NBER WORKING PAPER SERIES

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Working Paper 16595
http://www.nber.org/papers/w16595

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2010

The results or views expressed in this study are those of the authors and do not necessarily reflect those of the Banco de España, European Central Bank and Eurosystem. Corresponding Author: Mian, (510) 643 1425, atif@haas.berkeley.edu. We thank Michael Weber for excellent research assistance and Asim Khwaja and Amir Sufi for extremely helpful comments and discussion. We would also like to thank seminar participants at the University of Chicago Booth School of Business, European Central Bank, Universitat Pompeu Fabra, New York Federal Reserve, University of Michigan (Ross), Notre Dam, and University of California Berkeley for comments. Financial support from the Coleman Fung Risk Management Research Center at University of California Berkeley is gratefully acknowledged. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Local Versus Aggregate Lending Channels: The Effects Of Securitization On Corporate Credit Supply In Spain
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NBER Working Paper No. 16595
December 2010
JEL No. E44,G01,G21

ABSTRACT

While banks may change their supply of credit due to bank balance sheet shocks (the local lending channel), firms can react by adjusting their sources of financing in equilibrium (the aggregate lending channel). We formalize a methodology for separately estimating these effects. We estimate the local and aggregate lending channel effects of the banks' ability to securitize real estate assets on non-real estate firms in Spain. We show that equilibrium dynamics nullify the strong local lending channel effect on credit quantity for firms with multiple banking relationships. However, credit terms for these firms become significantly more favorable due to securitization. Securitization also leads to an expansion in credit on the extensive margin towards first-time bank clients, and these borrowers are significantly more likely to end up in default. Finally, the 2008 collapse in securitization leads to a reversal in local lending channel.

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1 Introduction

The banking sector often takes center stage in economic controversies. Banks are accused of excessive credit creation and asset bubbles on the upside, and of being too stingy with credit on the downside, both with important consequences for economic activity. The primary suspect in such scenarios is the credit supply channel, i.e. the fear that credit growth (or lack thereof) is being dictated by malfunctions in the credit supply process rather than economic fundamentals. It was such a fear in 2008 that forced central banks around the world to intervene with hundreds of billions of dollars in the banking industry.

While shocks to balance sheets of banks may have real effects via changes in bank credit supply (Bernanke 1983; Gertler and Kiyotaki, 2010; Holmstrom and Tirole 1997), how do we know that observed fluctuations in credit are driven by supply shifts, and not demand fundamentals? Most calls for policy makers to "lean against the wind" in the midst of a credit boom, or to subsidize banks in a credit crunch, are based on the premise that the primary failure lies on the *supply* side.

Furthermore, it is increasingly recognized that supply side failures at the bank level (the "local" lending channel effect) only reflect partial equilibrium outcomes. The general equilibrium consequences could be very different and require a "macroprudential approach" to analysis (Trichet 2009; Hanson, Kashyap and Stein, forthcoming). For example, a reduction in credit supply due to an adverse bank balance sheet shock may not have any negative impact if affected firms can go elsewhere to compensate for the loss in credit. We refer to the latter response as the "aggregate" lending channel effect. Indeed proponents of non-interventionist central banking, such as Mulligan (2008), argue that such general equilibrium effects are strong enough to let credit markets heal on their own. Unnecessary interventions, they argue, create more mischief by punctuating the virtuous cycle of creative destruction.

This paper formalizes a methodology that estimates the supply side effects of both local and aggregate lending channels. Our approach separates the impact of supply from demand of credit while taking into account firm-level equilibrium adjustments. It builds upon earlier work by Khwaja and Mian 2008 (KM henceforth). KM estimate the supply-induced credit channel effect by using firm fixed effects that absorb credit demand shocks experienced by a firm. We extend this technique by estimating the otherwise unobservable covariance between bank-specific credit supply shocks and firm-specific credit demand shocks. We then use this covariance term to construct an unbiased estimate of the *aggregate* impact of bank lending channel that explicitly takes into account firm-level equilibrium adjustments.

We apply our methodology to the case of Spain and test whether the boom in securitization enables banks with large real estate assets to expand credit supply. We investigate the possible lending channel consequences of securitization for credit quantity, credit terms, and firm performance. The rapid expansion in global market for securitized products enabled Spanish banks – especially those with large real estate assets – to access wholesale financing by securitizing their real estate assets.[1]

Using ex-ante (year 2000) variation in real estate holdings to proxy for the capacity of banks to securitize assets during the securitization boom, we test if securitization expanded credit supply and encouraged riskier lending in the non-real estate sectors of the economy.[2] We utilize a comprehensive loan level data set for this purpose from the credit register of the Bank of Spain. The data include loan level information for all bank loans granted in Spain at quarterly frequency from 1999Q4 to 2009Q4. This information is then merged with balance sheet information for borrower (the firm) and lender (the bank).

We show that securitization is indeed higher for banks that had more real estate assets before the boom, and that these banks have stronger credit growth for non-real-estate firms. Applying the KM methodology, we use firm fixed-effects to absorb credit demand shocks at borrower-level and show that the securitization-induced credit growth is primarily driven by changes in the banks' credit supply. Thus improved access to wholesale financing allows banks to increase credit supply. The effect is economically large as well, with one standard deviation increase in exposure to real estate more than doubling the growth in credit supply to non-real-estate firms between 2004 and 2007.[3]

[1] We use the term "securitization" to include both covered bonds and asset-backed securities in the case of Spain.

[2] Allen and Gale (2007) and Adrian and Shin (2010) present possible mechansims through which securitization might impact credit supply.

[3] As we explain later, these results are based on firms with multiple banking relationships at the start of securitzation boom in 2004. Such firms represent 78 percent of overall bank credit in Spain.

However, despite a large local lending channel effect at bank-firm level, the net impact of securitization, i.e. the aggregate lending channel effect, is significantly lower due to "crowding out" of existing credit at firm level. Crowding out may occur for a couple of reasons. First, some firms may not be credit constrained and may not want to increase their net borrowing. If a bank offers to increase its credit supply for such a firm, the firm is likely to demand better terms and likely to cut back its borrowing from other banks. Second, even for firms that are credit-constrained, banks may not be willing to go beyond the firms' total debt capacity. For example, total borrowing capacity of firms may be fixed in the short run if they need to have scarce collateral or equity to credibly commit to banks against future misbehavior. In such a scenario, greater willingness by some banks to lend is likely to lead to a shift in borrowing towards banks that want to expand credit rather than an aggregate increase in lending. A unique advantage of our methodology is that we can incorporate such crowding out effects.

We find strong support for the crowding out hypothesis. For the set of firms with multiple borrowing banking relationships at the time of securitization boom, the aggregate lending channel effect is close to zero despite a large local lending channel effect! Crowding out thus dramatically reduces the net impact of securitization-induced credit supply on the *quantity* of credit.

There is, however, a significant impact of aggregate lending channel on the *price* of credit. We show that firms with unused lines of credit start to disproportionately favor banks with greater access to securitization, suggesting improved credit terms through a revealed preference argument. Consistent with this interpretation, we find that securitization leads to a reduction in the rate of collateralization and a lengthening of loan maturity. These results suggest that securitization leads to more favorable credit terms for borrowers as credit supply expands.

Despite the zero impact of securitization-induced credit supply channel on the *quantity* of credit, there could be some positive real effects through the effect on credit terms. However, we find no evidence of any impact on real firm outcomes, including firm sales, employment, and default rate.

The results above are based on firms that already have borrowing relationships at the time of securitization boom. When we look at the effect of securitization on the extensive margin of lending to new clients, we find a large effect on credit quantity. Growth in credit to new clients between 2004 and 2007 is much stronger for banks with greater exposure to securitization. A one standard deviation increase in exposure to real estate assets generates credit to new clients that is equivalent to 10.7 percent of bank assets. Moreover, new credit granted is riskier, as it is about a third more likely to default.

On the whole, securitization leads to favorable credit terms for firms with established access to credit but has no impact on their total borrowing or real outcomes. However, it does have a large effect on credit extension to new clients that turn out to be significantly more risky. The expansion in credit adds fragility to the financial system as new loans are significantly more likely to default during the downturn.

Finally, we also evaluate the credit supply consequences of the collapse in securitization market in 2008. There is a sharp reversal in the local lending channel as bank's with exposure to real estate securitization cut back their credit line significantly. However, the aggregate impact is more modest as borrowing firms are partially able to adjust their borrowing from other banks.

Our paper contributes to the large literature on bank transmission mechanisms in four ways.[4] First, our proposed methodology uses loan-level credit register data that are increasingly available in many countries around the world. Our technique is thus practical to implement and should help policy makers gain a better understanding of the overall strength of credit supply channel in the economy.

Second, we are the first to formally incorporate the equilibrium feedback effect from borrowers when estimating bank transmission channel. As observers such as Mulligan (2008) have emphasized, incorporating these effects is critical for proper evaluation of central bank interventions. The results of some of the previous studies that estimate transmission channel at the bank level – such as Kashyap and Stein (2000) – may be incomplete without incorporating firm level equilibrium response. Indeed, our own analysis of Spanish banks reveals

[4] A partial list on the empirical side includes Bernanke (1983), Kashyap and Stein (2000), Peek and Rosengren (2000), Ashcraft (2005), Paravisini (2008).

that while the bank transmission mechanism is strong, its aggregate impact is reduced due to the firm level crowding out effect for large segments of the economy.[5]

Third, the role of financial innovation in precipitating credit booms and subsequent financial crises through the financial intermediary system is emphasized by numerous economic historians (e.g. White (1996), Calorimis (2008), Bordo (2009) and Kindleberger (1978)). Most recently, Kohn (2009) notes "the tendency for financial crises to be preceded by bubbles spurred by financial liberalization or innovations". Our paper provides the first formal evidence on the extent to which financial innovation - in the form of securitization - induces banks to extend more credit and at riskier terms.

Fourth, there is an emerging literature on the effects of securitization on bank lending and risk-taking. Securitization has been associated with lax lending and excessive credit creation in mortgage markets during the 2000's (Keys et al (2010) and Mian and Sufi (2009)). Loutskina and Strahan (2009) show that securitizability of a loan helps disconnect the dependence of loan origination on bank financials. We contribute to this literature by analyzing the effects of securitization on lending standards and credit risk for non-real-estate related business loans.

Finally, there is some related work on the Spanish banking system using data similar to ours. Jiménez et al. (2010a and 2010b) evaluate the credit channel consequences of monetary policy. They find a significant effect of monetary policy on credit supply and risk taking. Our paper differs in its focus on securitization, as well as in introducing a new methodology that incorporates equilibrium crowding out effects. We also provide evidence on real outcomes that earlier studies did not have access to.

The rest of the paper is organized as follows. Section 2 provides the theoretical foundation for our empirical methodology. Section 3 describes the data and institutional details. Sections 4, 5 and 6 present empirical results and section 7 concludes.

[5] Another paper that tests the real effects of bank credit supply shocks is Peek and Rosegren (2000). They show that a negative credit supply shock from Japanesse banks, stemming from the real estate price bust in Japan, has negative real repercussions in US for real estate construction. However, their analysis on real effects is *only* at the *US-state level*. We, instead, do it at the *loan* and *firm* level.

2 Methodology

2.1 Basic Model

We outline our basic methodology for estimating the net impact of credit supply channel effect. Consider an economy with banks and firms indexed by i and j respectively. Firm j borrows from n_j banks at time t and assume that it borrows the same amount from each of the n_j banks.

The economy experiences two shocks at t : a firm-specific credit demand shock η_j and a bank-specific credit supply shock δ_i. η_j reflects changes in the firm's demand for credit driven by productivity or customer demand shocks. δ_i reflects changes in the bank's funding situation, such as a run on short term liabilities (a negative shock), or new opportunities to access wholesale financing (a positive shock.)

Let y_{ij} denote the log change in credit from bank i to firm j. Then the basic credit channel equation in the face of credit supply and demand shocks can be written as:

$$y_{ij} = \alpha + \beta * \delta_i + \eta_j + \varepsilon_{ij} \tag{1}$$

Equation (1) assumes that the change in bank credit from bank i to firm j is determined by an economy wide secular trend α, credit supply and credit demand shocks, and an idiosyncratic shock $\varepsilon_{ij.}$ While equation (1) is reduced form in nature, it can be derived as an equilibrium condition by explicitly modeling credit supply and demand schedules (see KM). We keep the analysis deliberately simple here to focus on the core estimation problem.

In a frictionless world (as in the Modigliani-Miller theorem), bank lending is independent of credit supply conditions and only depends on "fundamental" credit demand factors. Financial intermediaries in such scenarios have no impact on the economy and, hence, there is no bank transmission channel, i.e. $\beta = 0$ in equation (1). The presence of financing frictions, however, may force banks to pass on their credit supply shocks δ_i to borrowing firms, making $\beta > 0$.

β if often referred to as the "bank lending channel", and we refer to it as the local lending channel in this paper. It can be estimated from (1) using OLS, giving us $\widehat{\beta}_{OLS} = \beta + \frac{Cov(\delta_i, \eta_j)}{Var(\delta_i)}$.

The expression implies that as long as credit supply and demand shocks are significantly correlated, $\widehat{\beta}_{OLS}$ in (1) would be a biased estimate of the true β. For example, if banks receiving a positive liquidity shock are more likely to lend to firms that simultaneously receive a positive credit demand boost, then β would be biased upwards. KM resolve this issue by focusing on firms with $n_j \geq 2$, and absorbing out η_j through firm fixed-effects. The estimated coefficient $\widehat{\beta}_{FE}$ then provides an unbiased estimate of β.

However, $\widehat{\beta}_{FE}$ does not give us a complete picture of the net effect of bank lending channel on the economy. In particular, individual firms affected by the local lending channel due to a positive β in equation (1) may seek alternative sources of bank financing to compensate for any loss of credit. Alternatively, if firms benefit from greater provision of credit via a positive credit supply shock to an individual bank, their borrowing from elsewhere may be cut either voluntarily or due to a crowding-out effect. Thus, in order to gain a complete picture of the credit channel effect, one must compute its consequences at the aggregate *firm* level. We can do so by estimating the firm-equivalent version of (1):

$$\overline{y}_j = \overline{\alpha} + \overline{\beta} * \overline{\delta}_j + \eta_j + \overline{\varepsilon}_j \tag{2}$$

$\overline{y}_j$ denotes the log change in credit for firm j across *all* banks.[6] It is *not* a simple average of y_{ij} from (1) since a firm can start borrowing from new banks as well. $\overline{\delta}_j$ denote the *average* initial exposure to real estate assets of banks lending to firm j at time t, i.e. $\overline{\delta}_j = \sum_{i \epsilon N_j} \frac{\delta_i}{n_j}$, where N_j represents the set of banks lending to firm j at time t. $\overline{\varepsilon}_j$ is an idiosyncratic error term. The same credit demand shock η_j appears in both equations (1) and (2) under the assumption that the shock equally affects a firm's borrowing from all banks.

The aggregate impact of credit supply channel is captured by the coefficient $\overline{\beta}$, which we refer to as the aggregate lending channel. If there is no adjustment at firm-level in the face of bank-specific credit channel shocks, then $\overline{\beta} = \beta$. However if there is some adjustment at firm-level, for example a crowding-out effect, then $\overline{\beta}$ should be less than β.

[6] Depending on data availability, it could include non-bank sources of credit as well.

How does one estimate $\overline{\beta}$? An OLS estimate of (2) yields $\widehat{\overline{\beta}}_{OLS} = \overline{\beta} + \frac{Cov(\delta_i, \eta_j)}{Var(\overline{\delta}_j)}$.[7] While the variance of $\overline{\delta}_j$ can be estimated in data, the covariance term between credit demand and credit supply shocks is unobservable to the econometrician. However, a unique advantage of the preceding fixed-effects estimator at loan level is that it allows us to back-out the covariance term. Since $\widehat{\beta}_{FE}$ is an unbiased estimate of β, we can write $Cov(\delta_i, \eta_j) = \left(\widehat{\beta}_{OLS} - \widehat{\beta}_{FE}\right) * Var(\delta_i)$, where variance of bank credit supply shocks δ_i can be estimated directly from data. Thus the aggregate lending channel effect, $\overline{\beta}$, can be estimated as:

$$\widehat{\overline{\beta}} = \widehat{\overline{\beta}}_{OLS} - \left(\widehat{\beta}_{OLS} - \widehat{\beta}_{FE}\right) * \frac{Var(\delta_i)}{Var(\overline{\delta}_j)} \tag{3}$$

The second term on the right hand side of (3) is the adjustment term that corrects for any bias in the OLS estimate of (2). The adjustment term corrects for the otherwise unobserved covariance between credit supply and demand shocks. The extra variance term in the denominator corrects for the fact that the variance of bank shocks averaged at the firm level may be different from the variance of bank shocks overall.

Equation (3) summarizes our methodology for estimating the net impact of bank credit channel. It is simple and practical to implement as loan level credit register data are now available in most countries of the world. The procedure can be summarized as follows. For any given bank shock δ_i that is suspected of generating a transmission channel, run OLS and FE versions of (1) to estimate $\widehat{\beta}_{OLS}$ and $\widehat{\beta}_{FE}$ respectively. Then estimate firm level equation (2) using OLS to generate $\widehat{\overline{\beta}}_{OLS}$. Finally plug these three coefficients in (3) to estimate the unbiased impact of credit supply channel at the firm level.

2.2 Calibration and Robustness

Our model uses simplifying assumptions to keep the analysis tractable. Real world data may not satisfy some of these assumptions. How robust is our core result, i.e. equation (3), to such perturbations? Since close-form solutions are not possible with more generic assumption, we present numerical solutions to our model under alternative scenarios.

[7] This follows from the observation that $Cov(\overline{\delta}_j, \eta_j) = Cov(\sum_{i \epsilon N_j} \frac{\delta_i}{n_j}, \eta_j) = Cov(\delta_i, \eta_j)$.

Table I summarizes the results of our simulation exercise. Panel A takes our baseline scenario, i.e. the model presented above, and calibrates it using different assumptions on two key parameters of interest: the (unobservable) correlation between credit demand and credit supply shocks (ρ), and the extent of firm-level adjustment to bank transmission shocks (Λ). $\Lambda = 100\%$ implies there is full adjustment at the firm-level making $\overline{\beta} = 0$. The calibration exercise assumes that true $\beta = 0.5$ and shocks are normally distributed with mean zero and variance equal to 1.0.[8] The results show that while OLS estimates $\widehat{\overline{\beta}}_{OLS}$ and $\widehat{\beta}_{OLS}$ can be significantly biased with high absolute levels of ρ, our fixed-effects and bias-correction procedure in (3) successfully backs out the true coefficients of interest. In a way, Panel A also serves as a "numerical proof" of our baseline methodology.

The baseline analysis assumes that banks continue to lend to firms after realization of shocks. This may not happen in practice. Some loans may be dropped for idiosyncratic reasons and others due to either credit supply or credit demand shocks. Our OLS and FE regressions from the preceding section ignores such dropped loans. Does ignoring dropped loans change the results in Panel A? We test this by simulating dropped loans and then running our estimation procedure on surviving loans. In particular, add a first-stage before our estimation procedure that drops some loans from our sample depending on the loans' credit demand shock, the credit supply shock, and an idiosyncratic factor. The probability of a loan getting dropped is modelled as a probit, with weights on various factors chosen to match what we find in data[9]. We then rerun our estimation procedure on the remaining sample. The results in Panel B show that our estimate of betas remains valid even when conditioning on loans that do not get dropped[10].

[8] The variance roughly reflects the variance of firm-level credit changes from 2004Q4 to 2007Q4.

[9] We set these parameters such that the coefficient on supply shock is -0.25 (as we will see in column (7) of table 5). The coefficient on demand shock is also assigned the same magnitude. Finally, the level effect is chosen such that about a third of total loans are dropped, as in our Spanish data.

[10] Our model also assumes that each firm borrows the same amount initially from its set of lenders. We also tested for robustness of our results to this assumption by similating borrowing across banks by a firm that matches our data. Our methodology continues to perform very well with these changes.

3 Data and Institutional Background

3.1 Data

Our data come from loan level credit register of the central bank of Spain (*Banco de España*), which also the banking supervisor in Spain. It covers all loans to all non-financial firms. For computational purposes, we restrict to loans with an average borrowing of at least €60,000. We further restrict the data to non-real-estate loans in order to avoid the concern that our results may be spuriously driven by the boom in real estate sector during our sample period.

The data come at quarterly frequency and cover the period from the fourth quarter of 1999 to the fourth quarter of 2009. The 10 year coverage has the advantage of covering the full lending cycle in Spain. There are 487,090 firms borrowing from any of a possible of 215 banks during this time period. In order to avoid data management issues due to large size, we randomly sample 10% of the firms based on the random, penultimate digit of the firm fiscal identity number. Once a firm is selected we keep all of its loans over the 10 year period in our sample. Our 10% random sample consists of 48,709 firms. While a firm may have multiple loans from the same bank at a point in time, we aggregate loans at the firm-bank-quarter level which forms our unit of analysis. Thus a "loan" in this paper refers to a firm-bank pair.

Firms can enter and exit the sample during our sample period. The average tenure of a firm in our sample is 25.7 quarters (out of a possible of 41 quarters), with a median tenure of 26 quarters and 25th and 75th percentile of 14 and 41 quarters respectively. The distribution of bank credit across firms is highly skewed with top 10% of firms borrow 75.3% of total credit in the economy (Figure 1, top-left panel). The skewed nature of firm-size distribution is typical around the world. The dotted line in the top-left panel of Figure 1 shows that the cumulative distribution function of credit across banks is very similar to the CDF picture for firms. As with firms, the top 10% of banks dominate the credit market.

There is a tendency for banks to merge over our sample period as well. There are 246 banks at the beginning of sample period and 214 banks by our sample's end. However, major bank mergers (in terms of size) happen before 2001Q4. Therefore, in order to keep a more consistent panel, we focus on the period 2001Q4 till 2009Q4 in our analysis.[11] Since our core variation of interest occurs in mid-2000's, starting in 2001Q4 does not constrain our analysis.

The top-right panel in Figure 1 plots the total cumulative bank credit over time. There is a sharp increase in the growth of bank credit in 2004 followed by sudden stagnation in 2008 when the global financial crisis hits. One of our aims in this paper is to test the extent to which the boom in credit between 2004 and 2007 can be attributed to the rise in securitization. As such many of our tests focus on loans outstanding in 2004Q4, and follow them forward.[12]

Table II presents summary statistics for this set of firms. There are 29,848 firms taking out 67,838 loans in the fourth quarter of 2004. Since our methodology relies on firms with at least two banking relationships, Table II also presents summary statistics for this subset of firms. There are 15,697 such firms taking out 51,397 loans. While about half the total firms have multiple banking relationships, they represent 78% of total firm credit in the economy.

The average loan size is €288,000 and the average firm borrows a total of €662,000 from the banking sector. 1.9% of loans are in default as of 2004Q4. However, there is a sharp increase in defaults in 2008 and, by the end of 2009, almost 8% of loans are in default (Figure 1 bottom-left panel).

One of our key variables at bank level is a bank's exposure to real estate assets at the beginning of our sample period. This variable is constructed as the share of total bank loans that go to the real estate sector as of 2001 (residential mortgages as well as loans to construction and real estate firms). The average exposure to real estate sector is 44% with a standard deviation of 15.7%. The idea is to take into account the original stock of financial assets that directly or indirectly can be easily securitized[13].

Finally, we also have information at the loan level on total loan commitments, whether the loan is collateralized by an asset and the maturity of the loan. For a large subset of firms we also have information on total assets, sales and number of employees. Summary

[11] If a bank is acquired by another bank, its loan portfolio shows up in the portfolio of the acquiring bank in our sample.

[12] There are 192 banks in 2004Q4.

[13] There was almost no securitization of loan to real estate developers in Spain. However, these loans turn into mortgages - often from the same bank - after sale of houses and then may be securitized.

statistics of all these variables are presented in Table II.

3.2 The Spanish Financial System

Since securitization is largely limited to real estate loans, we discuss some key features of the Spanish mortgage industry. There is no counterpart to Freddie Mac and Fannie Mae in Spain. Consequently all mortgage loans are held by banks on their books in the beginning of our sample period when there is negligible securitization. This helps to explain the high share of real estate loans on banks' books in Spain. Another difference from the U.S. is that mortgage loans in Spain have full recourse to the borrower.

Banks in Spain can be classified in two broad categories: commercial banks and savings banks (or *Cajas*). Out of the 192 banks in 2004Q4 for which we have financial information, there are 46 savings banks representing 41.9% of total bank assets. Commercial banks are traditional banks (including foreign banks) that have shareholders as owners of the bank. Cajas on the other hand rely on a general assembly for governance, consisting of representatives of regional and municipal government, depositors representatives, and non-governmental organizations (NGO) such as the catholic church, for instance. The general assembly elects a board of directors who look for a professional manager to run the banking business. Commercial banks profits can either be retained as reserves or pay out as dividends. For the Cajas, the profits are either retained or paid out as social dividend (i.e. to build and run educational facilities, libraries, sport facilities, pensioners clubs and so on where the Cajas operate). However, despite their differences in governance structures, both commercial banks and Cajas operate under the same regulatory framework and compete against each other in common markets.

Historically, Cajas have focused on households and engaged in providing mortgage and deposit facilities. Commercial banks, on the other hand, have been more dominant in lending to the corporate sector. However there has been considerable convergence in the scope of the two types of banks since liberalization began around mid-seventies. Nonetheless, there remain differences between Cajas and commercial banks today with Cajas being more reliant on lending to real estate and household sectors.

3.3 The Securitization Boom

The global boom in market-mediated securitization is well known. Adrian and Shin (2010) and Ashcraft, Goldsmith-Pinkham and Vickery (2010) show that the issuance of non-GSE ABS and subprime MBS in the U.S. rose dramatically during 2004 to 2007. Securitization was driven by a series of global factors, such as trade imbalances and accommodative monetary policy in the U.S. Furthermore, the rise in securitization was not limited to the U.S. Countries with characteristics similar to the U.S., such as large current account deficits and a housing boom, also saw a rise in the issuance of mortgage-backed securities. One such country was Spain.

The lower-right panel in Figure 1 plots Spanish house prices over time. There is a sharp increase in the growth of house prices beginning in 2001 that runs until 2007 when the global recession kicks in. As with the U.S., the increase in house price appreciation is also associated with a rapid increase in the issuance of securitized real estate assets in Spain.

We use the term "securitization" for issuance of both covered bonds and asset-backed securities by banks in Spain. While the two securities differ in some aspects, they share the basic characteristic of allowing banks to access liquidity by pledging their real estate assets. We explain these two securities in more detail below.

Covered bonds are backed by a portfolio of mortgages with a loan-to-value ratio of at most 80%. Moreover, banks can only issue covered bonds up to 80% of the total value of underlying mortgages. Finally, covered bonds also provide recourse to the issuing bank if needed. Thus covered bonds are heavily collateralized, and their sole purpose is the provision of liquidity. There is no capital advantage for issuing covered bonds and these bonds remain on a bank's balance sheet.

Asset backed securities (ABS) are issued by selling a portfolio of loans (usually mortgages). In Spain the originating bank is usually the servicer of loans as well. Thus one important difference between covered bonds and ABS is that ABS enable banks to transfer some credit risk out of their balance sheet.

However, even this distinction is not black and white. In certain cases, banks provide "credit enhancement" to an ABS, thus promising to absorb a certain percentage of the first losses in case of default. The accounting rules in Spain instructed banks to keep ABS on their balance sheets if they retain some component of credit risk. Since we do not know exactly whether a given ABS issuance is kept on the books or not, we cannot back out ABS issuance at the bank level from bank balance sheets alone. This is one of the reasons we use banks' holding of real estate assets as our main proxy for exposure to securitization.

Figure 2 plots the aggregate issuance of asset-backed securities and covered bonds in Spain over time. The top panel plots the annual flow, while the bottom panel shows the stock of securities issued. The issuance of securitized assets (whether ABS or covered) was close to negligible in the early 2000s. However, by 2004 issuances become substantial with over 50 billion Euros of securities issued every year. By 2008, the stock of securitized assets represents 29.9% of total bank credit.

4 Securitization and the Lending Channel

What does the securitization shock imply for Spanish banks? As highlighted earlier, 44% of bank loans are granted to the real estate sector in Spain. Therefore, securitization (i.e. issuance of ABS and covered bonds) provides a novel opportunity for banks to use their real estate assets as collateral for wholesale financing. Securitization thus enhances a bank's access to liquidity, especially for banks with large loan portfolios backed by real estate assets.

Does greater access to liquidity encourage banks to make more loans to non-financial, non-real-estate firms? Relatedly, does enhanced liquidity lead banks to alter the terms at which they lend? We test such credit supply channel consequences of securitization.

4.1 Bank Level Evidence

The effect of securitization is not uniform across all banks. Since securitization depends on real estate assets, banks with greater exposure to real estate assets are impacted more. This is confirmed in the top panel of Figure 3 that plots the change in securitized assets between 2004 and 2007 for a bank against its exposure to real estate assets in 2000. One can see that banks with greater exposure to real estate assets are able to securitize more assets.

This result is confirmed by columns (1) through (3) of Table III. Columns (1) and (2) present the bivariate relationship in un-weighted and weighted (by bank assets) regressions. The correlation between real estate exposure and securitization at the bank level is strong and highly significant. Since there is negligible securitization in the beginning of 2000s, an equivalent test for new securities issued is to regress the stock of securities issued by 2007 against initial real estate assets. This is done in column (3) and the correlation becomes even stronger.

Does increased access to liquidity due to securitization also lead banks to extend more credit? The bottom panel of Figure 3 presents preliminary evidence in this regard. It plots the change over 2004-07 in bank credit to non-real-estate sector against a bank's initial exposure to real estate. There is a strong and significant relationship between the two. This is further confirmed by column (4) of Table III. Column (5) shows that the same result holds if we replace real estate exposure with issuance of new asset-backed securities between 2004 and 2007.

Figure 3 and Table III provide preliminary evidence in favor of the presence of a credit channel at bank level. However, such evidence cannot be considered conclusive since banks with higher real estate exposure (our ex-ante proxy, instrument, for securitization) might be systematically different. For example, banks with higher exposure to real estate loans may be lending to firms that experience faster credit demand growth during the housing boom. If this were true, our bank level results would be spuriously driven by credit demand shocks, and could not be attributed to credit supply consequences of securitization.

4.2 Are Banks with Real-Estate Exposure Different?

Table IV tests whether banks with high real estate exposure are systematically different. The top panel regresses various bank characteristics against banks' exposure to real estate assets and reports the coefficient on real estate exposure.

Banks with more real estate exposure as of 2000 are similar to other banks in terms of profitability (return on assets), risk (non-performing loans) and capital ratio. However for reasons already highlighted, banks with real estate exposure are more likely to be Cajas, or saving banks.

The middle panel tests whether firms borrowing from banks with high real estate exposure are systematically different. Since a firm may borrow from multiple banks, we take the average of initial real estate exposure for banks lending to a given firm. We find that firms borrowing from banks with greater real estate exposure are smaller in size along all dimensions – total assets, bank credit and sales. These firms also have higher tangible assets to total assets ratio, and are less likely to borrow short term.

The bottom panel tests if loan level outcomes as of 2000 differ for banks with greater real estate exposure. While there is no difference in default rates, loans from banks with more real estate exposure are smaller on average, more likely to be collateralized and more likely to have longer maturities. The right-lower panel repeats these loan level tests, but includes firm fixed effects to focus only on within-firm variation. The loan size result goes away, showing that conditional on lending to the same firm, loan amount does not differ across banks with differential real estate exposure.

The picture painted by Table IV reveals that banks with more real estate loans as a fraction of their total loan portfolio do not differ by profitability, risk, or capital, but are more likely to be Cajas. In terms of their portfolio, real-estate exposed banks lend to smaller firms that have more tangible assets and rely on longer term financing. Consequently, loans of real-estate dependent banks are more likely to be collateralized and have longer maturity.

5 Estimating the Aggregate Lending Channel

Since firms borrowing from real estate exposed banks are quite different, there is a legitimate concern that the increase in credit by these banks between 2004 and 2007 is not driven by securitization, but by stronger credit demand from the type of firms borrowing from these banks. Even if the firms borrowing from real estate exposed banks were not different on observables, one could worry about differences along unobservable dimensions. However, as Section II explained, we can address such concern by using firms fixed effects to fully absorb changes in credit demand at firm level.

5.1 Local Lending Channel Estimates

We regress change in credit from 2004Q4 to 2007Q4 against a lender's initial exposure to real estate assets. We use real estate loan share as of 2000 as our main proxy for banks' exposure to securitization – rather than a direct measure of securitized assets – for three reasons.

First, data on securitized assets is not available for some banks whereas real estate exposure is available for all banks. Second, as we mentioned in the previous section, securitized assets are not always kept on banks' books. Therefore, it is difficult to keep an accurate count of securitized assets. However, we have already seen in Table II, banks with more real estate loans issue more covered bonds and ABS (to the extent observed). Third, and perhaps most importantly, what matters most for credit channel is the *ability* and *expectation* of access to liquidity. Even for a bank that has not yet securitized many of its assets, the knowledge that it has securitizable assets and hence access to liquidity could make it extend new credit[14].

Column (1) of Table V estimates equation (1) without firm fixed effects. In line with the bank-level results of Figure 3 and Table II, there is a strong correlation between business loan growth and a bank's initial exposure to real estate assets. Can we attribute this correlation to a credit supply effect? Since we need firm-fixed effects to answer this question, we limit ourselves to firms with multiple banking relationships as of 2004Q4. Column (2) restricts sample to such firms with results similar to column(1).

Column (3) adds firm fixed effects. The coefficient on bank real estate exposure (0.386) implies that a one standard deviation increase in real estate exposure generates a 6.1 percentage points higher growth in credit supply. This is more than a doubling of the average loan-level credit growth rate of 5.7% between 2004Q4 and 2007Q4.[15]

Since real estate exposed banks tend to grant longer term and more collateralized loans, there may be a residual concern that our results are driven by differences in the types of loans extended by real estate exposed banks. For example, perhaps credit boom was driven

[14] Nonetheless our results are robust to using securitized assets by 2007 as our main right hand side variable.

[15] This should not be confused with the overall growth in credit at the firm level, which is 21.4%. Loan-level credit growth is smaller as a firm can stop borrowing from a bank between 2004 and 2007, and start borrowing from a different bank.

by greater demand for longer term loans which happen to be the specialization of real estate exposed banks. Column (4) therefore controls for a loan's collateralization rate and maturity as of 2004Q4 as well as changes in these variables between 2004Q4 and 2007Q4. There is no appreciable change in the coefficient of interest.

Finally, we know that savings banks or Cajas are more likely to have high real estate exposure. Could our results thus far be described as a Cajas phenomenon? We address this issue in column(5) by including bank-type *interacted* with firm fixed effects, where bank-type is either "commercial" or "Cajas". The regression thus forces comparison across loans of the *same* firm and from the *same* bank-type. As results show,our coefficient of interest is even stronger than before.

Columns (2) through (5) go through a strong battery of tests to isolate the supply side transmission channel driven by a bank's exposure to real estate. Firm fixed effects, loan level controls, and bank-type interacted with firms fixed effects control for credit demand shocks in a nonparametric way. The strong power of controls can be gauged from the fact that R-sq goes to 0.003 in column (2) to 0.7 in Column(5) *without* any decrease in the coefficients' magnitude. As Altonji et al. (2005) point out, the persistence of a coefficient despite a substantial increase in regression R-sq due to controls provides strong support for exogeneity of the right hand side variable of interest.

Finally, there may be a remaining concern that our results are driven by some pre-existing trends in data. Column (6) tests for this by repeating our core specification over the period 2001Q4 to 2004Q4. The estimated coefficient turns out to be negative and is statistically indifferent from zero.

A downside of the dependent variable we have used thus far is that we cannot compute change in loan amount for loans that are dropped before 2007Q4. In order to take such "dropped loans" into account, we construct an indicator variable that is 1 if a loan exists in 2004Q4 but not in 2007Q4, and 0 if it exists in both quarters.

Column (7) repeats our core specification using "loan dropped" as dependent variable. The number of loans increases in column (7) from 32,647 to 51,397 because of the inclusion of *all* outstanding loans in 2004Q4 regardless of their status in 2007Q4. Consistent with our earlier results, banks with higher real estate exposure are *less* likely to drop a loan. Column (8) uses a Tobit specification to combine the "intensive margin" effect of column (3) and the "extensive margin" result of column (7).[16] The combined effect of the two margins makes the overall impact in the credit channel even stronger.

5.2 Aggregate Lending Channel Estimates

The results thus far highlight a strong credit channel effect driven by exposure to real estate assets. However, as we emphasized in the Introduction and Section 2, these results are incomplete as they do not incorporate firm-level adjustments in response to credit supply shocks from banks. This section addresses this limitation by implementing the empirical strategy highlighted in Section 2.

Column (9) presents the OLS (and potentially biased) estimate of firm-level credit channel coefficient. The coefficient is close to zero and precisely estimated. The unbiased estimate of firm level credit channel is given by equation (3), which adjusts the coefficient in column (9) to take into account endogenous matching of firms with banks. Since the adjustment term depends on the differences between loan level OLS and fixed effect estimate, it is going to have a small effect in our case.[17] The adjustment term is equal to (0.404-0.386)*0.025/0.0123, i.e. 0.043. The unbiased firm level credit channel effect is thus equal to 0.23-0.043=-0.020. It turns out that despite a very strong bank channel effect at the bank level, the *net* impact is close to zero![18]

Our result thus highlights the importance of incorporating firm level adjustments in credit channel estimates. A simple correlation – or even causation – between bank credit extension and bank liquidity shocks can be highly misleading. The speed at which firm-level borrowing adjusts also points towards a dynamic banking system where borrowing relationships are created and destroyed at regular frequency. Consistent with this view, we find that about 45 percent of firms during our sample period break away an existing banking relationship *and*

[16] A downside of tobit is that it does not permit us to use firm fixed effects.

[17] Our simulation exercise in section 1 shows that in general these adjustments can have a significant impact.

[18] Non-bank sources are unlikely to play a significant role in our analysis since the net impact is close to zero with only bank sources alone.

start a new banking relationship with a *different* bank afterwards. Similarly, 75 percent of all firms borrow from at least two banks during our sample period.

5.3 Quarter by Quarter Estimates

The regressions in Table V focused on the 2004Q4 to 2007Q4 period, which is the heart of credit boom in Spain. Since the underlying data are quarterly and span a much longer time horizon, we can replicate our estimates at a quarterly frequency over the entire period.

We anchor 2004Q4 as our reference quarter, and use $\Delta \log(credit)$ between quarter t and 2004Q4 as dependent variable for each quarter t from 2001Q4 to 2009Q4. We estimate the OLS and FE regressions corresponding to columns (2) and (3) of table V respectively and plot the corresponding coefficients on bank exposure to real estate in the top panel of Figure 4. These coefficients capture the evolution of loan-level credit channel in Spain.

Both OLS and FE estimates are close to zero until 2004Q4 and statistically not different from zero.[19] Thus the credit channel documented in Table V is not driven by any pre-existing trend. There is no differential growth in credit prior to 2004Q4 for loans granted by banks with greater real estate exposure.

This finding also suggests that our earlier results are not driven by a boom in house prices alone. As Figure 1 shows, the growth in house prices was as strong during the 2001-04 period as the 2004-07 period. If the credit channel effect in Table V was driven by real estate exposed banks' loan assets appreciating in value, we should see a similar effect over 2001 to 2004. The fact that we do not suggests that the credit channel effect is driven by the boom in securitization that kicks into high gear between 2004 and 2007.

Our results indicate that once securitization market is strong enough in terms of volume and is sustained over a long enough period, banks begin to rely on the newly found source of liquidity and start lending against it. The credit channel effect of securitization builds gradually over time until 2008, when the private market for securitization shuts down. Once the global financial crisis begins in fall of 2008, the credit channel in Spain turns *negative:* Banks with greater exposure to real estate assets start contracting credit at a faster pace.

[19] Standard errors are not reported for brevity, but are similar to those shown in corresponding tables.

The top panel uses log change in loan amount outstanding as dependent variable. The lower panel replicates the analysis but uses log change in commitment amount as dependent variable. The coefficient estimates are similar to the top panel with one important difference. The post-2008 reversal in credit channel is stronger with loan commitment than loan outstanding. This difference reflects a stronger contraction in the *supply* of credit by real-estate exposed banks through loan commitments. The differential impact for outstanding loans is smaller because the drawn to commitment ratio rises faster for banks with more real estate exposure.[20]

The post-2008 reversal in bank lending channel at the loan level takes place despite massive European Central Bank (ECB) intervention in the securitization market. As Figure 2 makes clear, the flow of asset-backed securities issued by Spanish banks in 2008 and beyond is almost entirely driven by the interest of the banks to build up a portfolio of securities that can be used as collateral for liquidity through the ECB. The private market for securitized assets had pretty much evaporated by then[21]. Our result thus illustrates that banks with greater dependence on securitization start to cut back credit drastically when private securitization market dries up. However, the net impact of this cut is not as strong. As Figure 5 shows, firm level adjustment mutes the overall impact of bank-specific cuts in credit during 2008-09.

The OLS and FE estimates track each other quite closely in Figure 4. Since the FE estimate absorbs credit demand shocks at the firm-level, the compliance between OLS and FE estimates show that credit demand shocks during our sample period are largely orthogonal to credit supply shocks driven by exposure to real estate assets.

Figure 5 replicates firm-level OLS estimate of column (9) in Table V, but replaces the dependent variable with log change in firm credit between quarter t and 2004Q4. As in Figure 4, we plot the OLS coefficient separately for each t from 2001Q4 to 2004Q4. The top panel uses log change in firm credit outstanding as dependent variable, while the lower panel uses log change in loan commitment for a firm as dependent variable.

The dotted line in Figure 5 plots firm-level OLS coefficients, while the solid line reflects corresponding bias-corrected coefficients implied by equation (3). Since loan-level OLS and

[20] This is similar to the finding in U.S. by Ivashina and Sharfstein (2009).

[21] Source: Dealogic, ECB and Bank of Spain.

FE estimates in Figure 4 are close to each other, OLS and bias-corrected coefficients do not differ significantly in Figure 5 either. The bias-corrected coefficients in Figure 5 reflect the net impact of credit channel over time. As in the case of 2004Q4-2007Q7 period, net impact is close to zero throughout our sample period.

6 Credit Terms, Real Outcomes And Extensive Margin Lending

6.1 Local Lending Channel and Credit Terms

The local lending channel, i.e. loan-level impact of credit supply channel on credit quantity, is undone by firm level adjustments for firms with multiple borrowing relationships. But what about credit terms? Greater willingness by banks to extend credit supply could lead to greater competition, hence putting downward pressure on credit terms.

While we do not observe interest rates, we know the fraction of loan commitment that is drawn down by a borrower as well as loan maturity and collateralization rate. Changes in loan draw-down rate during the credit boom gives us useful information on the otherwise unobserved terms of credit (such as covenants and interest rates). This idea is based on a revealed preference argument. As banks compete more aggressively for a firm's business, the firm should prefer to draw down more aggressively from the bank with better loan terms.

Columns (1) through (3) in Table VI test if the draw-down ratio goes up faster during 2004Q4 to 2007Q4 for banks with greater exposure to real estate. Column (1) runs our core specification on data restricted to multiple relationship firms as of 2004Q4. There is a strong effect of bank real estate exposure on growth in drawn-down rate. A one standard deviation increase in bank's real estate exposure increases the drawn-down ratio by 1.33 percentage points.

The increase in drawn-down ratio could have resulted from declining loan commitments. However, as we have already seen in Figure 4, banks with greater real estate exposure are increasing their loan commitments at a faster pace during 2004-07 period. The increase in draw-down ratio *despite* faster growth in loan commitments from real-estate-exposed banks hence points towards better loan terms offered by these banks.

Column (2) shows that the increase in drawn to commitment ratio is not driven by real estate exposed banks making different types of loans. For example, if real estate exposed banks granted more shorter maturity loans during the time period, such loans are naturally going to have higher drawn to commitment ratio. Column (2) adds loan maturity and collateralization rate as of 2004Q4, as well as change in these variables between 2004Q4 and 2007Q4 as controls. There is no change in our coefficient of interest. Column (3) further adds firm fixed effects, thus absorbing shocks at the firm level and isolating credit-supply-driven changes in loan terms. Our coefficient of interest increases slightly.

A direct measure of credit terms in our data is the fraction of loan that is collateralized. If credit terms are relaxed over 2004-2007 by banks with more real estate exposure, then we would expect rates of collateralization to go down more for these banks. Columns (4) to (6) show that this is the case, although statistical significance depends on the specification chosen. However, once we control for loan maturity in 2004Q4 and change in loan maturity between 2004Q4 and 2007Q4, the drop in collateralization rate is stronger and significant for banks with more real estate exposure. This is consistent with our earlier interpretation that securitization leads to more favorable credit terms for borrowers.

The inclusion of controls for loan maturity is necessary when testing for differences in collateralization change for two reasons. First, as we saw in Table IV, real estate exposed banks are more likely to have longer maturity loans which naturally have higher rates of collateralization. Second, and more importantly, the *change* in propensity to make longer term loans is also stronger for banks with real estate exposure. This is shown in columns (7) though (9) of Table VI. Hence, as done in column (5), it is important to control for loan maturity and changes in loan maturity when comparing differences in collateralization rates.

Figure 6 plot the quarter-by-quarter OLS and FE coefficients for drawn-to-commitment and collateralization rate. The sharp increase in drawn to commitment ratio for real estate exposed banks kicks in around 2005. Before 2005 there is no differential effect. Similar, though a bit weaker, results hold for collateralization rate as well.

6.2 Aggregate Lending Channel, Credit Terms And Real Outcomes

Our methodology for estimating the net impact of credit channel at firm level (i.e. the aggregate lending channel) can be applied to any outcome where we can estimate OLS and FE regressions separately at loan level. Since we have done so for changes in drawn-to-commitment ratio,maturity and collateralization, we can estimate their bias-corrected firm level impact as well. Columns (1) though (3) in Table VII show that changes in all three of these outcomes are significant at firm level.

Thus while loan level impact in credit quantity is undone by firm-level adjustments, the same is not true for credit terms! As banks with real estate exposure become more willing to extend credit, there is greater competition for a given firm's overall debt capacity. The competition results in borrowing firms receiving more favorable credit terms.

Despite the zero impact of securitization-induced credit supply channel on the *quantity* of credit, there could be positive firm real effects through the induced lower price of credit. Columns (4) through (6) of Table VII show that firms borrowing from banks with greater real estate exposure do not experience any differential change in propensity to default, sales or number of employees. There is thus no evidence of any appreciable impact on real firm outcomes over the period 2004 to 2007 due to securitization. Hence, despite of large effects at the bank-firm level, the crowding-out completely mitigates these effects for firm real outcomes.

6.3 Extending Credit to New Clients

So far our core analysis was based on loans outstanding in 2004Q4, which were followed forward in time. Banks with greater exposure to real estate assets increased their credit supply for existing loans as securitization kicked in. While this credit channel is counter-balanced by crowding out adjustments at firm level, the question remains whether securitization led to a net increase in credit for new borrowers. A shift in the supply of bank credit should make banks more willing to lend to riskier firms on the extensive margin. These firms may have been denied credit in the past, but with securitization expanding the supply of credit, they have a better chance of getting a loan.

Table VIII tests whether banks with greater real estate exposure lend more to new clients on the extensive margin. We define "new credit" as credit given to first-time clients between 2004Q4 and 2007Q4 and regress the log of total new credit against a bank's initial exposure to real estate assets. We find that banks more exposed to real estate are significantly more likely to make loans to new clients on the extensive margin. A one standard deviation increase in real estate exposure is associated with 3.09 percentage points more credit given to new clients. Column (2) replaces new credit drawn with new credit commitments and gets similar results.

Column (3) normalizes new credit outstanding by total assets of the bank. The estimated coefficient implies that a one standard deviation increase in real estate exposure is associated with the bank lending out 10.4 percent more of its assets as credit to new clients. New bank clients can be of two types: firms that never borrowed from any bank in the past, and firms that start borrowing from the given bank for the first time after 2004Q4. Column (4) splits these two types by only focusing on lending to firms that never borrowed from any bank in the past. The coefficient drop to 0.38 from 0.665, showing that more than half of our extensive margin result is driven by lending to firms that did not borrow from any bank in the past.

Column (5) shows that new credit driven by exposure to real estate assets is significantly more likely to default by the end of 2009. We regress the 2009Q4 default rate of new credit against initial bank exposure to real estate. The estimated coefficient is statistically significant and economically large in magnitude. A one standard deviation increase in bank exposure to real estate is associated with 1.03 percentage point increase in default rate for new credit[22].

Figure 7 plots the quarter-by-quarter estimates of columns (3) and (4). The dependent variable is new credit granted between 2004Q4 and quarter t, with t going from 2005Q1 to

[22] The power gets weak if we try to split defaults by borrowers that did not borrow from any bank in the past, and borrowers that are first-time borrowers with the said bank. However, the coefficient on bank RE exposure is positive for both these groups.

2009Q4. The differential growth in new credit continues until 2008, before collapsing as the financial crisis kicks in.

The extensive margin regressions are run at bank level and hence suffer from the usual criticism that unobserved credit demand shocks might contaminate our coefficients. We cannot use our firm fixed effects approach to tease out the supply-driven effect anymore. However, our earlier results are useful for interpreting causality of our extensive margin results.

The estimated covariance between credit demand and credit supply shocks for firms borrowing from multiple banks in 2004Q4 was close to zero. It is reasonable to assume that similar correlation holds on the extensive margin as well. For instance, given the estimated covariance term for existing borrowers, it is unlikely that credit demand from future potential clients will go up disproportionately more for firms that tend to apply for loans with real-estate-exposed banks. We thus feel confident in interpreting the coefficients in Table VIII as being driven by supply-side shocks as well.

7 Concluding Remarks

As liquidity threatened to dry up and banks suffered major losses, governments all over the world fretted about the possibility of banks transmitting their adverse shocks to the rest of the economy. Many governments, including the U.S., intervened in the banking sector with large sums of money to try to prevent any amplification of the downturn through the banking system. Such fears are common in almost all instances of financial downturns. In fact, even in normal times, policy makers set monetary and credit policies with one eye open towards possible ramifications for the bank transmission channel.

However, despite the importance attached to bank transmission channels in real life, we lack a basic set of tools that policy makers can use in real time for understanding the impact of transmission mechanisms. The goal of this paper was to introduce a formal procedure that takes macro approach towards transmission mechanisms by taking into account equilibrium effects at the firm level. We illustrated the use of our methodology by estimating the transmission consequences of mortgage securitization in Spain.

It would be imprudent to suggest that bank transmission channel is always important, or that it is never relevant. The nature and magnitude of transmission channel is likely to depend on the particular environment and episode in question. Since each situation is different, we need a set of tools - rather than a pre-determined answer - to guide us in the real world.

The methodology introduced in this paper can serve as one of the tools used by the regulatory agency incharge of monitoring systematic risk. There are three main advantages that our methodology provides in this regard. First, it can be applied to a range of different situations where the shock affecting the banking sector may not be securitization necessarily. As long as one can identify cross-bank heterogeneity in exposure to possible banking sector shocks (e.g. some form of financial innovation, bank runs, specific industry or country exposure), our methodology can be utilized to separate supply-side effects from demand and to estimate local as well as aggregate lending channels.

Second, our methodology can be used to identify both the quantity and price effects of shifts in the supply of bank credit. Credit booms are often associated with more favorable credit terms for borrowers, such as lower collateral requirement, decline in credit spreads, or more "covenant light" loans. Our methodology provides a formal mechanism for understanding the extent to which such changes in the price of credit are driven by expansion on the supply side.

The methodology introduced in this paper goes beyond estimating whether banks per se transmit the liquidity shocks they face. It takes into account equilibrium adjustments that firms may undertake in response to any shocks from the banking system. As our results from Spain illustrate, this latter step is critical: without it one could have incorrectly concluded that securitization had a big impact on credit quantity for all firms. Instead we find that the aggregate impact of securitization in terms of credit quantity was limited to new borrowers, while credit terms were relaxed for all borrowers.

Our results on the impact of securitization on bank credit should be of independent interest to financial economists. The possible role of financial innovation in promoting excessive credit creation and risk taking has been emphasized by a number of economic historians in the past. More recently, securitization has been associated with lax lending and excessive credit creation in mortgage markets during the 2000's (Keys et al (2010) and Mian and Sufi (2009)).

Did these problems also spill over to non-financial corporate sector through bank transmission channel? Our analysis provides some mixed results in this regard. For firms that already had strong access to the banking sector, securitization did not lead to an increase in quantity of credit. There is no evidence that securitization had an appreciable effect on real firm outcomes either.

However securitization did lead to more relaxed credit terms for all firms. There is also a strong effect of securitization on credit to new borrowers. Securitization enabled banks with real estate assets to expand credit supply on the extensive margin. The new loans are riskier with greater propensity to default during the crisis, suggesting that bank's relaxed their screening rules in order to expand credit supply.

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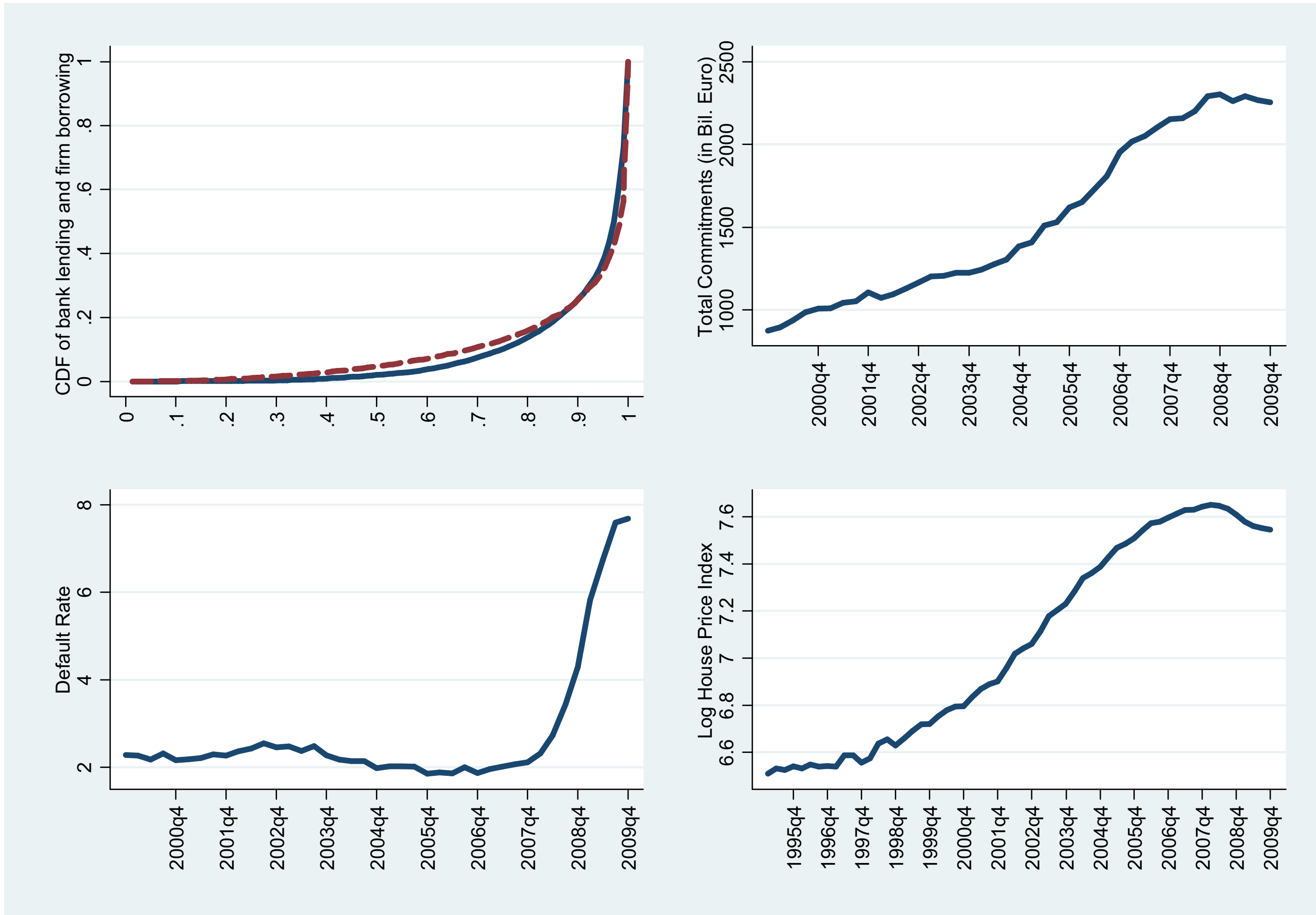
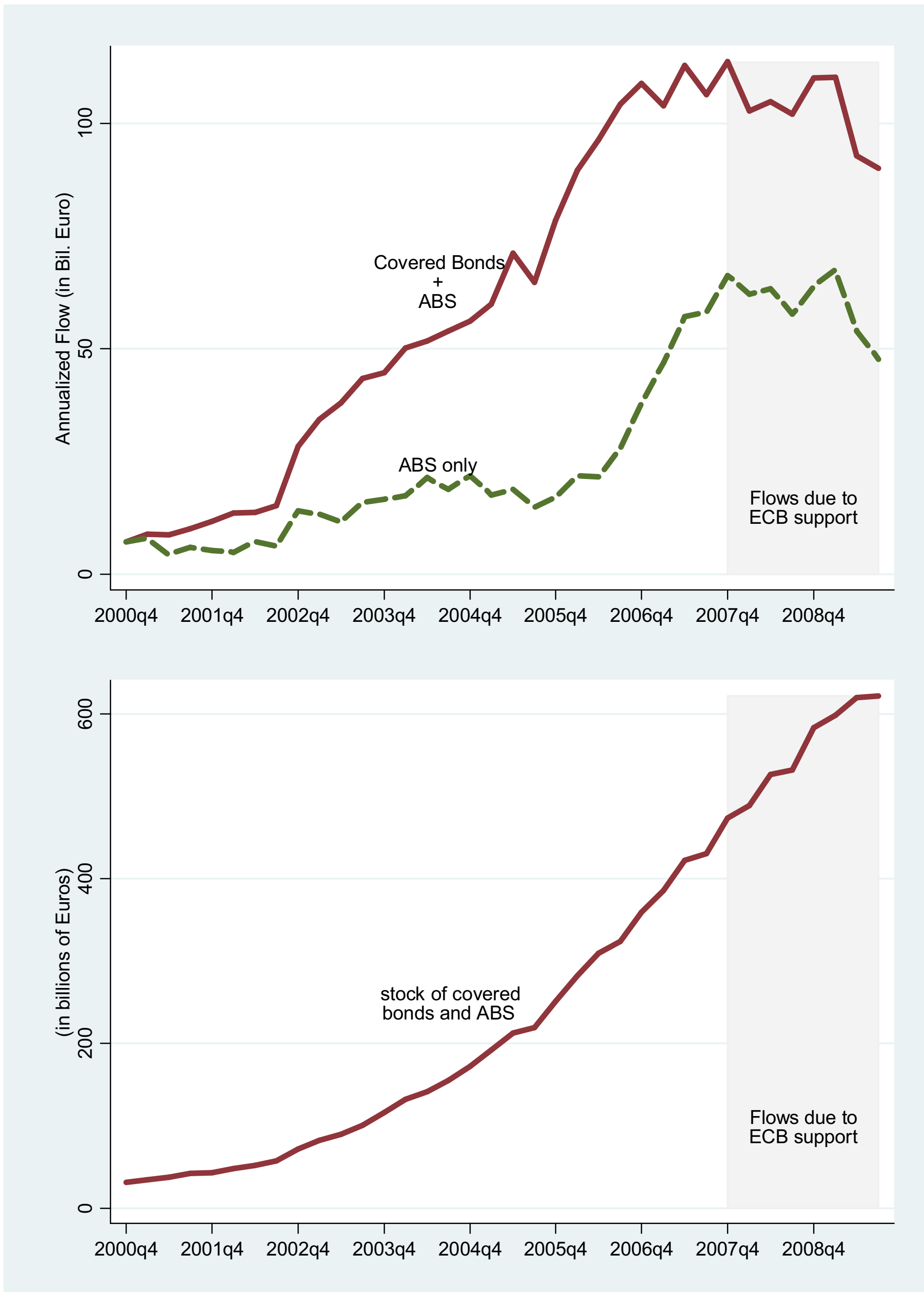
Figure 1
Credit and Housing Market in Spain



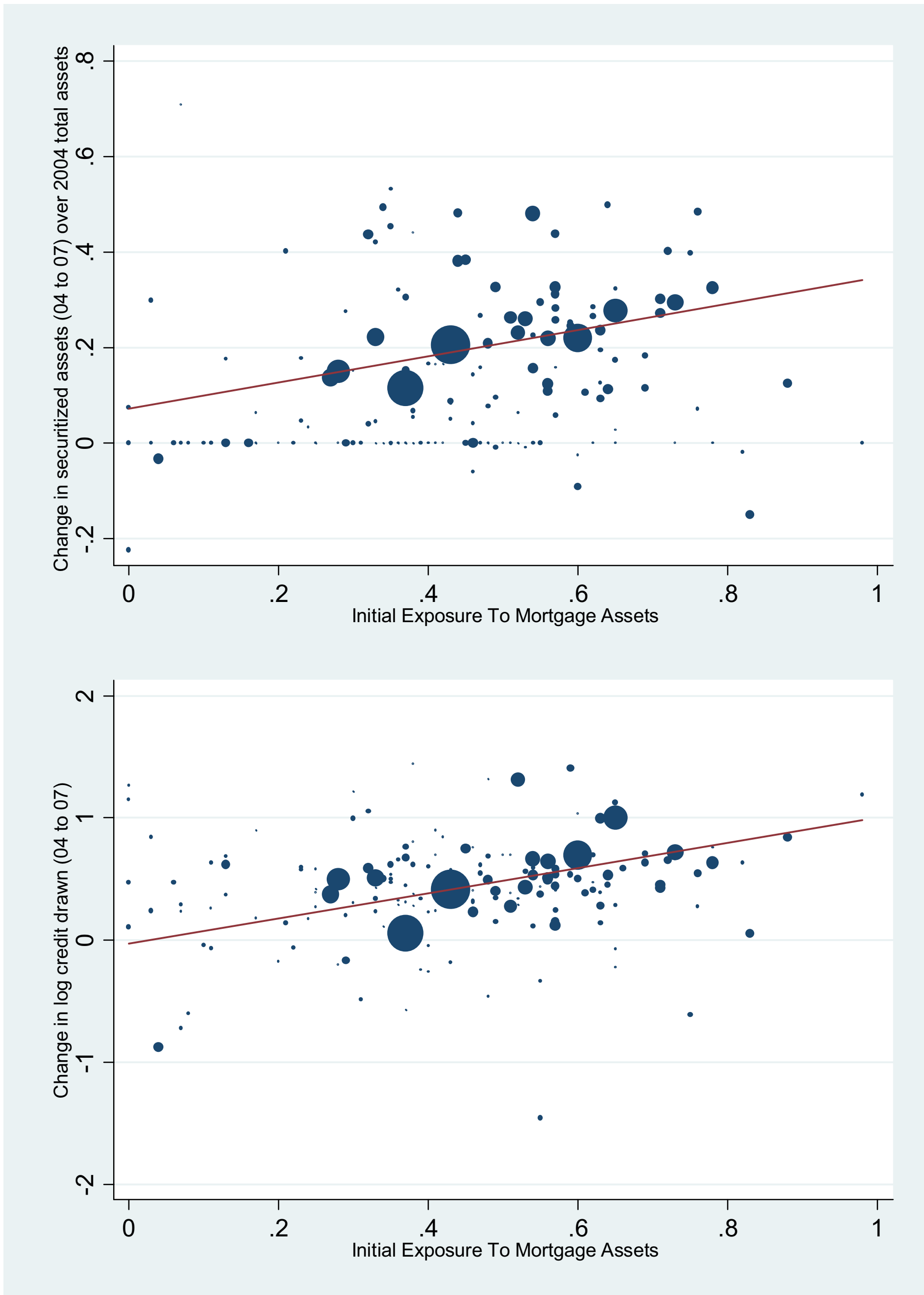
The top-left panel plots the cumulative distribution function for firm-level bank debt (solid line), and bank-level total lending (dashed line). The top-right panel plots total bank loan commitments to the non-real estate and non-financial sector in Spain. The bottom-left panel plots default rate for Spanish firms over time (limited to non-real estate and non-financial sector). The bottom-right panel plots the log of residential house price index in Spain.

Figure 2
ABS And Covered Bond Issuance In Spain



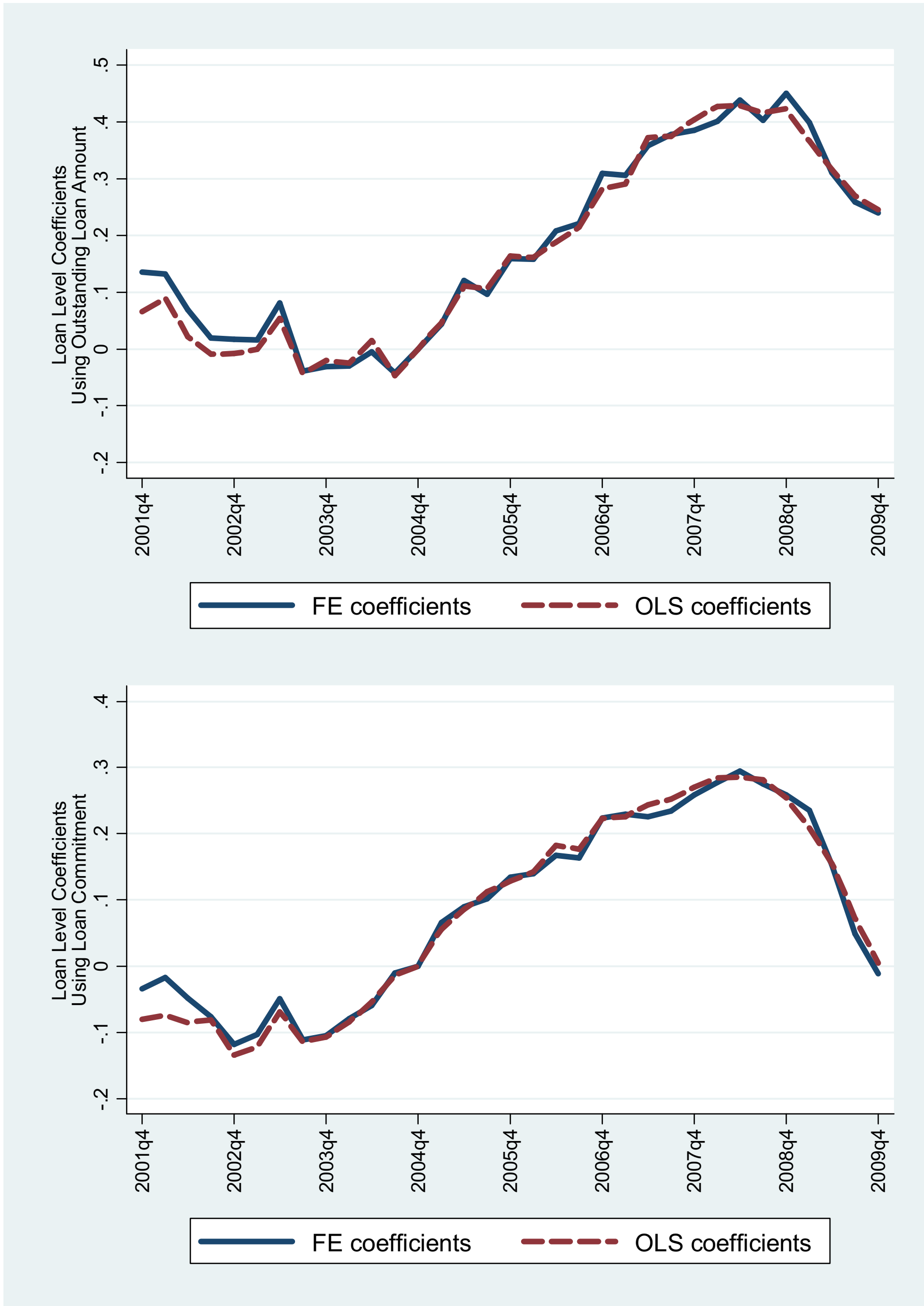
The top panel plots the annual flow of asset-backed securities issued in Spain. The solid line includes both ABS and covered bond issuance, while the dotted line only includes ABS issuance. The shaded area post 2007 represents ABS issuance that was put as collateral with the ECB for liquidity support. The bottom panel plots the stock of ABS and covered bonds over time in Spain.

Figure 3
Securitization, Bank Credit and Banks' Exposure to Real Estate



The top panel plots change in securitized assets (covered bonds and ABS) at the bank-level between 2004 and 2007 (normalized by bank total assets in 2004) against initial exposure to mortgage assets in 2000. Exposure to mortgage assets is defined as the share of total bank loans that go to the real estate sector. The size of each bank-level observation in the plot is proportional to bank size. The bottom panel plots the 2004 to 2007 change in log bank credit to non-real estate and non-financial sector against banks initial exposure to mortgage assets.

Figure 4
Loan-Level Credit Channel Coefficients By Quarter

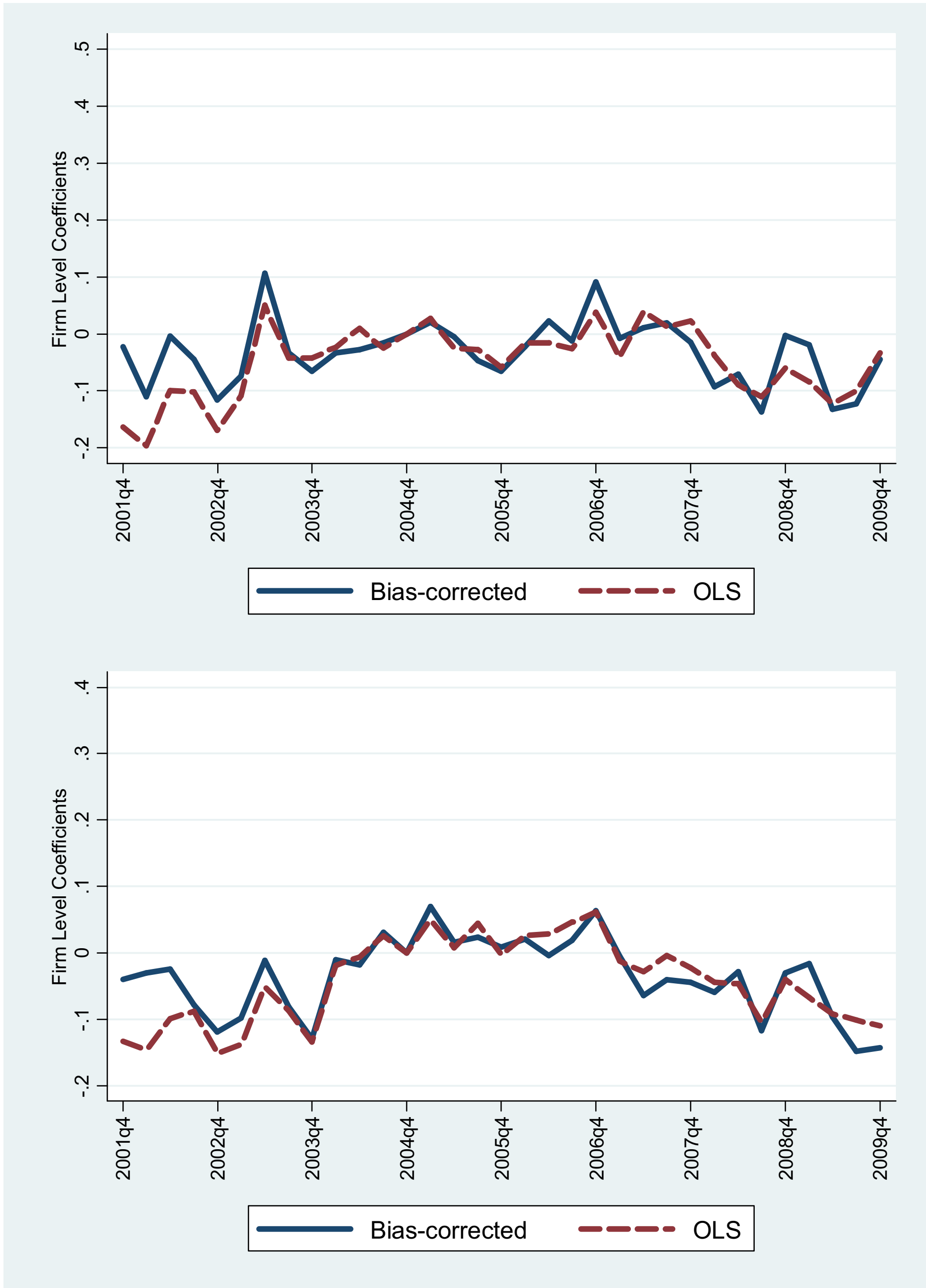


The top panel plots the coefficient estimates for $\boldsymbol{\beta}^t$ *for the following specification for each quarter* t*:*

$\boldsymbol{y}_{ijt} - \boldsymbol{y}_{ij,04q4} = \boldsymbol{\alpha}^t + \boldsymbol{\beta}^t * \boldsymbol{REexposure}_{i,2000} + \boldsymbol{\eta}_{jt} + \boldsymbol{\varepsilon}_{ijt}$

where $\boldsymbol{y}$ *is the natural logarithm of loan amount outstanding for firm* j *from bank* i*.* $\boldsymbol{REexposure}_{i,2000}$ *is the share of loan portfolio exposed to real estate for bank* i *in 2000. The OLS coefficient estimates do not include the firm fixed effects term,* $\boldsymbol{\eta}_{jt}$*. The bottom panel repeats the same exercise after replacing* $\boldsymbol{y}$ *with the natural logarithm of loan commitment for firm* j *from bank* i*.*

Figure 5
Firm-Level Credit Channel Coefficients By Quarter



The top panel plots the coefficient estimates for $\overline{\boldsymbol{\beta}^t}$ *for the following specification for each quarter* t*:*

$\overline{\boldsymbol{y}}_{jt} - \overline{\boldsymbol{y}}_{j,04q4} = \overline{\boldsymbol{\alpha}}^t + \overline{\boldsymbol{\beta}}^t * \overline{\boldsymbol{REexposure}}_{j,2000} + \overline{\varepsilon}_{jt}$

where $\overline{\boldsymbol{y}}$ *is the natural logarithm of total credit outstanding for firm* j*.* $\overline{\boldsymbol{REexposure}}_{j,2000}$ *is the average real estate exposure in 2000 of banks lending to firm* j *at time* t*. The solid line in top panel "bias corrects" the coefficient estimate according to equation (3) in the paper. The bottom panel repeats the same exercise after replacing* $\overline{\boldsymbol{y}}$ *with the natural logarithm of total commitment for firm* j*.*

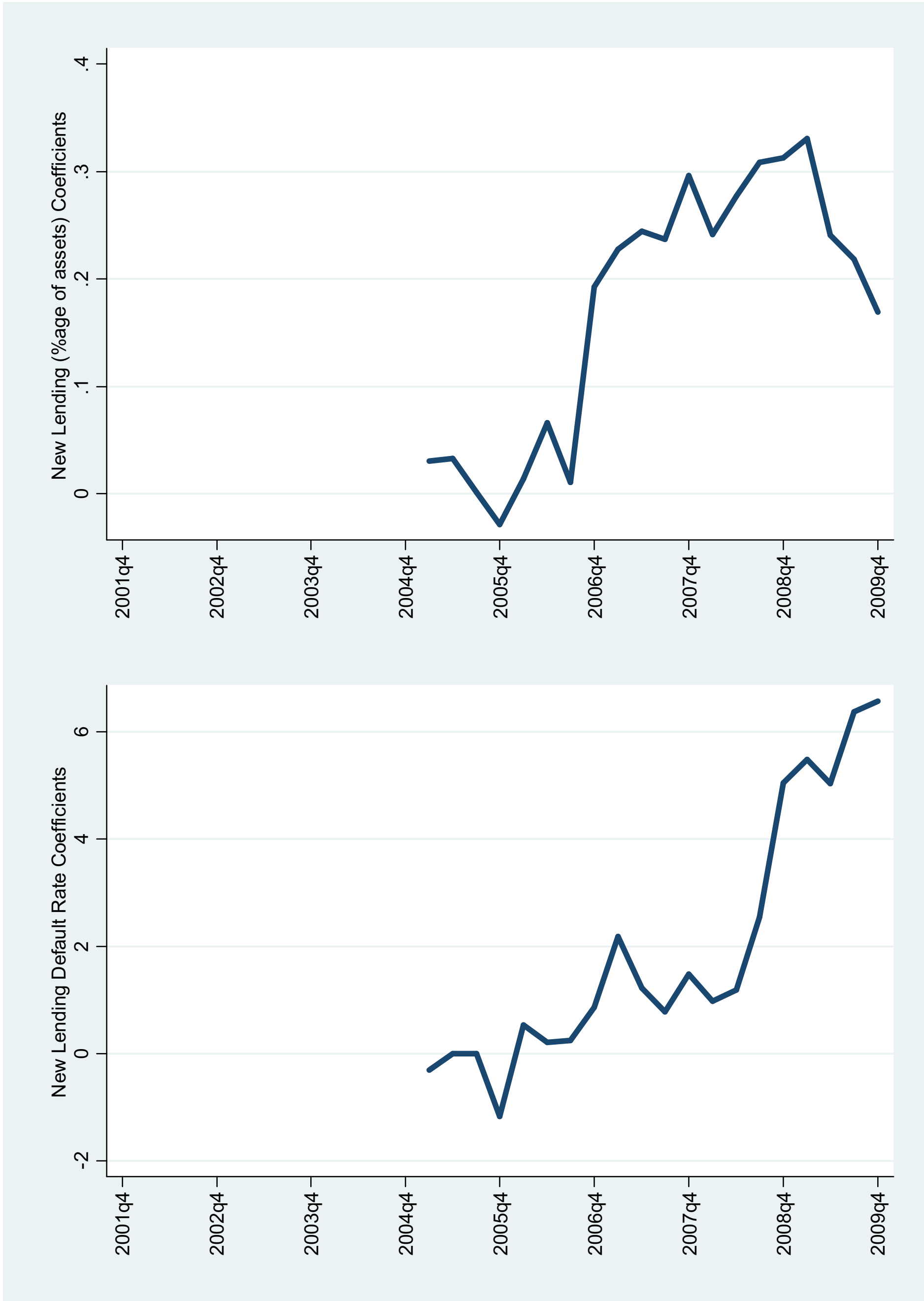
Figure 6
Loan Terms Credit Channel Coefficients By Quarter

The top panel plots the coefficient estimates for $\boldsymbol{\beta}^t$ for the following specification for each quarter t:

$\boldsymbol{y}_{ijt} - \boldsymbol{y}_{ij,04q4} = \boldsymbol{\alpha}^t + \boldsymbol{\beta}^t * \boldsymbol{REexposure}_{i,2000} + \boldsymbol{\eta}_{jt} + \varepsilon_{ijt}$

where $\boldsymbol{y}$ is the drawn to commitment ratio for firm j from bank i. $\boldsymbol{REexposure_{i,2000}}$ is the share of loan portfolio exposed to real estate for bank i in 2000. The OLS coefficient estimates do not include the firm fixed effects term, $\boldsymbol{\eta}_{jt}$. The bottom panel repeats the same exercise after replacing $\boldsymbol{y}$ with collateralization rate of loan for firm j from bank i.

Figure 7
Extensive Margin Bank Credit Channel Coefficients



The top panel plots the coefficient estimates for $\boldsymbol{\beta}^t$ *for the following specification for each quarter* t*:*

$$\boldsymbol{y}_{it} = \boldsymbol{\alpha}^t + \boldsymbol{\beta}^t * \boldsymbol{REexposure}_{i,2000} + \varepsilon_{ijt}$$

where $\boldsymbol{y}$ *is the ratio of credit given to new clients since 2004q4 and total outstanding loans of bank* i. $\boldsymbol{REexposure}_{i,2000}$ is the share of loan portfolio exposed to real estate for bank i in 2000. The bottom panel repeats the same exercise after replacing $\boldsymbol{y}$ with the default rate for new credit.

Table I
Simulation Of The Lending Channel – $\boldsymbol{\beta}$= 0.5

Panel A

	$\Lambda = 0\%$			$\Lambda = 50\%$			$\Lambda = 100\%$		
ρ	-0.50	0.00	0.50	-0.50	0.00	0.50	-0.50	0.00	0.50
$\widehat{\beta}_{OLS}$	0.0619	0.5036	0.9514	0.0522	0.4966	0.9425	0.0627	0.5016	0.9395
$\widehat{\beta}_{FE}$	0.5000	0.4998	0.4999	0.4994	0.4997	0.4997	0.4995	0.5009	0.4999
$\widehat{\widehat{\beta}}_{OLS}$	-0.2497	0.5025	1.2709	-0.5057	0.2432	1.0109	-0.7446	0.0009	0.7536
$\overline{\beta}$	0.4941	0.4942	0.5008	0.2510	0.2496	0.2599	-0.0058	-0.0009	0.0098

Panel B

	$\Lambda = 0\%$			$\Lambda = 50\%$			$\Lambda = 100\%$		
ρ	-0.50	0.00	0.50	-0.50	0.00	0.50	-0.50	0.00	0.50
$\widehat{\beta}_{OLS}$	0.0551	0.4904	0.9195	0.0567	0.4915	0.9130	0.0625	0.4951	0.9260
$\widehat{\beta}_{FE}$	0.4999	0.5003	0.4996	0.4988	0.5002	0.4991	0.5007	0.5006	0.4999
$\widehat{\widehat{\beta}}_{OLS}$	-0.1005	0.4921	1.0854	-0.3265	0.2537	0.8365	-0.5917	-0.0050	0.5903
$\overline{\beta}$	0.4854	0.5066	0.5295	0.2555	0.2667	0.2894	-0.0098	0.0030	0.0250
dropped	0.3811	0.3725	0.3685	0.3790	0.3743	0.3671	0.3799	0.3743	0.3702

This table reports the mean of 100 OLS and FE parameter estimates of the lending channel at the loan level ($\widehat{\boldsymbol{\beta}}_{OLS}$ and $\widehat{\boldsymbol{\beta}}_{FE}$), OLS estimates at the firm level ($\widehat{\widehat{\boldsymbol{\beta}}}_{OLS}$), as well as "bias corrected" estimates ($\overline{\boldsymbol{\beta}}$). We report parameter estimates for different correlation values between the firm- and bank-speficic shocks at the loan level ranging from $\boldsymbol{\rho} = -0.50$ to $\boldsymbol{\rho} = 0.50$ for different substitution levels $\boldsymbol{\Lambda}$ assuming normally distributed shocks with a mean 0 of and a standard deviation of 1. In Panel B we allow for the possibility that loans are dropped.

Table II
Summary Statistics

	All Firms			*Multiple Relationsship Firms*		
	N	Mean	Std Dev	N	Mean	Std Dev
Loan Level Variables						
Banks initial exposure to real estate assets	67,838	0.466	0.156	51,397	0.460	0.158
Loan amount outstanding (2004Q4)	67,838	288.1	3191.9	51,397	295.899	1637.3
Log loan amount within firm (2004Q4)	63,941	0.000	0.852	49,787	0.000	0.966
Loan amount committed (2004Q4)	67,838	367	3608.2	51,397	376.4	2169.2
Default Rate (2004Q4)	63,941	0.019	0.134	49,787	0.017	0.129
Loan drawn to commitment ratio (2004Q4)	67,838	81.066	30.752	51,397	83.2	27.9
Collateralization rate (2004Q4)	67,838	0.195	0.371	51,397	0.148	0.330
Maturity greater than 5 years (2004Q4)	67,838	0.230	0.390	51,397	0.185	0.356
Δ log loan amount, 01Q4 to 04Q4	33,274	-0.004	1.146	26,262	0.013	1.145
Δ default rate, 01Q4 to 04Q4	33,274	0.020	0.151	26,262	0.019	0.146
Δ log loan amount, 04Q4 to 07Q4	42,609	0.057	1.223	32,647	0.059	1.217
Δ log loan amount, 04Q4 to 07Q4 (within firm)	42,609	0.000	0.754	32,647	0.000	0.861
Δ default rate, 04Q4 to 07Q4	42,609	0.019	0.140	32,647	0.021	0.147
Δ log loan amount, 07Q4 to 09Q4	31,298	-0.250	1.016	23,322	-0.252	1.034
Δ default rate, 07Q4 to 09Q4	31,298	0.061	0.241	23,322	0.074	0.263
Firm Level Variables						
Banks initial exposure to real estate assets	29,848	0.471	0.131	15,697	0.463	0.111
Number of banking relationships (2004Q4)	29,848	2.250	1.848	15,697	3.302	2.017
Loan amount outstanding (2004Q4)	29,848	662	6720.6	15,697	982.507	7101.2
Commitment amount (2004Q4)	29,848	836.5	7833.6	15,697	1249.2	8681.9
Default Rate (2004Q4)	29,848	0.021	0.135	15,697	0.017	0.119
Total Assets (2004Q4)	14,984	4547.1	52221	9,093	6238.4	66362.5
Total Sales (2004Q4)	14,984	5155.4	67860	9,093	7028	86285.2
Total Employees	12,672	28.951	278.7	7,850	37.263	351.6
Δ log loan amount, 01Q4 to 04Q4	20,998	0.146	1.193	12,627	0.384	1.019
Δ default rate, 01Q4 to 04Q4	20,998	0.017	0.142	12,627	0.015	0.125
Δ log sales, 01Q4 to 04Q4	8,606	0.213	0.627	5,837	0.23	0.587
Δ log loan amount, 04Q4 to 07Q4	25,154	0.214	1.263	14,074	0.048	1.098
Δ default rate, 04Q4 to 07Q4	25,154	0.018	0.137	14,074	0.023	0.154
Δ log sales, 04Q4 to 07Q4	11,088	0.232	0.68	7,019	0.221	0.626
Δ log loan amount, 07Q4 to 09Q4	22,120	-0.204	0.942	12,681	-0.232	0.923
Δ default rate, 07Q4 to 09Q4	22,120	0.050	0.209	12,681	0.063	0.230
Δ log sales, 07Q4 to 09Q4	11,191	0.058	0.392	6,932	0.049	0.363
Bank Level Variables						
Total Assets (2004Q4)	192	7.8E+06	2.5E+07			
Initial exposure to real estate assets	191	0.440	0.157			
Capital ratio (2004Q4)	191	6.686	3.922			
Return on assets (2004Q4)	191	0.945	0.483			

This table presents summary statistics for loans outstanding as of 2004Q4. The underlying data represents a 10% random sample of all loans in Spain, with sampling done at firm level. A loan is defined as a firm-bank pair, i.e. separate loans from a bank to the same firm are aggregated at the firm level. Multiple Relationship firms have at least two banking relationships as of the fourth quarter of 2004.

Table III
Securitization and Initial Real Estate Exposure

	Δ Securitized Assets Over Total Assets ('04 to '07)		Securitized Assets Over Total Assets (2007)	Δ Log Bank Credit ('04 to '07)	
	(1)	(2)	(3)	(4)	(5)
Bank RE Exposure	0.197***	0.274***	0.349***	1.01 * **	
	(0.064)	(0.075)	(0.084)	(0.32)	
Securitized Assets Over Total Assets (2004 to 2007)					1.12 * **
					(0.415)
Constant	0.036	0.073*	0.15 * **	−0.014	0.24 * *
	(0.029)	(0.039)	(0.041)	(0.18)	(0.12)
	OLS	WLS	WLS	WLS	WLS
N	179	179	179	178	178
R^2	0.063	0.14	0.14	0.18	0.12

*This table presents bank-level regressions relating the change in securitized assets and change in bank credit between 2004Q4 and 2007Q4 to a banks initial exposure to real estate assets. Banks initial exposure to real estate is defined as the fraction of total loans that is given out to the real estate sector (residential, commercial, and construction) as of 2000Q1. All specifications report robust standard errors. ***,**,* imply that coefficient estimates are significant at 1%, 5% and 10% level, respectively.*

Table IV
Correlation Between Banks Exposure To Real Estate And Initial Characteristics

	Coeff	s.e.	Coeff	s.e.
Bank Level Variables (2000Q1)				
Return on assets	1.896	(1.569)		
Total Default Rate	0.0009	(0.0046)		
Capital Ratio	−0.705	(2.642)		
Cajas?	0.935***	(0.120)		
Firm Level Variables (2005Q4)				
Default rate	0.0104	(0.0114)		
Total assets	−7549.001***	(1739.05)		
Log total assets	−0.846***	(0.147)		
Total credit	−469.860 **	(253.369)		
Log total credit	−0.802 **	(0.379)		
Total sales	−8349.19 ***	(1836.714)		
Log total sales	−1.225***	(0.173)		
Number of banking relationships	−0.004	(0.343)		
Tangible assets ratio	19.109***	(2.912)		
Short term debt ratio	−27.557***	(3.213)		
Loan Level Variables (2005Q4)			*With firm fixed effects*	
Default Rate	0.013	(0.008)	0.007	(0.004)
Loan amount	−300.276***	(126.888)	−68.16	(83.267)
Log loan amount	−0.123	(0.312)	0.147	(0.285)
Collateralization rate	0.266***	(0.048)	0.150***	(0.034)
Maturity greater than 5 years	0.204***	(0.092)	0.106	(0.069)

*This table regresses various bank, firm and loan characteristics on banks exposure to real estate assets in 2000, and reports the coefficient and standard error on bank exposure variable. Banks initial exposure to real estate is defined as the fraction of total loans that is given out to the real estate sector (residential, commercial, and construction) as of 2000Q1. ***,**,* imply that coefficient estimates are significant at 1%, 5% and 10% level, respectively.*

Table V
Securitization And The Credit Channel

	Δ Log Drawn (04Q4 to 07Q4)					Δ Log Drawn (01Q4 to 04Q4)	Loan Dropped?	Tobit	Δ Firm-Level Log Drawn (04Q4 to 07Q4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bank RE Exposure	0.366***	0.404***	0.386***	0.382***	0.419*	−0.135	−0.245***	0.882***	0.023
	(0.099)	(0.104)	(0.113)	(0.111)	(0.225)	(0.145)	(0.070)	(0.285)	(0.100)
Firm-Bank Type fixed effects	No	No	No	No	Yes	No	No	No	-
Loan controls	No	No	No	Yes	No	No	No	No	-
Firm fixed effects	No	No	Yes	Yes	-	Yes	Yes	No	No
Data restricted to firms with multiple relationships	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	42,609	32,647	32,647	32,647	32,647	26,262	51,397	51,397	14,074
R^2	0.002	0.003	0.50	0.51	0.70	0.53	0.46		0.00

*This table presents coefficient estimates from specifications at the loan (firm-bank) level relating the growth in bank credit from 2004Q4 to 2007Q4 to lending banks initial exposure to real estate. Column (8) runs a tobit specification, taking into account that change in lending is censored for firms dropped by banks (or log loan amount dropping by more than -1.82, i.e. the bottom 5th percentile). Banks initial exposure to real estate is the fraction of total loans that is given to mortgages and construction/ real estate as of 2000:Q1. Loan controls include collateral and maturity. A firm is defined to have multiple relationships if it borrows from at least two banks of 2004:Q4. All specifications include a constant (not reported) and errors are cluster at the bank level. ***,**,* Coefficient estimate statistically distinct from 0 at the 1%, 5% and 10% levels, respectively.*

Table VI
Securitization And Loan Terms

	Change in Loan conditions from 2004Q4 to 2007Q4								
	Drawn to Committed Ratio			Collateralization Rate			Long-term maturity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bank RE Exposure	8.28***	8.33***	8.51***	−0.016	−0.065**	−0.048	0.134	0.16**	0.13**
	(2.69)	(2.65)	(3.34)	(0.0114)	(0.033)	(0.03)	(0.084)	(0.067)	(0.062)
Loan Controls		Yes	Yes		Yes	Yes		Yes	Yes
Firm fixed effects			Yes			Yes			Yes
Data restricted to firms with multiple relationships	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	32,647	32,647	32,647	32,647	32,647	32,647	32,647	32,647	32,647
R^2	0.0027	0.0410	0.50	0.0001	0.25	0.62	0.0052	0.15	0.46

*This table presents coefficient estimates from specifications at the loan (firm-bank) level relating the change in loan conditions from 2004Q4 to 2007Q4 to lending banks exposure to real estate. We use three different loan conditions: change in drawn to committed credit in column 1 to 3, change in collateralization rate in column 4 to 6 and change in long term maturity (over 5 years) in column 7 to 9. Loan controls in (2) and (3) include maturity and collateralization rate as of 2004Q4 as well as changes in these two variables during 2004-07. Loan controls in (5) and (6) have maturity as of 2004Q4 as well as change in this variable during 2004-07. Loan controls in (8) and (9) have collateralization rate as of 2004Q4 as well as change in this variable during 2004-07. All specifications include a constant (not reported) and errors are cluster at the bank level. Banks initial exposure to real estate is defined as the fraction of total loans that is given out to the real estate sector (residential, commercial, and construction) as of 2000Q1. ***,**,* imply that coefficient estimates are significant at 1%, 5% and 10% level, respectively.*

Table VII
Firm Outcomes

	Δ(drawn to commit)	Δ(%long-term)	Δ(collateral rate)	Δ(default rate)	Δ(log sales)	Δ(employees)
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Banks' RE Exposure	6.86 ***	0.054 **	−0.10 ***	0.0008	−0.0025	0.045
	(1.26)	(0.026)	(0.019)	(0.022)	(0.059)	(0.081)
Bias-Corrected Coefficient	**7.38**	**0.066**	**−0.074**			
Data restricted to firms with multiple relationships	Yes	Yes	Yes	Yes	Yes	Yes
N	14,277	14,277	14,277	14,277	7,019	5,964
R^2	0.0012	0.0005	0.0019	0	0	0.0001

This table presents coefficient estimates from specifications at the firm level relating the growth in firm level outcomes to a firms banks initial exposure to real estate assets. Banks initial exposure to real estate is defined as the fraction of total loans that is given out to the real estate sector (residential, commercial, and construction) as of 2000Q1. Firm banks real estate exposure is the weighted average of a firms lending banks exposure to real estate as of 2000Q1. Bias-corrected coefficients are calculated using the methodology outline in equation (3) of the paper. The calculations are as follows: Column (1), $7.38 = 6.86 + (8.54 - 8.28) * (0.157^2/0.111^2)$. *Column (2),* $0.066 = 0.054 + (0.14 - 0.134)) * (0.157^2/0.111^2)$. *Column (3),* $-0.074 = -0.10 + (-0.0030 + 0.016) * (0.157^2/0.111^2)$. *All specifications include a constant (not reported) and errors are cluster at the lead-bank level. ***,**,* imply that coefficient estimates are significant at 1%, 5% and 10% level, respectively.*

Table VIII
Extensive Margin – Extension of Credit to New Clients

	Log Drawn	Log Commitment	Drawn Normalized	New Firms Drawn Normalized	Defaults
	(1)	(2)	(3)	(4)	(5)
Bank RE Exposure	1.97 ∗ ∗	1.69 ∗ ∗	0.665∗∗∗	0.382∗∗∗	0.0657∗∗
	(0.79)	(0.73)	(0.22)	(0.153)	(0.0287)
Constant	7.99 ∗ ∗∗	8.37 ∗ ∗∗	0.193∗	0.115∗	0.0061
	(0.39)	(0.37)	(0.11)	(0.060)	(0.012)
N	175	177	179	179	163
R^2	0.025	0.019	0.064	0.08	0.068

*This table presents coefficient estimates from specifications at the bank level relating lending given out to new clients by banks between 2004Q4 and 2007Q4 to a banks initial real estate exposure. Banks initial exposure to real estate is defined as the fraction of total loans that is given out to the real estate sector (residential, commercial, and construction) as of 2000Q1. ***,**,* imply that coefficient estimates are significant at 1%, 5% and 10% level, respectively. All specifications report robust standard errors.*