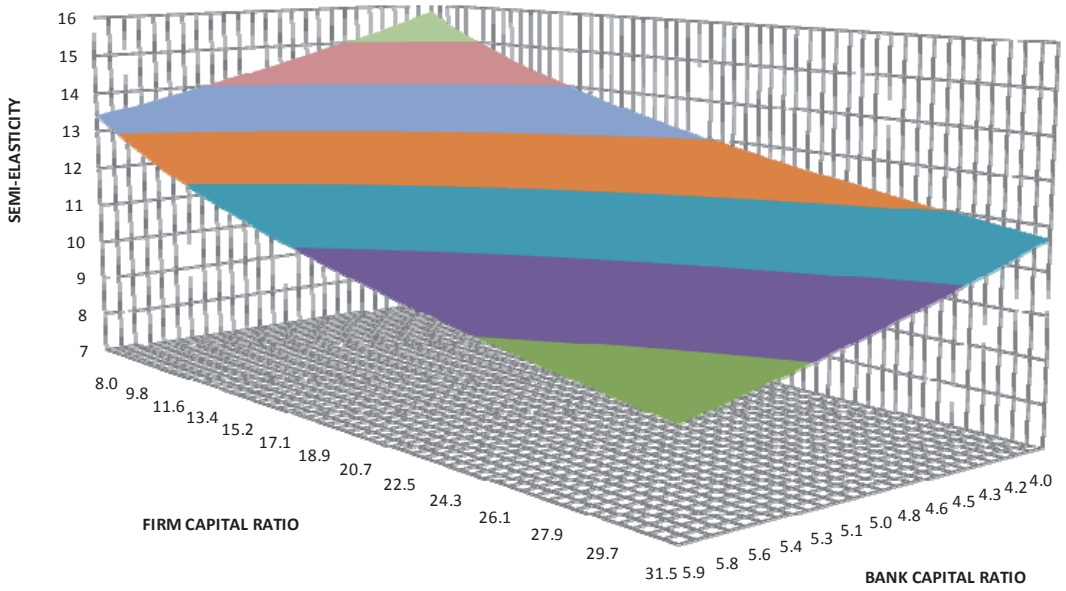
FIGURE 1. FIRM AND BANK CAPITAL RATIO AND THE EXTENSIVE MARGIN OF LENDING

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

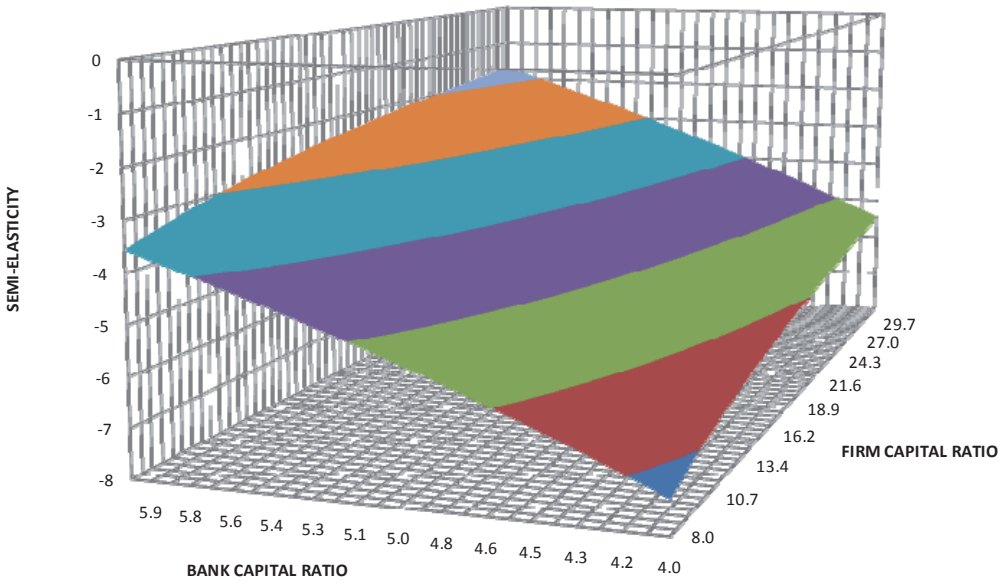
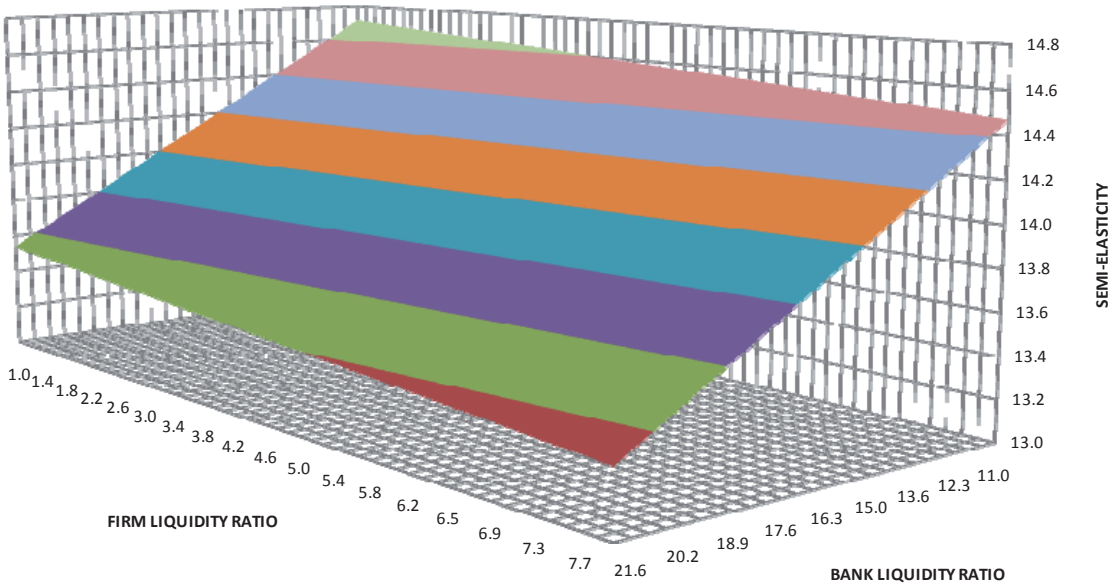


FIGURE 2. FIRM AND BANK LIQUIDITY RATIO AND THE EXTENSIVE MARGIN OF LENDING

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

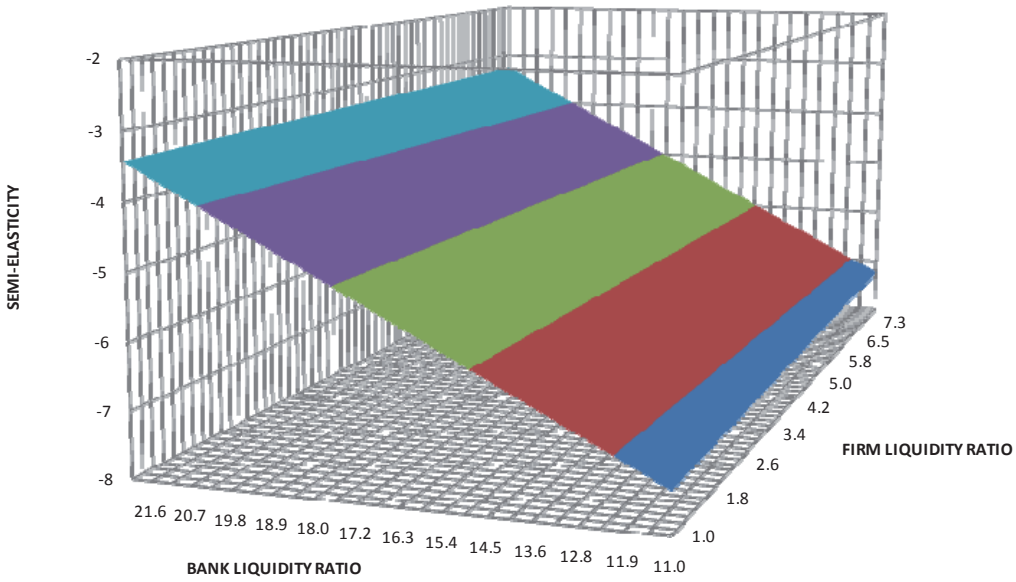


TABLE 1. DESCRIPTIVE STATISTICS FOR THE VARIABLES USED IN THE ANALYSIS OF THE EXTENSIVE MARGIN OF LENDING

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 capital ratio 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$_{bt-1}$)	-	The log of the capital ratio of the bank	1.61	0.46	-9.71	1.39	1.57	1.80	4.15
BANK CAPITAL RATIO$_{bt-1}$	%	The ratio of bank equity and retained earnings over total assets of the bank	5.35	2.09	0.00	4.00	4.82	6.02	63.15
BANK LIQUIDITY RATIO$_{bt-1}$	%	The ratio of liquid assets (cash and deposits with central banks and other credit institutions, and public debt with a maturity up to one year) 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$_{bt-1}$)	-	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$_{bt-1}$	000,000 EUR	The total assets of the bank	75,158	86,207	14	13,198	41,752	108,940	437,240
ROA$_{bt-1}$	%	The return on assets of the bank	0.94	0.55	-8.93	0.67	0.90	1.12	11.92
DOUBTFUL LOANS RATIO$_{bt-1}$	%	The doubtful loan ratio of the bank	0.84	0.85	0.00	0.34	0.57	0.97	31.24
HERFINDAHL BY INDUSTRY$_{bt-1}$	%	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 EXTENSIVE MARGIN OF LENDING

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		
Log pseudolikelihood	-236,579.05		

TABLE 3. CONDITIONS, CAPITAL AND LIQUIDITY, AND THE EXTENSIVE MARGIN OF LENDING

The estimates this table lists are based on conditional logit models. In Model IV borrowers whose loan applications were always accepted or rejected during the sample period are also included. In Model VI only borrowers with outstanding bank debt in the previous month are included. 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 II), firm-month (III), loan (IV) or bank-month (V) level, or not clustered (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 ***									50.015	15.047 ***
ΔGDP_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)	-24.483	3.559 ***	-26.116	2.252 ***	-17.290	1.478 ***					-0.417	8.369
ΔGDP_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)	-54.424	3.742 ***	-23.991	4.272 ***			-50.290	5.550 ***	-53.827	5.915 ***	-73.347	31.363 **
ΔGDP_t*FIRM LIQUIDITY RATIO$_{it-1}$	-6.503	1.756 ***	-6.382	1.743 ***	-3.877	1.235 ***					-2.627	6.843
ΔGDP_t*BANK LIQUIDITY RATIO$_{bt-1}$	-20.748	6.045 ***	-19.533	6.632 ***			-11.000	9.122	-11.037	9.846	-56.559	32.199 *
ΔIR_t	-64.210	2.868 ***									-28.784	11.392 **
ΔIR_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)	12.865	2.743 ***	13.653	2.446 ***	-0.004	1.412					1.172	6.530
ΔIR_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)	92.856	5.941 ***	17.871	6.142 ***			91.555	9.207 ***	89.109	9.841 ***	46.997	23.781 **
ΔIR_t*FIRM LIQUIDITY RATIO$_{it-1}$	4.316	1.973 **	2.632	1.989	2.032	1.242					-0.690	5.232
ΔIR_t*BANK LIQUIDITY RATIO$_{bt-1}$	77.687	6.728 ***	49.428	6.991 ***			64.552	10.314 ***	60.917	11.040 ***	20.595	22.742
ΔCPI_t	0.372	0.441									-1.417	1.771

Firm characteristics (i)																
Ln(FIRM CAPITAL RATIO$_{it-1}$)	1.075	0.081	***	1.116	0.083	***	0.640	0.048	***						-0.002	0.273
FIRM LIQUIDITY RATIO$_{it-1}$	0.175	0.061	***	0.184	0.062	***	0.301	0.040	***						0.059	0.223
Ln(TOTAL ASSETS$_{it-1}$)	0.029	0.011	***	0.041	0.011	***	-0.205	0.003	***						-0.112	0.008 ***
Ln(1+AGE$_{it-1}$)	0.080	0.022	***	0.144	0.024	***	-0.023	0.004	***						-0.125	0.013 ***
ROA$_{it-1}$	0.335	0.056	***	0.336	0.056	***	0.098	0.025	***						-0.125	0.064 *
I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST$_{it-1}$)	-0.437	0.051	***	-0.438	0.051	***	-0.632	0.029	***							
I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST$_{it-1}$)	-0.156	0.039	***	-0.135	0.039	***	-0.101	0.009	***						-0.322	0.065 ***
Ln(1+No. MONTHS WITH THE BANK$_{ibt-1}$)	0.031	0.003	***	0.033	0.003	***	0.082	0.002	***	0.048	0.006	***	0.052	0.006 ***	0.205	0.008 ***
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	-0.744	0.016	***	-0.725	0.016	***	0.285	0.006	***						-0.163	0.035 ***
Industry characteristics (s)																
INDUSTRY DOUBTFUL LOANS RATIO$_{st-1}$	-5.275	1.048	***	-6.674	1.111	***	-7.226	0.821	***						0.069	4.244
Province characteristics (p)																
Ln(No. BANKS$_{pt-1}$)	0.542	0.069	***	0.504	0.071	***	-0.138	0.016	***						-0.409	0.059 ***
Bank characteristics (b)																
ln(BANK CAPITAL RATIO$_{bt-1}$)	0.512	0.106	***	0.469	0.131	***				0.422	0.156	***	0.506	0.166 ***	1.269	1.030
BANK LIQUIDITY RATIO$_{bt-1}$	0.245	0.201		0.483	0.233	**				-0.303	0.296		-0.223	0.321	0.908	1.052
Ln(TOTAL ASSETS$_{bt-1}$)	0.000	0.003		-0.120	0.037	***				-0.005	0.004		-0.012	0.005 ***	-0.025	0.009 ***
ROA$_{bt-1}$	2.746	0.608	***	-0.316	0.868					6.577	1.064	***	6.681	1.138 ***	-3.154	1.929
DOUBTFUL LOANS RATIO$_{bt-1}$	2.128	0.511	***	0.131	0.719					1.137	0.777		0.976	0.834	0.734	1.660
HERFINDAHL BY INDUSTRY$_{bt-1}$	0.274	0.049	***	-0.274	0.118	**				0.121	0.076		0.124	0.082	0.664	0.195 ***
Region and Industry Effects	no			no			yes			no			no		yes	
Firm Fixed Effects	yes			yes			no			no			no		no	
Bank Fixed Effects	no			yes			no			no			no		no	
Month Fixed Effects	no			yes			no			no			no		no	
Bank-Month Fixed Effects	no			no			yes			no			no		no	
Firm-Month Fixed Effects	no			no			no			yes			no		no	
Loan Fixed Effects	no			no			no			no			yes		no	
No. Observations	562,020			562,020			813,115			155,167			134,445		42,029	
No. of Clusters and Level of Clustering	106,466	Firm		106,466	Firm		8,399	Bank-Month		68,228	Firm-Month		62,483	Loan	No	
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	
Log pseudolikelihood	-236,186			-232,060			-510,723			-54,898			-46,735		-28,090	

TABLE 4. CONDITIONS, CAPITAL AND LIQUIDITY, AND CREDIT SUBSTITUTION

The estimates this table lists are based on conditional logit models. The dependent variable is AT LEAST ONE LOAN APPLICATION IS GRANTED$_{it}$ which equals one if firm *i* applies for a loan at time *t* and one or more loans are granted in month *t* to *t+3* by any bank, and equals zero if firm *i* applies for a loan at time *t* but did not obtain any loans in *t* to *t+3*. The definition of the other variables can be found in Table 1. The bank characteristics are those of the average bank the firm either borrows from or gets rejected by. 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 level 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		
	Coefficient	S.E.		Coefficient	S.E.		Coefficient	S.E.	
Macroeconomic conditions (t)									
ΔGDP_t	20.985	1.061	***	56.097	8.412	***			
ΔGDP_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)				-13.026	3.017	***	-17.099	3.052	***
ΔGDP_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)				-47.646	20.776	**	-41.239	20.603	**
ΔGDP_t*FIRM LIQUIDITY RATIO$_{it-1}$				-9.114	2.451	***	-8.263	2.457	***
ΔGDP_t*BANK LIQUIDITY RATIO$_{bt-1}$				-39.351	16.469	**	0.118	17.440	
ΔIR_t	-12.851	1.332	***	-26.550	7.570	***			
ΔIR_t*Ln(FIRM CAPITAL RATIO$_{it-1}$)				-1.074	3.609		5.701	3.666	
ΔIR_t*Ln(BANK CAPITAL RATIO$_{bt-1}$)				5.630	16.943		10.857	17.114	
ΔIR_t*FIRM LIQUIDITY RATIO$_{it-1}$				8.511	2.974	***	7.017	2.982	**
ΔIR_t*BANK LIQUIDITY RATIO$_{bt-1}$				52.196	14.949	***	40.614	16.878	**
ΔCPI_t	-1.146	0.689	*	-0.768	0.694				
Firm characteristics (i)									
Ln(FIRM CAPITAL RATIO$_{it-1}$)	0.173	0.058	***	0.588	0.112	***	0.754	0.114	***
FIRM LIQUIDITY RATIO$_{it-1}$	0.038	0.042		0.315	0.087	***	0.297	0.087	***
Ln(TOTAL ASSETS$_{it-1}$)	0.131	0.017	***	0.132	0.017	***	0.144	0.017	***
Ln(1+AGE$_{it-1}$)	0.011	0.034		0.016	0.035		0.200	0.039	***
ROA$_{it-1}$	0.241	0.075	***	0.244	0.075	***	0.198	0.075	***
I(DOUBTFUL LOANS AT THE TIME OF THE REQUEST$_{it-1}$)	-0.906	0.080	***	-0.892	0.080	***	-0.889	0.080	***
I(DOUBTFUL LOANS BEFORE THE TIME OF THE REQUEST$_{it-1}$)	-0.486	0.065	***	-0.472	0.065	***	-0.456	0.065	***
Ln(1+No. MONTHS WITH THE BANK$_{ibt-1}$)	0.071	0.009	***	0.071	0.009	***	0.070	0.009	***
Ln(1+NUMBER OF BANK RELATIONSHIPS$_{ibt-1}$)	-0.025	0.023		-0.022	0.023		-0.013	0.023	
Industry characteristics (s)									
INDUSTRY DOUBTFUL LOANS RATIO$_{st-1}$	-9.138	3.364	***	-8.201	3.382	**	-10.717	3.478	***
Province characteristics (p)									
Ln(No. BANKS$_{pt-1}$)	0.453	0.111	***	0.456	0.111	***	0.290	0.114	**
Characteristics of the mean lending or rejecting bank (b)									
ln(BANK CAPITAL RATIO$_{bt-1}$)	0.498	0.160	***	2.005	0.707	***	1.601	0.701	**
BANK LIQUIDITY RATIO$_{bt-1}$	-0.092	0.150		1.204	0.552	**	-0.386	0.590	
Ln(TOTAL ASSETS$_{bt-1}$)	0.022	0.009	**	0.023	0.009	***	0.045	0.009	***
ROA$_{bt-1}$	0.117	1.842		0.212	1.869		4.437	1.984	**
DOUBTFUL LOANS RATIO$_{bt-1}$	1.366	1.374		2.131	1.412		1.263	1.479	
HERFINDAHL BY INDUSTRY$_{bt-1}$	-0.313	0.164	*	-0.255	0.166		0.450	0.180	**
Firm Fixed Effects	yes			yes			yes		
Month Fixed Effects	no			no			yes		
No. Observations	240,107			240,107			240,107		
No. of Clusters and Level of Clustering	56,387	Firm		56,387	Firm		56,387	Firm	
Sample Period	2002:M2-2008:M12			2002:M2-2008:M12			2002:M2-2008:M12		
Log pseudolikelihood	-88,200			-88,157			-87,948		

TABLE 5. DESCRIPTIVE STATISTICS FOR THE VARIABLES USED IN THE ANALYSIS OF THE INTENSIVE MARGIN OF LENDING

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 9,983,463 for all variables. The sample period equals 1988:Q2 – 2008:Q4.

	Mean	SD	Min	P25	Median	P75	Max
Dependent variable							
ΔLN(LOAN CREDIT$_{ibt}$)	-0.01	0.48	-12.08	-0.09	0.00	0.01	12.08
Macroeconomic conditions (t)							
ΔGDP$_{t-1}$	3.28	1.29	-1.67	2.70	3.56	3.97	5.82
ΔIR$_{t-1}$	-0.36	1.71	-7.78	-1.24	-0.01	0.61	4.59
ΔCPI$_{t-1}$	3.64	1.27	1.41	2.68	3.50	4.34	7.07
Characteristics of the mean bank (b)							
Ln(BANK CAPITAL RATIO$_{bt-1}$)	1.75	0.34	-0.62	1.51	1.69	1.96	4.53
BANK CAPITAL RATIO$_{bt-1}$	6.10	2.40	0.54	4.52	5.43	7.10	92.56
BANK LIQUIDITY RATIO$_{bt-1}$	25.93	13.31	0.17	15.06	25.26	35.25	96.42
Ln(TOTAL ASSETS$_{bt-1}$)	17.02	1.65	8.15	15.95	17.14	18.27	19.86
TOTAL ASSETS$_{bt-1}$	68,400	90,300	3	8,455	27,800	86,200	422,000
ROA$_{bt-1}$	1.16	0.74	-16.38	0.72	1.00	1.46	9.42
DOUBTFUL LOANS RATIO$_{bt-1}$	2.54	3.50	0.00	0.60	1.20	2.93	100.00

TABLE 6. CONDITIONS, CAPITAL AND LIQUIDITY, AND THE INTENSIVE MARGIN OF LENDING

The estimates this table lists are based on ordinary least squares models. The dependent variable is ΔLN(LOAN CREDIT$_{ibt}$) which is the change in nominal outstanding credit of firm *i* granted by bank *b* during quarter *t*. The definition of the other variables can be found in Table 1, their descriptive statistics are in Table 5. Subscripts indicate the time of measurement of each variable. The sample period equals 1988:Q2 – 2008:Q4. For each model coefficients are listed in the first column and the standard errors clustered at the bank-month 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%.

	I		II		III		IV	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Macroeconomic conditions(t)								
ΔGDP_{t-1}	2.415	0.310 ***	3.573	0.340 ***				
ΔGDP_{t-1}*CAPITAL RATIO$_{bt-1}$	-2.964	0.689 ***	-4.135	0.738 ***	-1.680	0.654 **	-2.101	0.845 **
ΔGDP_{t-1}*LIQUIDITY RATIO$_{bt-1}$	-1.978	0.432 ***	-3.372	0.452 ***	-0.483	0.470	-0.641	0.580
ΔIR_{t-1}	-0.781	0.223 ***	-1.775	0.228 ***				
ΔIR_{t-1}*CAPITAL RATIO$_{bt-1}$	1.058	0.471 **	1.795	0.476 ***	0.767	0.427 *	1.103	0.546 **
ΔIR_{t-1}*LIQUIDITY RATIO$_{bt-1}$	0.594	0.313 *	2.083	0.321 ***	-0.221	0.350	-0.282	0.432
ΔCPI_{t-1}	-0.124	0.059 **	0.330	0.063 ***				
Characteristics of the bank (b)								
CAPITAL RATIO$_{bt-1}$	0.100	0.026 ***	0.163	0.028 ***	0.050	0.024 **	0.067	0.030 **
LIQUIDITY RATIO$_{bt-1}$	0.059	0.015 ***	0.173	0.016 ***	-0.004	0.018	-0.004	0.021
LN(TOTAL ASSETS$_{bt-1}$)	-0.001	0.000 ***	-0.003	0.000 ***	-0.001	0.000 ***	0.000	0.000
ROA$_{bt-1}$	0.031	0.078	0.190	0.086 **	0.105	0.071	0.041	0.095
DOUBTFUL LOANS RATIO$_{bt-1}$	-0.053	0.018 ***	0.048	0.021 **	-0.070	0.022 ***	-0.008	0.026
Quarter Fixed Effects	no		no		yes		no	
Firm Fixed Effects	no		yes		no		no	
Firm-Quarter Fixed Effects	no		no		no		yes	
No. Observations	9,983,463		9,983,463		9,983,463		9,983,463	
No. of Clusters and Level of Clustering	16,588	Bank-Quarter	16,588	Bank-Quarter	16,588	Bank-Quarter	16,588	Bank-Quarter
Period	1988:Q2-2008:Q4		1988:Q2-2008:Q4		1988:Q2-2008:Q4		1988:Q2-2008:Q4	

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