The recent slowdown of bank lending in Spain: are supply-side factors relevant?*

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Abstract

Using information of the balance sheets of Spanish banks between 1995 and 2009, we estimate the average impact of current and anticipated changes in banks' capital on firm lending. We isolate the role of credit supply factors using the variation in capital growth associated to the bank-specific historical exposure to real estate development and its interaction with the change in housing prices in the provinces where they operate. We control for the quality of borrowers by using region and industry fixed effects. A 1% increase in capital growth increases business lending to non-real estate firms by .6-.7% -a limited magnitude compared to the literature. The relatively small magnitude of credit supply factors may be explained by the weakness of loan demand in a context of a deep recession

Keywords: bank lending, bank capital, loan supply, instrumental variables.

JEL Codes: E51, G21.

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1 Introduction

The role of bank's balance sheets in shaping the evolution of credit growth has been subject to debate during the 2008 recession. On one hand, there is evidence that exposition to "toxic" assets has affected some banks' ability to lend (Puri et al., 2011). On the other, even in banking systems without structured off-balance products, but with a high exposition to real estate, drops in housing prices have deteriorated financial intermediaries' capital positions and, possibly, the overall supply of credit. This paper analyzes the case of Spain, an economy that experienced a housing boom until 2007 and a drop of business lending in 2009 to gauge the impact of actual and anticipated changes in bank's capital on business lending.

The Spanish financial system was not severely hit by the first wave of the global financial crisis, as a result of a number of factors: the negligible presence of toxic assets in their balance sheet, the regulation that prevented the creation of off-balance sheet investment vehicles and the large weight of long-term instruments in their funding structure. However, as the initial financial turmoil changed into a deep recession, Spanish banks were increasingly affected as their high exposure to the real estate sector and the sharp increase in unemployment led to an important deterioration in the quality of their loan portfolios. The existence of provisioning buffers required by the demanding Spanish prudential regulatory system mitigated the impact on profits of the surge in doubtful loans. Nevertheless, the progressive reduction in these buffers as well as the increasing capital ratios considered as acceptable by regulators and markets have put additional pressure on banks' capital what, in turn, might have constrained the credit supply, especially in the case of those institutions that took on more risks during the cyclical upturn.[1]

Disentangling the specific contribution of bank capital from demand related factors is always a difficult task. In a time series context, in a recession there is a downward revision of spending plans and loan demand, while both bank capital and borrowers' creditworthiness deteriorates, so stricter lending standards are applied by financial institutions. In a cross-section context, banks and firms do not match randomly and firms whose demand for credit is more sensitive to recessions may end up borrowing from the smallest and least capitalized banks. A strand of the literature uses aggregate data and identifies demand and supply effects out of the assessment of banks through bank lending surveys (Hempell and Kok-Sorensen, 2009) or instruments based on lagged capital (Berrospide and Edge, 2010, Francis and Osborne, 2009).[2] This methodology typically permits assessing the magnitude of the effects by running counterfactuals on the evolution of overall credit. Another strand of the literature uses firm-level data

[1] For a more detailed review of the recent developments of credit in the Spanish economy, see chapter 1 in Banco de España (2010).

[2] The information provided by the answers to bank lending surveys, that are usually the only source of information explicitly distinguishing between demand and supply factors, although useful to better understand the recent behavior of credit and the banks' prospects, is often insufficient to assess the relative contribution of both components, mainly because of its qualitative and subjective nature.

to cleanly identify bank specific balance sheet impacts by using the subsample of firms that continue borrowing from at least two banks during the period of analysis. By relating the growth of bank-specific lending to the same firm to bank characteristics, several authors find that banks' liquidity or capital position do affect lending growth (Khwaja and Mian, 2008, Jimenez et al., 2010a, Albertazzi and Marchetti, 2010, or Gan, 2007 provide excellent examples in Pakistan, Spain, Italy and Japan, respectively). While very elegant, identification of credit-supply effects in the latter case is silent about the role of the bank's capital channel for the borrowing behavior of firms that end up relying on a single bank or of those that close down during a recession. The latter can be a non-trivial subgroup. For example, the business demographics database compiled by the Spanish National Statistical Institute suggests that the number of firms fell by 10% between 2008 and 2009.

We provide evidence on the impact of changes in bank capital on business lending that complements both approaches by using bank-industry level data. Our approach allows us to track the evolution of aggregate lending within an industry (including that granted to firms that close or firms relying on a single bank) while controlling for industry-year specific quality effects. Furthermore, Jimenez et al. (2010b) have recently documented that tests of the bank lending channel based on firm-level data may overstate the role of bank capital if firms are able to substitute lending across banks. Adapting their methods to industry-level data, we can obtain insights about the prevalence of firm reshuffling. The price we pay for using bank-industry level data is that we need to do extra work to show that our estimates do not confound supply with demand effects within industries.

Our strategy is the following. Firstly, guided by a simple model of bank behavior according to which lending growth is conditioned by capital growth only when the level of capital is near the amount required either by the regulator or the funding markets, we study two different channels through which the capital position of a bank may affect its lending behavior (see Van den Heuvel, 2001). The first one relates changes in lending to firms to current changes in the capital position of a bank. The second one is emphasized in the literature on banks' lending under uncertainty and captures cuts in lending associated to anticipated future capital drops stemming from expected losses.

Secondly, to identify the role of supply factors in the evolution of business lending, we use financial statements (balance-sheets and profit and loss accounts) reported by the Spanish deposit institutions to the supervisor between 1995 and 2009. As mentioned above, we construct a sample at the bank-industry level. We use an instrumental variable procedure as well as industry fixed effects to address the simultaneity between lending and capital. Our instrument is based on Watanabe (2007) and relies on the historical (as of 1995) exposure to real estate development. The underlying idea is that, unlike banks that enter in the real estate development industry during a real estate boom, institutions with a traditionally high exposure to real estate development are likely to better know the industry than the rest, but possibly due to relationship lending, they are more likely to be exposed to the ups and downs of real estate prices. That fact, combined with whether or not these banks operate in areas that experienced housing price declines, permits us to track the evolution of bank's capital position for reasons weakly related to the quality of firms' demand of loans as of 2007.

Our findings can be summarized as follows. Firstly, we find that lagged exposure to real estate development and its interaction with local housing prices are good predictors of capital growth only in 2009, when housing prices had accumulated two years of negative growth at the national level. Secondly, we find that those same instruments predict changes in the overall doubtful loans ratio already in 2008. Given that industry level dummies may not fully account for the quality of the demand, we run a number of specification checks. We find that the exposure to real estate and its interaction with housing prices predicts the doubtful loans ratio only in the real estate development sector and for banks that operated in provinces where housing prices fell. Those findings suggest that banks exposed to real estate were not lending to "worse" quality firms. In addition, we also find that exposure to real estate development and its interaction with local housing prices are not correlated with deposit growth or proxies of the liquidity position of a bank, suggesting that we are indeed capturing a capital effect.

Finally, we estimate Two Stage Least Squares (TSLS) models of credit growth (both including and excluding construction related industries) on current and (proxies of) anticipated capital growth. We find that 1% increase in capital growth increases business lending by .6-.7% on average. Nevertheless, our back-of the envelope computations suggest a limited role for the capital channel during the sample period we consider (accounting for between 6 and 23 percent of the actual credit drop).

The rest of the paper is organized as follows. The next section contains a brief review of the recent literature that has analyzed the influence of a bank's capital position on its lending provision. Section 3 describes the theoretical framework and our empirical strategy. Section 4 deals with some empirical issues. Specifically, it presents the procedure used to address the potential simultaneity of capital and lending and it describes the data sources and the variables included in the empirical specifications. Section 5 discusses the results obtained while section 6 provides some robustness checks. Finally, section 7 offers some concluding remarks.

2 Bank capital and lending growth: an overview of the empirical literature

The detailed theoretical model linking bank capital and bank lending operates through capital regulation. This bank capital channel is explicitly modeled by Van den Heuvel (2001, 2002). Assuming both an imperfect market for bank equity and risk-based capital requirements, he shows that when capital drops to a sufficiently low level, as a result of an increase in loan losses, the bank will reduce lending because of the capital requirement and the cost of issuing new equity. Capital does not necessarily need to fall below the capital requirement to trigger a reduction in lending, as the bank might prefer to forego some lending opportunities in order to reduce the risk of breaching the capital regulatory limit in the future.

On the empirical side, the impact of bank capital on loan growth has been a highly researched area in specific episodes of credit slowdown. In particular, a number of papers explored the role of the introduction of new bank capital regulations (Basel I) in explaining the credit slowdown in the early 1990s in the U.S. economy. These studies did not provide a conclusive answer on the potential existence of a bank-capital induced credit crunch. Bernanke and Lown (1991), using a cross-section of y-o-y growth rates for 1991:Q1 found that actual capital-to-asset ratios had a significant effect on loan growth, although the relevance of this effect was significantly lower than that of economic activity.[3] Berger and Udell (1994) did not find a significant effect of alternative definitions of capital ratios on loan growth during the period 1990-1992. By contrast, Hancock and Wilcox (1993) found, for a sample of U.S. banks in 1990, that shortfalls in capital ratios (measured in relative terms to a target level) had a significant effect on loan growth. Using an alternative approach and a sample of banks in New England over the period 1989:Q2 to 1994:Q4, Peek and Rosengreen (1995) found that capital growth was the main determinant of lending growth for a sample of banks with low regulatory ratings (and hence presumably constrained) whereas it did not have a significant effect for the a priori unconstrained banks. Given the large number of banks with low regulatory ratings in New England in the early 1990s, these authors argue that capital constraints may had played an important role in the sluggish lending growth and weak economic activity at that time. Their estimates suggest that an increase in capital growth of 1 pp increased the supply of credit (among low regulatory ratings banks) by 5 pp, a very large effect.

Several papers have analyzed whether or not the weakness of lending growth might be related to regulatory developments such as the adoption of Basel I in the early 1990s or the demand by the Japanese regulator of a more rigorous self-assessment of their assets, which led to a substantial amount of loan loss write-offs and provisions. Focusing on this later development, Woo (2003) and Watanabe (2007) found that Japanese banks significantly reduced their lending in response to a large loss on bank capital resulting from the reinforcement of the prudential policy guidelines by the Japanese regulator. Watanabe's results suggest a very large role of the contraction of capital on business lending: had capital not been squeezed, business lending to non-troubled industries (that actually fell, depending on the industry, between 3 and 5 pp) would actually have increased.

The magnitude of the current financial crisis has renewed the interest on this literature. Some recent papers have shed some light on the relevance of the

[3] It has been often argued that the credit slowdown became stronger later in 1991, so Bernanke and Lown (1991) could not fully capture the potential credit crunch because of the period they analyzed.

effect of bank capital on lending growth during the current crisis. However, their results are far from being conclusive, mostly because the crisis or, at least, its effects on bank balance-sheets are still underway. Using a sample of U.S. bank holding companies over the period 1992:Q1 to 2008:Q3, Berrospide and Edge (2010) find small effects of capital surpluses/shortfalls on lending. Larger effects are found by Francis and Osborne (2009) using a sample of U.K. banks over the period 1996:Q2 to 2007:Q4 and a similar methodology to that in Berrospide and Edge (a panel regression of loan growth on the deviation of bank capital with respect to a target). Albertazzi and Marchetti (2010) use highly detailed data on bank-firm relationships (compiled by the Credit Register of the Banca d'Italia) and find that those banks with poor capitalization displayed a higher contraction in bank lending over the period from September 2008 (just after the collapse of Lehman Brothers) to March 2009. In a paper similar in spirit to ours, Jimenez et al. (2010b) set the consequences of increasing securitization of credit to firms, explicitly taking into account for the possibility that firms substitute credit across banks. Once the possibility of substitution of loans across banks is taken into account, they find a negligible role for the credit supply channel. While their results mostly reflect the expansion that ended in 2007, we focus on the 2008-2009 period, and compare their findings to ours below.

3 The link between capital and lending

As the previous literature review shows, most of the empirical work on the role of supply factors to explain lending developments considers a reduced form relationship between loan growth and a capital ratio (or alternatively a measure of capital surplus, i.e. the difference between the observed and the desired capital ratios).[4] By contrast, in theoretical models of corporate finance, decisions are usually modeled in terms of levels rather than in terms of ratios. Using a simple model of bank behavior, it is possible to derive a relationship between the growth rate of lending and the growth rate of capital.

3.1 A simple model of bank behavior and the empirical specification

To explore the role of capital constraints on lending growth we use a multiperiod stylized model of bank behavior based on Van den Heuvel (2001). Appendix 1 lays out this model in more detail. We assume that the bank holds only loans (L_t), and has two types of liabilities, capital (K_t) and deposits (D_t). The bank faces an inelastic demand for deposits at a given rate r_D and chooses its level of capital and loans yearly, while its yearly profits can be written as follows:

[4] An important remark is that we consider as supply effects those stemming from weak capital positions. However, similar effects might arise from weak liquidity ratios. In the empirical part, we examine proxies of the banks' liquidity position to assess if our results are driven by weak liquidity ratios.

$$\pi_t = [R(L_t)L_t - r_D D_t]$$

The capital of a bank evolves as follows:

$$K_t = K_{t-1} + (1-\tau)\pi_t - d_t]$$

That is, capital can only be augmented through retained profits: the difference between post tax profits $(1-\tau)\pi_t$- where τ is the corporate tax- and d_t are dividends. The regulation typically requires banks to have a minimum level of capital:

$$K_t \geq \gamma^R L_t$$

We assume that whenever capital falls below its regulatory minimum γ^R, banks are not allowed to extend new loans or to pay dividends. Hence, when the level of capital falls below the regulatory minimum banks might forego profitable opportunities. The problem of the bank is then to maximize the discounted stream of future dividends subject to the evolution of capital and to the capital regulatory constraint.[5]

Van den Heuvel (2001) derives the solution of a model similar to that one described above, but with uncertainty about both the cost of borrowing and about the future evolution of non-performing loans. He shows that banks accumulate a buffer of reserve capital on top of the legal requirement. The magnitude of such capital buffer depends on the distribution of expected losses θ and of the cost of deposits r_D. In other words:

$$K_t \geq (\gamma^R + \gamma_t^U)L_t$$

In the former expression, the level of capital K_t includes both the amount required by the regulator (γ^R) and an additional, possibly time varying amount (γ_t^U) capturing anticipation of losses or capital requirements by financial markets. In the empirical application, we focus on the current share of non-performing loans (NPLs) as a main component of γ_t^U, in turn, a predictor of future losses and future negative additions to capital.[6] In any case, when the capital constraint is binding (either for legal or precautionary motives) lending growth is equal to the growth of bank's capital (see Appendix 1 for a derivation).

$$\Delta \log L_t = \Delta \log \frac{1}{\gamma^R + \gamma_t^U} + \Delta \log K_t \tag{1}$$

[5] In the Spanish banking market, a set of institutions (savings banks) do not give dividends, as they are supposed to devote their returns to social enterprises. We assume still that they maximize the discounted "dividends" as a way of funding such enterprises.

[6] NPL is the ratio of non-performing loans that is defined as the share of loans that are considered unlikely to be fully or partially repaid on the contractually agreed terms, either due to customer arrears or for other reasons (if the institution has reasonable doubts regarding their recovery). Throughout the paper we use indistinctively the term doubtful loans ratio and NPLs.

By contrast, in the unconstrained case (i.e., those banks whose capital is strictly above the minimum), lending growth reflects the growth in the marginal benefit from lending relative to the marginal cost of funds. Neither of those magnitudes depends on capital growth. Hence, like in Peek and Rosengreen (1995), in a cross-section of banks, capital growth affects business lending only because current capital falls between the legal minimum and the desired level of capital for a fraction of (constrained) banks.

Note that two related factors affect the credit supply of a constrained bank. The first is the direct impact of capital losses $\Delta \log K_t$, as mentioned above. The second factor (the term captured by $\Delta \log \frac{1}{\gamma^R + \gamma_t^U}$ reflects a cut in lending that is due either to an anticipation effect or to higher requirements by financial markets: banks anticipate future capital drops and thus target a lower ratio between business lending and capital. Distinguishing between direct impact of capital losses and and anticipation factors $\Delta \log \frac{1}{\gamma^R + \gamma_t^U}$ is important: the latter term identifies if predicted losses help predicting business lending in the medium term –even if banks comply with their regulatory minimum–.[7]

3.2 Identification strategy

We work with year-specific regressions of business lending growth on capital and dudosity growth between 2004 and 2009, using banks as unit of analysis (specifically, as we discuss below, the unit of analysis is the pair bank-industry).[8] Namely, we implement a reduced form version of [1]:

$$\Delta \log L_t = \beta_1 \Delta \log(\gamma^R) + \beta_1 \Delta \log(\gamma_t^U) + \beta_2 \Delta \log K_t + \varepsilon_t \tag{2}$$

Where β_1 multiplies the first two terms as both enter additively in [1]. Equation [2] is an average of the responses of capital-constrained banks (for whom $\beta_1$and β_2 are both equal to 1) and capital unconstrained banks (for which both coefficients are zero). We treat $\Delta \log(\gamma^R)$ as a constant. Next, we assume that $\Delta \log(\gamma_t^U)$ is a year-specific function of expected future losses and of the market's perception of the situation of the bank (that in turn determines the cost of borrowing).

$$\Delta \log(\gamma_t^U) = \delta_0 + \delta_1 \Delta NPL_t + \delta_2 \frac{K_t}{L_t} + u_t \tag{3}$$

Cost of funding: This simple model abstracts from differences across banks in the cost of raising funds. Yet, heterogeneity in capital positions may affect the relationship between capital growth and loan growth. For example, if banks with higher capital are able to obtain lower financing rates in the funding

[7] An alternative modeling of the relevance of the role of capital in the evolution of business lending is in Ehrmann et al (2003) or Peek and Rosengreen (1995). Nevertheless, these are static models that do not permit a discussion of the role of actual and anticipated capital losses.

[8] As opposed to pooled regressions, year-specific regressions have the advantage of allowing for unrestricted time-varying effects of each of the covariates of interest, allowing us to identify when changes in capital or dudosity are likely to have an effect on business lending.

markets, then capital growth would also be positively related with loan growth among unconstrained banks. Peek and Rosengreen (1995) incorporate such considerations and show that the response of loan growth to capital growth would still be larger among constrained banks. We include the capital asset ratio as of 1995 and the asset size as of 1995 to control for those factors. While 13-year is arguably an extremely long lag for a capital, we argue below that by dating covariates well before the financial crisis, we circumvent the theoretical and empirical problem that arises because balance sheet and lending decisions are all simultaneously determined. We also examine the evolution of liquidity and deposit growth during the financial crisis to determine whether differences in the availability of funding drive our results.

T*ime variation in the profitability of loans:* In the Appendix we assume that $R(L_t)$ is a decreasing, constant-over time function linking the interest rate charged on business loans to the amount of loans extended. Nevertheless, it is likely that $R(L_t)$ varies over the business cycle. For example, during a downturn, all borrowers will be less likely to repay their debt. If the set of banks that we identify as potentially subject to capital constraints lend to customers that are specially likely to default, and their pricing decisions reflect such increased risk, the drop of business lending would not reflect a capital effect on lending, but movements along the marginal revenue curve that the bank faces. In other words, we would be attributing to a drop in banks' capital what really is a shift of the demand for credit.[9] In the empirical section, we examine the evolution of interest rates charged by banks

Identification: To estimate the separate effects of capital growth and of changes in $\frac{1}{\gamma^R+\gamma_t^U}$ on loan growth, we use an instrumental variable procedure. The reason is that capital growth and loan growth are simultaneously determined. In an economic downturn we may observe a drop in loan demand quality (reflecting weaker activity) and a drop in capital (as a result of an increase in non-performing loans). A valid instrument must then be correlated with the growth of capital while uncorrelated with the quality of recent loans.

The dynamics of capital accumulation suggests that any shock that changes non-performing loans is likely to affect capital growth. Given the exposition of the Spanish banking system to real estate development as of 2007 and the dependence of profits in that industry on housing prices, changes in the evolution of housing prices are likely to affect NPL and, subsequently, capital growth. Hence, we use lagged exposure to real estate development and its interaction with housing prices to identify movements in capital and dudosity growth. Below, we argue that the Spanish regulation allows us to identify each effect separately. Our identification strategy builds on the approach used by Watanabe (2007), who also examines the link between bank's capital and loan growth in

[9] Imagine that the marginal curve faced by the bank is $R(L) = a_0 - a_1 L$. We assume that the "cost" of issuing loans is $c_1 L$ –on top of funding issues. If during a recession, c_1 increases due to a higher fraction of NPLs, even unconstrained banks will cut their lending and increase the interest rate on loans. While a general recession effect would be absorbed by a constant term, if the borrowers from banks subject to capital constraints (by our definition) are more prone to NPLs, we would erroneously identify a "capital effect".

the aftermath of a housing boom. In particular, he explores the role of the capital position of Japanese banks to explain lending growth in the second half of the 1990s and uses an instrumental variable approach to overcome the endogeneity of capital. Watanabe uses the bank's share of lending to the real estate industry in 1989 (and the change in this share over the period 1980-1989) as an instrument for the capital to asset ratio in the late nineties. The underlying rationale for this instrument is similar to ours: Japanese banks substantially expanded their lending to the real estate industry during the 1980s as a result of regulatory changes and those banks which showed a higher shift towards this sector experienced a sharper increase in their doubtful loans ratios and a deep weakening in their capital positions ten years later when housing prices started to fall and regulatory reforms required banks to accordingly revaluate unrealized losses. Nevertheless, unlike Watanabe, we focus on bank-industry cells and control for industry fixed effects to hold demand quality constant.

In our case, we instrument ΔNPL_t and $\Delta \log K_t$ using variation in bank's industrial specialization 13 years before the crisis. The weight of lending to real estate development on total business lending grew from 3% in 1995 to 30% in 2008 (see Figure 1). Our identifying hypothesis is that specialization in a sector creates persistence due to informational advantages. In our case banks that were more specialized in borrowing to real estate developers before the construction boom were in a better position to take advantage of the increasing demand of activity in that sector because of their expertise. Secondly, specialization in 1995-1997 is unlikely to be correlated with demand quality in industries other than construction in 2007.

$$\Delta \log K_t = \eta_0 + \eta_1 Exp\,\mathrm{real}_{95-97} + \eta_2 Exp\,\mathrm{real}_{95-97}\, \Delta HPRICE_t + u_t \qquad (4)$$

Admittedly some of the institutions that dramatically expanded their lending to the real estate development sector over the boom years were not highly exposed to this sector at the end of the past decade. In addition, among those that ended up with a high exposure to this sector there is considerable dispersion of doubtful assets ratios of this type of lending. Still, initial exposure to real estate development between 1995 and 1997 seems to be a significant predictor of exposure in 2007. Figure 1 shows that those banks with a high exposure to this industry at the initial years of the boom ended up with a very high exposure when the slowdown started in 2007.

Instrumenting doubtful loans:

We instrument the share of doubtful loans using the fact that unlike other sectors, the profitability of the real estate development sector is closely linked to the evolution of housing prices, which have a strong national and regional component on top of the quality of the bank-specific particular loan portfolio. In particular, changes in regional housing prices are a likely driver of losses of banks that were initially exposed to real estate development. Thus, we use the interaction between the bank's exposure to real estate developers at the beginning of the boom and the average change in the housing price in the years previous to the bust in the provinces where the bank operates (weighted by the number of branches in such provinces). As we control for regional fixed effects, such interaction captures the drop in loan profitability within a province that is due to a bank's traditional exposure to real estate development.

$$\Delta NPL_t = \theta_0 + \theta_1 Exp\,\mathrm{real}_{95-97} + \theta_2 Exp\,\mathrm{real}_{95-97}\,\Delta HPRICE_t + u_t \qquad (5)$$

Separate identification of capital growth $\Delta \log K_t$ *and the share of doubtful loans* ΔNPL_t.

Distinguishing between the contemporaneous effects of capital growth and of anticipated future losses on business lending is difficult. The driver of both developments, namely loan losses, is the same. Nevertheless, the regulation of Spanish banks creates a lag between the moment when losses associated to non performing loans arise and the moment when those losses can result in capital losses. Namely, the Spanish legislation requires banks to set aside loan provisions in expansionary periods when typically the share of NPLs falls below an historical average. Conversely, in downturns, when the share of NPLs is high relative to historical averages, banks can draw from such "forced saving". As there is no need to fully provision losses in the moment when the expected loss occurs increases in the doubtful loans ratio do not result immediately in lower profits and, hence, in lower capital growth for accountancy reasons. Therefore, using sharp increases in the share of NPLs like those observed in the period we analyze we can net out anticipatory and pure capital growth effects. We discuss threats to validity in Section 6.

4 Data and empirical specification

4.1 Data

The data used in this paper come from the bank statements (balance-sheets, profit and loss accounts, and capital adequacy declarations) reported to the Banco de España by all commercial banks and savings banks between 1995 and 2009.[10] Most of the information required is available with (at least) a quarterly frequency. However, the information on capital requirements is only available for the whole sample on a consolidated basis at a yearly frequency.

We have excluded bank-quarter data when credit shares in the balance-sheet are below 10% in order to drop institutions that are not relevant for the purpose of this study.[11] We have also excluded two savings banks whose management was taken over by the supervisor and yet another institution for whom we lacked

[10] That is, we focus on all deposit-money institutions excluding cooperative banks, whose share in the credit market have been around 5% over the sample period.

[11] Most of the institutions excluded as a result of this filter are subsidiaries or branches of foreign banks. The results reported in the paper have been obtained using a sample excluding branches and subsidiaries of foreign institutions, but we also included those in previous versions of the study –see Footnote 14.

information on the historical exposure to real estate development. Our preferred sample of domestic commercial and saving banks contain 1369 bank-industry observations corresponding to 69 banks that in 2009:12 accounted for 77.8% of total loans granted by deposit institutions, 82.5% of total deposits and 83.7% of total assets. In turn, those 69 banks belong to 55 groups that present consolidated balances yearly.

The bank balance sheets contain the stock of outstanding lending to firms grouped in 23 different industries. For each of those industries, we also know the share of non-performing loans up to 2009:Q3. Our main analysis takes as the sample unit the pair bank-industry. For example, a bank that has outstanding loans with firms in all 23 industries would contribute 23 cases to the sample. Organizing the sample this way, we are able to control for the industry specialization of banks.

Provincial housing prices are obtained from the series elaborated between 2005:Q1 and 2008:Q4 by the Housing Ministry (Ministerio de Vivienda). The data consists on assessments of the market value of a house made by private companies typically prior to a mortgage concession. The Ministerio constructs the series for the main city in each of the 50 Spanish provinces –excluding the autonomous cities of Ceuta and Melilla located in the African continent–. We use the cumulative provincial housing price growth between 2005:Q1 and the last period prior to the year when we analyze lending behavior.

4.2 Empirical specification

The purpose of this paper is to assess whether or not a bank's capital position affects its willingness to lend to healthy borrowers. Obviously, if an industry experienced a large shock leading to a sharp deterioration in the creditworthiness of the firms in that sector, all banks will likely cut their lending to that industry. However, only those that are weakly capitalized will probably reduce the volume of loans granted to sound industries. For this reason, our dependent variable is the growth rate of loans to non-financial companies measured at the industry level.

As a proxy for the capital position we use Tier 1 capital (which mainly includes capital, disclosed reserves, preference shares and nonvoting equity units, less goodwill). In line with the discussion in section 3, we estimate the separate impact on business lending growth of two different variables: the change in capital and the change in the doubtful loans ratio. The specification is given by the following system of equations:

$$\begin{aligned}\Delta \log L^{J}_{i,t} \quad &= \quad \beta_0 + \beta_1 \Delta NPL_{i,t} + \beta_2 \Delta \log K_{i,t} + \\ &+ \sum_{j=0}^{J} d_{j,t} Industry_j + \sum_{r=1}^{R} d_{1,r} R_i + d_{1,s} Sav\_bank_{i,t} + \varepsilon^{j}_{i,t} \quad (6)\end{aligned}$$

$$\Delta \log K_{i,t} = \alpha_0 + \alpha_1 Exp\,\mathrm{real}_{95-97} + \alpha_2 Exp\,\mathrm{real}_{95-97}\,\Delta HPRICE_{i,t-1} + \alpha_3 \Delta HPRICE_{i,t-1} + \sum_{r=1}^{R} d_{2,r} R_i + d_{2,s} Sav\_bank_{i,t} + u^1_{i,t} \quad (7)$$

$$\Delta NPL_{i,t} = \delta_0 + \delta_1 Exp\,\mathrm{real}_{95-97} + \delta_2 Exp\,\mathrm{real}_{95-97}\,\Delta HPRICE_{i,t-1} + \delta_3 \Delta HPRICE_{i,t-1} + \sum_{r=1}^{R} d_{3,r} R_i + d_{3,s} Sav\_bank_{i,t} + u^2_{i,t} \quad (8)$$

where $L^J_{i,t}$ is the amount of loans granted by bank i to industry j at time t, $K_{i,t}$ is the volume of Tier 1 capital of bank i at time t, $\Delta NPL_{i,t}$ is the change in the doubtful loans ratio, and $Industry_j$, R_i and $Sav\_bank_{i,t}$ are dummy variables indicating industry, region and type of institution, respectively. $Exp\,\mathrm{real}_{95-97}$ is the bank-specific share of lending to real estate development between 1995 and 1997, constructed taking into account all mergers and acquisitions the bank undertook during the last 11 years. We discuss other regressors below.

The coefficients of interest are β_1 and β_2. The first coefficient isolates cuts in lending due to the anticipation of future capital drops. The second coefficient measures how changes in the capital position of a bank affect its lending to a particular industry relative to banks whose capital grows less. As discussed above, we aim to isolate drops in bank capital that are unrelated to current industry-specific demand conditions. To reiterate, β_2 is unlikely to capture the relationship between capital and lending among heavily exposed banks that entered the real development sector after 1997. While such "latecomers" may have suffered heavy losses and cut their lending between 2008:Q4 and 2009:Q4, it can also be argued that those banks were picking up the worst quality borrowers.

Controls related to the demand for loans. We also introduce additional covariates to control for demand quality. First, we introduce 22 industry dummies (the omitted category is "trade") that absorb any factor that affected the quality of the industry during the 2008-2009 period. By including industry dummies, β_1 and β_2 are identified by comparing differences in lending growth to the same industry by banks with different capital growth (or a different variation in the share of doubtful loans). By focusing on industry-level growth for a given bank, we also control for the fact that banks specialize in industries that behave differently over the business cycle. Now, while our approach can take care of differential quality across industries, it cannot control for differences in loan quality across banks within a given industry. In other words, if banks differentially exposed to real estate development lend to firms whose demand is especially sensitive to the business cycle, the industry fixed effect strategy would attribute to loan supply factors what really is a demand factor. To control for such possibility, Section 6.1. examines the correlation between exposure to real estate development and the share of non-performing loans within each of the 23 industries we observe in our sample. An alternative approach to control non-parametrically for the quality of borrowers is to include firm specific dummies in the model (see Khwaja and Mian, 2007, Gan, 2007, Jimenez et al., 2010a, among others). Unfortunately, and as mentioned above, that strategy is not suitable for our purposes. A specification that includes firm fixed-effects identifies β_1 and β_2. using the sample of firms that borrow from at least two different banks and stay in the sample during the sample period. The first selection criterion is always debatable, as firms borrowing from only one bank may be very different from the rest. The second assumption excludes firms that close down, a contentious restriction between 2008 and 2010 when the stock of firms with at least one employee fell down by 10% according to the Spanish National Statistics Institute. If the subsample of firms that close down were especially responsive to limitations in credit supply an approach based on fixed effects could underestimate the true impact of credit supply conditions on business lending. By using aggregate data within the industry, we are sure that we are picking up such margin of adjustment.

Secondly, we introduce 9 regional dummies (excluded category: Madrid) based on the region where the bank had most of its branches as of 2006:Q3. Such dummies absorb region-specific trends that may affect lending during the sample period.

Bank-specific controls. The summary statistics in Table 1 suggest that institutions involved in real estate development during 1995-1997 have somewhat different characteristics than the rest. On one hand, these are more likely to be savings banks. Hence, we control for institution type. On the other hand, they seem to have slightly higher capital asset ratios and a higher share of doubtful loans. To be sure that we are not capturing an effect related to a specific type of institution, we examine if our estimates vary when we include bank specific variables measured between 1995 and 1997, the period when initial exposure to real estate development is determined. In particular, the model in the Appendix gives us some clues about relevant differences in bank characteristics. A higher discount rate results in a lower level of capital-asset ratio (and higher dividends). As not all institutions pay dividends, we proxy for differences in the discount rate by using the bank-specific Tier 1 average capital asset ratio in 1995:Q1-1997:Q4.[12] We also include the average total asset size during the same period as well as the dudosity level as of 1998 to control for differences in attitudes toward risky industries (see Kashyap and Stein, 2002 for evidence of cross-sectional differences in lending across US banks as a response to monetary policy).[13]

[12]Several authors control for measures of tightness of bank's capital in the evolution of business lending by using deviations from bank's capital from some long-run average (see Gambacorta and Mistrulli, 2004, Watanabe 2007 and others). We chose not to, for various reasons. Firstly, capital asset ratio exhibited a trend during the sample period, so a long run average would be a bit arbitrary. Second, the inclusion of a term proxying for expected losses partially captures such effects.

[13]$Exp\,\text{real}_{95-97}$ is constructed by adding up all the credit to real estate development among institutions that ended up being the same bank in 2007 and comparing it to all lending (corporate and household) in 1995-1997. As for controls for non-performing loans, we use

Equation [6] is estimated both by (unweighted) OLS and TSLS for the cross-section of banks in the fourth quarter of 2009. As discussed in section 4.1, in the first stage of the TSLS procedure the growth rate of capital and the growth in NPL are regressed on each bank's historical exposure to the real estate development sector (measured by the average of this exposure over the period 1995-1997) using the 55 groups that present consolidated balances yearly. The capital loss is then imputed to each of the 69 banks that enter the TSLS regression.

5 Results

5.1 The first stage for capital growth: historical exposition to real estate development

Table 2 displays the estimates of OLS regressions of the model for the growth rate of Tier 1 capital between 2008:Q4 and 2009:Q4. This specification uses the sample of 55 consolidated groups. All specifications include regional dummies and the standard errors are corrected for heteroscedasticity. The estimate for the coefficient of the bank's historical exposure to the real estate sector is -1.042 and implies that banks that were 10% more exposed to real estate development in 1995-1997 experienced a 10.4% lower growth of Tier 1 capital between 2008:Q4 and 2009:Q4.[14] The F-statistic of the estimate is around 8, suggesting a reasonable quality of the instrument.

Interestingly, when we run the specification in the first column in Table 2 for each year in the 2004-2009 period, the results change significantly. Figure 2 displays the coefficient of the historical exposure to real estate obtained in an OLS estimation of a specification identical to that reported in column 1 of table 2 but for alternative years as well as 95 percent confidence bands. The coefficient of historical exposure to real estate development is basically zero for every year between 2004 and 2008 but it turns out to be negative and statistically different from zero only in 2009. Therefore, the exposition to real estate development between 1995 and 1997 appears to be an adequate instrument for banks' capital growth between 2008:Q4 and 2009:Q4.

We have also estimated the first stage using as an instrument for each bank's capital growth not only each bank's historical exposure to the real estate sector but also the interaction of this variable with a measure at the bank level of the change in the housing price between 2006:Q1 and 2008:Q4.[15] Columns 2 to 4 of Table 2 display the estimates of this alternative approach, using different sets

1998 as the first year, as it is then when a measure comparable to the current one is available.

[14] This result is also robust to the inclusion of branches and subsidiaries of foreign banks in the sample (not shown). Nevertheless, in this latter case the size of the coefficient of the historical exposure is almost halved, suggesting that the effect of real estate specialization on the growth rate of capital is significantly lower for these types of institutions.

[15] The change in housing prices for each bank is the weighted average of the growth rate of housing prices over the period 2004-2008 in the provinces where the bank is present, weighted by the number of branches in each province in December 2006.

of control variables. The rationale for using that interaction is that the historical exposure to real estate might anticipate a weakening of the banks' capital growth during the current financial crisis that might be sharper in the case of those banks operating in areas where the decline in housing prices has been larger. While the effect is large and of the expected sign, once we control for bank-specific characteristics (columns 3 and 4), the interaction of real estate development and average provincial housing prices does not affect capital growth. A possible explanation is based on the timing of price drops. As we mentioned above, the legislation about loan provisioning in Spain make it unlikely that capital growth is likely to reflect relatively recent losses, so the evolution of housing prices up to 2008:Q4 may not affect capital growth in 2009:Q4.

Figure 3 displays the coefficient of the historical exposure to real estate obtained in an OLS estimation of an equation linking the lending growth to the historical exposure to real estate. It is noteworthy that this coefficient is also significantly related to lending growth only in 2009 whereas the effect is almost negligible for the remaining years. This is reassuring, as suggests that other confounding factors were not differentially affecting the supply of credit among banks exposed to real estate during the expansion.[16]

5.2 The first stage for NPL ratios: historical exposure to real estate interacted with local housing prices

As mentioned in Section 2, the ratio of doubtful loans anticipates the evolution of capital through its impact on profits. We start by examining if the NPL ratio in 2009:Q4 is explained by the bank's historical exposure to real estate development as well as its interaction with the average cumulative change (between 2005:Q1 and 2008:Q4) of the price of housing.

The estimate of the impact of exposure to real estate in 1995-1997 on the growth of the NPL ratio is shown in Column 1 in Table 3 (panel A), and suggests a modest positive effect –an increase from the median of zero to the 75 centile of 3 percent increases growth of the NPL ratio in 2009 by 0.33 percentage points-. When we include an interaction of past specialization in real estate development with cumulative housing price growth (column 2 in Table 3), the OLS coefficient of historical exposure is positive and the interaction with cumulative price growth is negative. Banks with an exposition of 3% to real estate development in 1995 experienced growth in their NPL ratio by about 0.8 percentage points. Therefore, the exposure to real estate has a positive influence on the doubtful loans ratio that is mitigated by positive growth rates in housing prices where the bank operates. More precisely, the effect of exposure on the growth of the NPL ratio becomes negative for banks settled in provinces where the average growth rate of housing prices between 2005:Q1 and 2008:Q4 exceeds 20%. The results are rather stable when we add further controls for the capital asset ratio in 1995

[16] For example, Jimenez et al. (2011b) show that exposure to mortgage, construction and real estate development increased business lending in the expansion period because of a greater use of securitization. When we reclassify banks in exposure to real estate development alone back in 1995, we no longer find differential impact on credit during the expansion.

(column 3), the NPL ratio in 1998 (column 4) or when we weight estimates by asset size in 1995 (column 5).

Panel B runs basically the same regression as in Panel A but the dependent variable is now the growth in the NPL ratio in 2008. Cumulative housing price growth refers now to the period between 2005:Q1 and 2007:Q4. In 2007:Q4 housing prices started to fall, so according to our conjecture that housing prices were driving the evolution of capital and growth in the NPL ratio, we should see a link between the instruments and those variables already in that year. The estimates have the same sign as in 2009:Q4 but are weaker in magnitude.

To get additional insight on the timing of losses associated to bank lending to real estate, Figure 4 shows OLS estimates of the response of the share of doubtful loans to our measure of the relevance of credit supply factors during the period 2004-2009. We evaluate the response of doubtful loans to exposure evaluating the price change between 2005:Q1 and 2008:Q4 at the 10th centile of the distribution of housing prices.

We note two results in Figure 4. Firstly exposition to real estate development and its interaction with housing prices was not a significant determinant of bank-specific growth in the NPL ratio between 2005 and 2007, periods when national housing prices were increasing. Only in 2008, when housing prices started to fall, the share of doubtful loans started to increase among banks initially exposed to real estate development. The response was highest among banks operating in provinces with lower housing price increases.

Secondly, we find a significant impact of exposure to real estate interacted with housing prices already during 2008. Interestingly, among banks exposed to real estate development, increases in loans default ratios actually precede capital losses (for which Figure 2 only finds evidence in 2009). This is what one should expect, as due to regulatory reasons it takes time that expected losses result in relative capital drops.

5.3 Capital growth and business lending growth

Table 4 reports the estimates of equation [6] both by OLS and TSLS. In the TSLS specification, we instrument both capital growth and growth of the NPL ratio using historical exposure to real estate development and its interaction with changes in provincial housing prices. The evidence in Tables 2 and 3 suggests that both instruments have predictive power.

The coefficient of capital growth in the OLS regression (column 1) is 0.005, statistically not different from zero and rather small. In Column 2, we show the TSLS estimated impact on business lending growth of capital growth, and the estimate is much larger, 0.71 (standard error: 0.23). By contrast, according to the discussion in section 4.1, we could expect that the coefficient of capital growth in the OLS regression was larger than the corresponding one in the TSLS. The usual argument in the literature for this positive bias in the OLS coefficient is of a cyclical nature: that is, in a recessionary period, both lending and capital tend to contract (or, at least, to experience a reduction in their growth rates). In a cross-section estimate, the idea would be that those banks who lend to firms that are affected most by downturns in the business cycle experience drops in capital and cut their lending because their customers are of worse quality in a recession. An explanation for the negative bias in the OLS coefficient that we obtain is that in the 2008-2009 period there has been a generalized increase –although of a different magnitude across banks- in the banks' capital ratios, as a result of the higher demand by the financial markets and the expectations of more strict regulatory capital requirements, that might have altered the cross-sectional relationship between changes in capital and lending.[17] For example, markets have likely required higher capital increases for banks with worse business prospects. Both factors bias the relationship between lending growth and capital growth toward zero. Note also that the increase in capital by some institutions (mainly through profits retention) might have not been enough to meet markets' requirements.

The estimated elasticity of lending to capital is 0.71 for the whole sample of industries, and the result is not changed much when we include a set of industry dummies to take into account that banks may specialize in different industries, some of which may be more riskier than other ones (column 3). The coefficient does not change much either when we control for other pre-determined bank characteristics, such as asset size in 1995-1997 or the average capital-asset ratio in the same period (column 4) or when we control for lagged dudosity (column 5). Finally, our estimates do not change substantially when we exclude construction-related industries (columns 6 to 8).

Our estimates are substantially lower than the value of 3.84 reported in Peek and Rosengreen (1995) for their whole sample of banks. These authors split their sample between constrained and unconstrained banks (on the basis of regulatory ratings) and find that this elasticity is, respectively, 5.71 and 0.48, being non-significant in the latter case. Part of the discrepancy between our results and those of Peek and Rosengreen stems from the fact that we are controlling for unexpected losses by including the growth of the NPL ratio in the loan supply equation. When we fail to do so, the impact of capital growth on business lending increases to about 1.00 (standard error: 0.33). That result highlights the relevance of controlling for expected future drops in capital.

5.4 Doubtful loans and growth of business credit

Table 4 also displays the response of business lending growth to the yearly growth in the doubtful loans ratio, holding capital growth constant. As mentioned above, the OLS relationship between credit growth and growth in the NPL ratio can be affected by either evergreening or specialization in "worse" customers. By using 10-year lagged industry exposure, biases due to specialization in "worse" customers are mitigated. It can still be argued that banks specialized in real estate lend to a different set of firms. For example, Jimenez et al. (2010b) provide some evidence that banks generally involved in financing

[17] For instance, the overall solvency ratio for the Spanish deposit institutions has risen from 11.3 in December 2008 to 12.2 one year later.

construction activities tend to have a different set of customers: smaller firms with more collateral. In section 6.1, we explore whether, within a given industry, banks more exposed to real estate development are more likely to lend to worse firms.

We find a positive and significant coefficient for the doubtful loans ratio in the OLS regressions (see Table 4, column 1). However, once we exploit variation in the NPL ratio associated to historical exposure to real estate development, the growth of the NPL ratio has a negative coefficient, although it is not significant. The results for both samples (all industries and excluding construction and real estate) are again very similar.

5.5 The magnitude of the estimates

In order to obtain a first tentative estimate of the impact of banks' capital restrictions on lending growth we adopt an indirect approach. As we have already discussed, most banks have increased their capital in 2009. In spite of this fact, it is likely the case that some banks might have a volume of capital below its target level because of the increase in the amount demanded by either the markets or the expected raise in regulatory requirements. To evaluate the magnitude of the channel we are interested in, we assume that those banks with a capital ratio below an arbitrary level have experienced a capital contraction that is equivalent to the gap between the level of capital and the implicit level of capital that would be consistent with the level of banks' assets and the arbitrary level of the capital ratio. Taking 7% as the benchmark level of Tier 1 capital ratio and using the estimated coefficient in column 1 of Table 3, the implied effect on lending growth amounts to -0.16 pp, while the average growth of business lending in 2009 for the banks in the sample was -3.93pp.[18] Thus, this channel would explain around 6% of the total contraction in loan supply in 2009. Taking 8% as the benchmark capital ratio the implied effect on lending growth would be -1.08 pp (around 27% of the drop in business lending growth).

Growth in the NPL ratio:

To evaluate the magnitude of the effect of the growth of the NPL ratio on business lending growth in 2009 we run the following counterfactual: what would have been the growth in business lending had the doubtful loans ratio evolved not as it did, but as predicted by the model in column 2 of Table 3 but with cumulative growth in housing prices in 2008:Q.4 staying at the 2007:Q4 level. We first compute the growth in the doubtful loan ratio that would have been observed if the housing price had remained at the 2007:Q4 level. That level was 1.22pp, while the actual one was 1.55pp. Then we used this counterfactual doubtful loans ratio to estimate what would had been the growth rate of lending in the alternative scenario of no yearly housing price change in 2008. We find that even with constant housing prices, the average growth rate of lending would have been -3,3pp, while the average growth of business lending in 2009 for the

[18] This effect is computed as $\sum_i \beta_2 (K_i - \overline{K}) w_i$ where β_2 is the elasticity of lending growth to capital growth, $(K_i - \overline{K}\ )$ is the gap between current capital and the benchmark level and w_i is the weight of bank i in total business lending.

banks in the sample was -3.9pp. Thus, this channel would explain around 10% of the total contraction in loan supply in 2009. Rerunning the specification excluding lending to industries related to construction, we obtain that business lending dropped by 2.6 pp, while the counterfactual with no price drop amounts to a 2.00 pp reduction. In that case, loan supply factors would contribute up to 18% of the observed drop in credit.

6 Robustness checks and other outcomes of interest

6.1 Unobserved quality: NPL ratios by industry

The estimated impact of capital growth and changes in the NPL ratio on business lending may capture factors other than actual or anticipated capital drops if banks specialized in the real estate development sector lend to firms that, within a given industry, are more sensitive to changes in the economic situation. Such result would arise if for example, real estate development banks lend to smaller firms, or are more likely to grant loans tied to the value of housing collateral. We assess such possibility using as a measure of borrower's quality the share of doubtful loans within an industry. If banks historically exposed to real estate development lend to firms that are more likely to default in the event of housing price drops, they should have a higher share of doubtful loans for all industries. Alternatively, if borrower's quality is similar for banks exposed to real estate and the rest, the ratio of doubtful loans within a given industry should be orthogonal to historical exposure.

Using balance sheet data of 2009:Q1 (the last period for which we have NPL ratio disaggregated by industry) we run the following set of industry-specific regressions:

$$\begin{aligned}\Delta NPL_{i,t}^{J} &= \delta_0 + \delta_1^j Exp\,\text{real}_{95-97} + \delta_2^j Exp\,\text{real}_{95-97}\,\Delta HPRICE_{i,t-1} \\ &\quad + \delta_3^j \Delta HPRICE_{i,t-1} + \sum_{r=1}^{R} d_r^j R_i + d_{j,s} Sav\_bank_{i,t} + u_{j,i,t} \qquad (9)\end{aligned}$$

If banks specialized in real estate lend to more collateral-dependent firms, we should expect δ_1^j to be positive and δ_2^j to be negative at least for some industries. Rather than showing 23 industry-specific regressions, we plot in Figure 5 an estimate of $\delta_1^j + \delta_2^j \Delta HPRICE_{i,t-1}$ where $\Delta HPRICE_{i,t-1}$is the 10th centile of the price change between 2005:Q1 and 2008:Q4 in our sample. In other words, we evaluate the impact of exposure on the NPL ratio in the provinces with highest price drops. We also show the 95% confidence interval around the value.

The pattern of responses of the share of doubtful loans to historical exposition to real estate development interacted with housing prices in Figure 5 suggests that, for all industries but real estate development, there were small differences in the quality of borrowers across "real estate banks" and the rest. Excluding the trade sector (where estimates are still zero, but imprecise), provinces that experienced the lowest price increases between 2005q1 and 2008q4 did not have a higher share of NPLs. We only find a higher share on doubtful loans in the real estate development sector for banks operating in those provinces where prices increased the least. Such evidence is at odds with the notion of differences in borrower's quality driving our results.

6.2 Does the definition of capital matter?

Table 2 examines whether exposition to real estate developers diminishes Tier 1 Capital growth. Now, it is unclear what measure of capital growth is the most relevant one for bank's behavior. Furthermore, as we mentioned above, the Spanish regulator requires banks to accumulate extra provisions during expansionary periods as a way of self-insuring against the risk of unrealized but latent losses when credit is expanded. The resulting buffer (arising from the so-called dynamic provisioning) are not included in Tier 1 Capital, but in Tier 2 Capital. Hence, we also explore the relationship between exposure to real estate development and its interaction with housing prices and capital growth using this broader measure of capital changes. The results are shown in the first two columns of Table 5. They are quite similar to those in Table 2. The main result is that historical exposure to real estate significantly affects capital growth in 2009 but not in 2008.

6.3 A capital drop vs other changes: deposit, liquidity growth and interest rate responses

We are examining a crisis period, so the link between capital growth and business lending can partially capture the impact on lending of impacts other than capital growth, such as differential evolution of *deposits growth*. For example, disruptions in the functioning of the interbank market may lead less liquid banks, or banks less able to attract depositors to cut lending to firms. Such confounding factors are likely to bias the estimates in Table 4 if banks with heavier exposition to real estate development, or located in provinces with heavier price drops also experienced liquidity shortages or lower deposit growth. Table 5 presents the results of OLS equations of total deposit growth on exposure to real estate (column 3) and its interaction with local housing prices (column 4). The results are somewhat unstable across specifications. In Table 5, column 3 the estimate is 8.2 (standard error: 4.8). The estimate suggests that banks more exposed to real estate development increase faced higher deposit growth (albeit the link is statistically not very precise). Nevertheless, when we introduce the interaction between exposure and housing prices, the relationship changes sign. In view of the unstable relationship, we further included as a regressor one year lagged deposit growth in a model otherwise similar to that in column (8) of Table 4. The results (not shown) were unchanged, suggesting that the unstable relationship between deposit growth and lagged exposure to real estate does not bias the estimates.

The last column of Table 5 examines how *bank liquidity* responds to exposure to real estate development. We proxy bank liquidity using balance-sheet information on the bank lendings position relative to other institutions in the interbank market and to the European Central Bank. In particular, our measure of liquidity is the difference between how much assets the bank lends to the interbank and Central Bank (the balance amount of reverse repos held by the bank) and the liabilities (assets sold under repurchase agreements). The dependent variable is year-on-year growth in liquidity. The estimates in Table 5, column 5 suggest that exposure to real estate development is a weak predictor of the evolution of bank liquidity.

Interest rate responses An alternative explanation of the findings in Table 4 is due to a differential increase in interest rates across banks. Such interpretation would be at odds with the relevance of capital growth, a factor that operates through a quantity, not a price effect. To explore the issue we examine the behavior of interest rates during 2008 and 2009 using bank-level information on the amount of new loans originated quarterly as well as the interest rate charged by the bank on those operations. Lending institutions provide information on interest rates split by loan size (below and above 1 million euro) and maturity. Maturity is reported in three brackets: below 1 year (some 70% of total lending) between 1 and 5 years and above 5 years. Unfortunately, not all banks provide that information, so we use a selected sample of 45 institutions. Table A.1.shows the results of year-specific OLS regressions of interest rates on the same set of covariates as in Table 5. Columns 1 and 2 show the average interest rate (weighting the interest rate in each maturity-loan size cell for the share of total lending in that cell relative to total business lending by the bank). Columns 5 and 6 introduce a correction for the fact that the weights used in the first column change with real estate exposure during the recession –banks more exposed to real estate development cut business lending in 2009.[19] Panel B of Table 7 displays the predicted interest rates for different levels of lagged exposure to real estate. In column 1 of Table A.1., the coefficient of exposure to real estate development is positive but not statistically significant at usual confidence levels. The interaction of exposure to real estate development and the change in housing prices is negative and statistically different from zero. Nevertheless, the magnitude seems small. The results in Panel B of Table 7 suggest that banks in the 10th centile of the (asset-weighted) distribution of real estate exposure would charge some 25 bp lower interest rate than.those in the 90th centile. Furthermore, interest rates charged during the first quarter of 2009 were 200 bp smaller than the interest rates charged in the same period of 2008. That is, for the whole sample interest rates fell while credit dropped. We doubt that the small gradient on interest rates can generate the differences in business lending

[19] The correction amounts to computing average interest rate charged by each bank across the 6 cells using not the share of loans originated as a fraction of total lending in 2009 or 2008, but weighting by the share of each cell in total business lending in the pre-crisis period of 2006Q1.

we find in the data.

6.4 Lagged exposure to real estate development and credit growth: different specifications.

Firstly, we estimate the relationship both in 2009 and 2008 but excluding from the sample the two largest institutions in the Spanish market. The reason for this omission is that the capital level and lending of those banks can be determined by their international portfolio, so the inclusion in the sample may alter the link between exposure to real estate development and loan growth. The results are not altered by such exclusion (columns 1 and 2 in Table 6).

Secondly, as the distribution of lending is rather skewed, with a few banks accounting for a large share of business lending, we ran weighted least squares models using as weights the lagged share of the bank's lending to all industries. The WLS estimates in columns 3 and 4 of Table 6 are similar in absolute value to those we obtain when we do not weight bank-industry cells, but they are also less precise.

Thirdly, in Table 4 we trimmed the data by dropping the top and bottom 2 percentiles of the unconditional distribution of credit growth in our sample. The choice was based on the need to get more efficient estimates. To gauge whether the trimming strategy is affecting our estimates, we ran quantile regression models on the whole sample. The results are shown in columns 5 and 6 of Table 6. While much less precise, these results are qualitatively similar to the trimmed OLS estimates, suggesting that trimming does not substantially bias the magnitude of the estimates.

6.5 Did firms reshuffle their debt portfolios?

Under some circumstances firms may overcome bank-specific credit supply problems by reshuffling their debt portfolios and borrowing less from stressed banks and more from unconstrained ones. Actually, using data from Spain between 2002 and 2007, Jimenez et al (2010b) document that, prior to the recession, firms that borrowed in 2002 from banks with a lower ability to securitize overcame bank-specific liquidity problems by borrowing more from the rest of banks.

If loan reshuffling is prevalent, a model like [6] would overstate the relevance of bank-specific variables. Even if total lending remained constant and banks with high capital levels merely increase their share of lending at the expense of banks with low capital, a model like [6] would yield negative estimates for β_1 and β_2. Jiménez et al. (2010b) propose to gauge the relevance of bank-specific factors by running a modified version of [6] aggregated at the firm level. In our case, that strategy would amount to running the following regression:

$$\begin{aligned}\Delta \log L^J_{i,t} &= b_j + b_1 \sum_{i=1}^{i=N_j} \frac{\Delta NPL_{i,t}}{N_j} + b_2 \sum_{i=1}^{i=N_j} \frac{\Delta \log K_{i,t}}{N_j} \\ &+ d_s \sum_{i=1}^{i=N_j} \frac{Sav\_bank_{i,t}}{N_j} + \sum_{i=1}^{i=N_j} \frac{\varepsilon^j_{i,t}}{N_j} \qquad (10)\end{aligned}$$

where $\Delta \log L^J_{i,t}$ is loan growth at the firm level and the rest of the variables are industry-specific averages of the covariates of interest. N_j is the number of banks lending to industry j. If reshuffling was very important in the data, the coefficients in the industry level regression $b_1$and b_2 would be smaller in absolute value than those of the bank-industry level regresssion β_1 and β_2 respectively. The extreme case of firms being able to borrow regardless of the capital position of lenders would lead to estimates of $b_1$and b_2 around zero. As a robustness check, we implement a model like [10] averaging bank conditions of banks that, at the beginning of period 2008:Q4, were lending to a particular industry. Given the limited number of industries (23, 22 excluding real estate development) we supplement the analysis with scatter data plots.

We make some modifications to model [10]. First, rather than running IV regressions of loan growth on average non-performing loans and capital growth, we use OLS regressions of industry-level capital growth on the main instrument directly (exposure to real estate developers). Secondly, we compute the average exposure to real estate development at the industry level as follows:

$$E(Exp\,\text{real}_{95-97})_j = \sum_{i=1}^{i=N_j} \frac{Exp\,\text{real}_{95-97,i,t}}{N_j} 1(L^J_{i,t-1} > 0)$$

That is, the independent variable is the average exposure to real estate developers among banks that at the beginning of 2009 were lending to the industry.

Figure 6 shows a scatter plot of data where the Y axis shows credit growth at the industry level while the X axis shows to what extent industries were dependent on banks traditionally exposed to real estate development. The graph suggests a negative relationship between both variables in 2009:Q4: industries that, as a whole, were more dependent on banks with traditional expertise on lending to real estate developers in 1995-1997 experienced lower credit growth in 2009. Whether or not we weight the data by the size of the industry does not affect the qualitative pattern by much.

In Table 7, we compare results of OLS regressions ran at the bank-industry (columns 1 and 2) and at the industry level (3) on measures of bank's exposure to real estate development and type of institution. In column (3) the dependence on real estate development is measured at the industry-level dependence and the share of savings banks is also measured at that level. Indications of credit reshuffling across banks arise when the coefficient of bank-industry regressions is larger in absolute value than that at the industry level. The results clearly suggest the opposite: An increase of average exposure to "real estate banks" of 1 pp reduces credit growth by 10 pp (standard error: 0.6). Contrary to the "reshuffling" hypothesis, the estimate is significantly different from zero at the 10 percent confidence level and larger in absolute value than the bank-firm level estimate of -.77 or -.88 in columns 1 and 2 of Table 7. We infer that while obtaining credit from alternative borrowers can be an option during an expansion (as findings in Jimenez et al, 2010b suggest), a recession period offer firms very limited possibilities of switching to other loan suppliers.

6.6 Possible sources of biases.

Endogeneity of local housing prices. It can be argued that (one-year lagged) housing prices at the province level are determined by bank's past borrowing and reflect the evolution of demand, rather than supply factors. While we make no adjustment for such source of bias, we note that housing prices are not used as an instrument throughout the analysis, but its interaction with 13 year-lagged exposure to real estate development. In other words, as wide region dummies and housing prices are included as additional regressors, we end up comparing differences in credit growth of banks located in similar regions and similar price drops but that vary in terms of their initial exposure to real estate development 12 years prior to 2008.

In addition, and to further examine if the housing price is really picking up demand factors, we re-did the analysis substituting housing prices by the provincial unemployment rate. As unemployment rate increased mainly in the construction sector between 2008 and 2009, it is to be related to regional demand factors associated to the construction boom. Unlike the interaction of lagged exposure to real estate development and housing prices, the interaction of lagged exposure with unemployment explains a very limited fraction of the variance of capital growth, dudosity or business lending growth (not shown). Hence, we interpret that the interaction of housing prices and real estate development in our specification picks up balance sheet effects that differ from demand factors.

Unobserved demand conditions A major concern with the link between capital growth and business lending is the ability to control for the quality of firms demanding loans. For example, Jimenez et al (2010a) use matched firm-bank data to estimate the impact of monetary conditions on the lending behavior of less capitalized banks during the 2002-2008 period. The evidence we find seems to counter the possibility of exposure to real estate being strongly related to demand factors: the timing of dudosity in Figure 2 does not suggest a differential trend prior to 2008. Figure 5 does not give us many reasons to think that banks relatively more exposed to real estate development have worse borrowers when lending to the same industry as of 2009. Third, controlling for lagged dudosity in Table 4 does not seem to change our results. At any rate, if a deterioration of the quality of borrowers is driving our results, it must be a drop in the demand of credit that (a) is correlated with local housing prices only among borrowers from banks exposed to real estate development and that (b) cannot be detected in higher NPLs in sectors other than real estate development.

7 Conclusions

Bank credit to the non-financial private sector in the Spanish economy has experienced a sharp deceleration, from annual growth rates well above 20% in 2007 to negative figures registered at the trough of this cycle. The assessment of the relative contributions of demand and supply-side factors faces two main obstacles: the qualitative nature of the information sources explicitly distinguishing between both components and the simultaneity in their movements driven by the cyclical position of the economy and other factors.

This paper explores one specific supply channel: whether banks' actual and expected capital growth influences loan supply to a given industry. We argue that the deleveraging process that is taking place in the banking system (driven both by expectations of higher regulatory capital requirements and by larger demands from financial markets) in the case of some banks might have not been enough to meet the increase in capital requirements. This is likely to be the case for those institutions with limited access to market funding, either because of institutional limitations or as a consequence of higher perceived risk (as might be the case, for instance, of banks with a high exposure to real estate sector). These institutions might have been able to rise own funds only by retaining profits and, in this period of declining profitability, this might have been insufficient to reach the desired level of capital. Under these circumstances, these banks might have had to cut back their lending.

Using financial statements for a sample of Spanish banks, we have estimated different specifications for the separate impact of changes in banks' actual and expected capital growth on bank lending. We have used an instrumental variable approach as well as industry fixed-effects to control for the simultaneity of supply and demand factors. We show that the historical exposure to real estate development is a good instrument for banks' actual capital growth and that lagged exposure and its interaction with local housing prices affects the share of NPLs and, hence, future capital growth. Overall, we find that banks' actual capital growth has been a relevant factor to explain lending supply, at least in 2009. We interpret that banks that have either experienced capital shortfalls or increased their capital but without reaching the level that is demanded by financial markets might have had no option but to reduce their lending.

The assessment of the magnitude of the effect is necessarily tentative as different assumptions are needed and different approaches lead to a wide range of estimates for this magnitude. In particular, we find that the contraction in lending stemming from the deterioration in banks' capital position associated to the fall in housing prices accounts for between 6 and 25% of the observed decline in lending growth in 2009. The relatively small magnitude of this effect may be explained by the weakness of loan demand in a context of a deep recession. However, as loan demand reacts to the economic situation, the capital position of particular institutions might become more binding and this channel might gain in strength. Future work could then examine if the more recent evolution of housing prices and its interaction with bank's specialization pattern affects either the supply of credit or other outcomes, such as employment levels.

8 Appendix

The model is adapted from Van den Heuvel (2002). An infinitely-lived bank maximizes the expected stream of dividends d_t. The bank borrows at an interest rate r_t and keeps a level of capital K_t. The bank uses those funds to lend an amount L_t to firms obtaining a return $R(L_t)$ per unit lent. We further assume that the returns $R(L_t)$ are a decreasing with L_t. The level of bank's capital can be increased by retaining pos-tax profits $(1-\tau)\pi_{t+1}$ and it diminishes when the bank pays dividends.

We assume that the level of capital must exceed a minimum legal amount that is a fraction of the bank's total amount lent $\gamma_L L$ plus an amount γ_U reflecting either market requirements or anticipation of future losses.

$$\max_{d_t, L_t} \sum_{t=0}^{\infty} [\frac{1}{1+r_t}]^t d_t$$

$$\begin{aligned} s.t. K_{t+1} &= K_t + (1-\tau)\pi_{t+1} - d_t \\ \pi_{t+1} &= R(L_t) - r_t(L_t + d_t - K_t) \\ K_t - d_t &\geq (\gamma_L + \gamma_U)L_t \\ d_t &\geq 0 \end{aligned}$$

The value function can be written as follows

$$V(K_{t+1}) = \max_{\{d,L\}} \qquad d_t + \frac{1}{1+r_t} V\{K_t + (1-\tau)[R(L_t) - r_t(L_t + d_t - K_t)] - d_t\}$$

$$s.t. \qquad K_t - d_t \geq (\gamma_L + \gamma_U)L_t \qquad (\varphi_t)$$

$$s.t. \qquad d_t \geq 0 \qquad (\theta_t)$$

The first order conditions of the problem are the following

$$\frac{\partial \vartheta}{\partial d_t} = 1 - \frac{[1 + (1-\tau)r_t]}{1+r_t} \frac{\partial V_{t+1}}{\partial K_{t+1}} - \varphi_t + \theta_t = 0 \qquad \text{(D)}$$

$$\frac{\partial \vartheta}{\partial L_t} = \frac{[1-\tau]}{1+r_t} \frac{\partial V_{t+1}}{\partial K_{t+1}} [\frac{dR(L_t)}{dL_t} - r_t] - \varphi_t(\gamma_L + \gamma_U) = 0 \qquad \text{(R)}$$

Where ϑ is the Lagrangian of the constrained maximization problem and V is the value function. The first condition says that the dividend policy must be such that the benefit of distributing one additional euro must equal the associated cost: less capital accumulated for next period and less funds available for lending, on top of the cost when the regulatory constraint binds φ_t or the financial constraint that no additional capital can be raised (θ_t).

The second condition shows that banks must lend until the return of the last euro invested equals its cost, both in terms of the cost of funding r_t and the cost in terms of the capital requirement.

Finally, the envelope theorem condition is the following:

$$\frac{\partial V_t}{\partial K_t} = \frac{[1+(1-\tau)r_t]}{1+r_t}\frac{\partial V_{t+1}}{\partial K_{t+1}} + \varphi_t \tag{E}$$

Case 1: $\theta_t = 0$

We start by examining the case when the financial constraint does not bind - or $\theta_t = 0$. In that case, combining the envelope condition (E) and the first order condition for the dividend policy (D), one obtains that $\frac{\partial V_t}{\partial K_t}$=1, which in turn implies thatgh

$$\frac{dR(L_t^*)}{dL_t} = r_t - \frac{\tau r_t}{1+r_t}(\gamma_L + \gamma_U) \tag{A.2.}$$

Somehow abusing notation, we denote L_t^* as the amount of lending that solves (A.2). Importantly, the lending policy is determined by the marginal cost of funds, that combines the cost of raising funds and the cost of the regulatory constraint. The amount of lending does not depend on the capital position of the bank. If $\tau = 0$, the regulatory constraint does not even enter the decision of how much to lend.

Case 2: $\theta_t > 0$

In such case, the solution is determined by conditions (E) and (R). Assume capital is large enough so that $\varphi_t = 0$.[20] Hence, the solution implies that $\frac{dR(L_t^{**})}{dL_t} = r_t$, where L_t^{**} may differ from L_t^*.

It can be shown that in this setting the regulatory constraint always binds, as carrying excess capital is suboptimal under perfect certainty. We assume that there is an initial distribution of values γ_U^0. Assume that either because capital markets require higher capital levels or because higher losses due a change in the expectations about housing prices, the capital level of the bank falls short of the new amount needed, i.e., for all banks such that

$$K_t + d_t = (\gamma_U^0 + \gamma_R)L_t^* < (\gamma_U^1 + \gamma_R)L_t^*$$

Hence, in the new regime, the original choices L_t^* or L_t^* are non longer feasible. In such setting, the only feasible level of borrowing is

$$L_t = \frac{K_t}{\gamma_U^1 + \gamma_R}$$

As stated in the text.

[20] Otherwise, if both $\theta_t = \varphi_t = 0$, L_t is just determined by initial capital.

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Table 1: Summary statistics of the sample of bank-industries as of 2009:Q4

	Mean (std. Dev)	Exposure to real estate development 95-97		
		Above median	Below median	T-test
	(1)	(2)	(3)	(2)-(3)=0
Tier 1 capital -asset ratio in 2009Q4	.0956	.0974	.095	2.23
	(.019)	(0.020)	(0.019)	
Share of doubtful loans 2009Q4	4.45	5.02	4.46	6.53
	(1.58)	(1.76)	(1.36)	
Nominal growth in business lending in 2009	-.0392	-.062	-.0195	
	(.430)	(.366)	(.50)	
Mean growth business lending 2002-2006	.1419	.1408	.1655	
	(.583)	(0.572)	(0.566)	
Savings bank	.59	.62	.359	9.81
	(.49)	(.480)	(.480)	
Exposition to real estate development (2007Q4)	.2783	.381	.199	21.78
	(.177)	(.106)	(.181)	
Δ housing prices 5Q1-06Q4	.178	.177	.179	
Δ housing prices 5Q1-07Q4	.2309	.228	.2342	
Δ housing prices 5Q1-08Q4	.1907	.187	.194	
Characteristics in 1995-1997 (1)				
Exposure to real estate development (1995-1997)	.022	.034	.007	30.37
	(.023)	(.024)	(.002)	
Asset size 1995-1997	2.256	2.29	2.69	
(medians, unweighted)	(7.290)	(5.27)	(9.14)	
Tier 1 capital -asset ratio	.13	.119	.146	
(1995-1997 average)	(.060)	(.065)	(.050)	
Business dudosity ratio in 1998	.0128	.014	.0128	3.35
	(.006)	(.007)	(.006)	
Number of (bank-industry) cases:	1325	732	593	

The unit of analysis is the combination bank-industry, where we have 68 banks and 23 industries for 2009Q4.

(1) Statistics weighted by bank's lending to firms in 1995-1997 (but asset size). Asset size measured in million euros

Table 2: The exposure to real estate in 1995-1997 and the growth of Tier 1 capital in 2009Q4: OLS estimates

	Growth of Tier 1 capital (log difference between 2009.12 and 2008.12)			
	(1)	(2)	(3)	(4)
1. Exposure to real estate	-1.042	-1.791	-1.518	-1.498
development (1995-1997)	(.366)***	(.478)**	(.558)**	(.53)**
2. Exposure to real estate	--	3.375	2.354	2.079
* (Δ housing prices)		(1.974)	(2.24)	(2.154)
3. Savings bank	-.089	-.0922	-.09	-.0904
	(.032)	(.031)	(.032)	(.031)
4. Δ Housing prices	--	-.4764	-.442	-.359
(06Q1-08Q4)		(.240)	(.238)	(.255)
Bank characteristics as of 1995-1997				
5. Asset size, 1995-1997			.002	.002
			(.001)	(.0012)
6. Log Tier 1 capital-asset ratio			-.007	-.007
			(.024)	(.024)
7. Log dudosity (as of 1998)				.026
				(.0212)
8. Constant	.189	.272	.22	.317
	(.023)	(.048)	(.067)	(.101)
Number of banks:	55	55	55	55
R-squared	.45	.49	.49	.504
F-test (H0: Exposure=0)	8.12	14.06	7.40	7.90

1. Each observation belongs to a "consolidated group presenting balances both in 2008Q4 and 2009Q4
2. Housing price: weighted average of the growth of the housing price between 2008Q4 and 2006Q1 in the province where the main bank of the group is present, weighted by the number of branches in that province in 2006Q1
3. All specifications include 9 region dummies, indicating the region where the bank has most branches. The regions are Andalucia (including 2 autonomous cities), Balearic Islands, Canary Islands, Castile (both regions), a joint dummy for Catalonia and Aragon, another joint dummy for Valencia and Murcia, abother for Galicia, Cantabria and Asturias, a joint dummy for Basque country and Navarre. The omitted region is Madrid
4. Standard errors corrected for heteroscedasticity. ***,**,* over the standard error imply that the coefficient is significantly different from zero at the 1, 5 and 10 percent confidence level.

Table 3: The exposure to real estate in 1995-1997 and the doubtful loans ratio in 2009Q4 and 2008Q4

Panel A: Dependent variable:	Δ Non-performing loans 2009Q4/Outstanding credit 2009Q4				
	(1)	(2)	(3)	(4)	(5)
1. Exposure to real estate	.114	.392	.3829	.375	.307
development (1995-1997)	(.083)	(.095)**	(.096)**	(.083)**	(.12)**
2. Exposure to real estate	--	-1.933	-1.882	-1.762	-1.596
* (Δ housing prices 06Q1-08Q4)		(.450)**	(.447)**	(.351)**	(.652)**
3. Savings bank	.0019	-.0013	-.0018	-.003	-.007
	(.003)	(.002)	(.002)	(.0017)	(.0018)
4. Δ Housing prices 06Q1-08Q4	.0258	.126	.113	.124	.105
	(.042)	(.035)	(.036)	(.042)	(.046)
5. Asset size, 1995-1997			2e-5	5e-5	6e-5
			(.0001)	(.0001)	(5e-5)
6. Capital-asset ratio in 1995-1997	--	--	-.0045	-.0054	.0009
			(.0017)	(.0024)	(.0024)
7. Log dudosity (as of 1998)	--	--	--	.0005	.0009
				(.0009)	(.0007)
8. Constant	.0064	-.0041	-.0025	-.013	.007
	(.008)	(.009)	(.009)	(.013)	(.013)
Number of banks:	67	67	67	67	67
R-squared	.24	.537	.542	.58	.538
F-test (H0: Exposure=Exposure*Price change=0)	1.13	9.22	8.86	14.54	7.99
Panel B: Dependent variable:	Δ Non-performing loans 2008Q4/Outstanding credit 2008Q4				
9. Exposure to real estate development	.00034	.1218	.17	.193	.458
(1995-1997)	(.027)	(.073)*	(.067)**	(.054)***	(.223)***
10. Exposure to real estate	--	-.585	-.745	-.857	-2.105
* (Δ housing prices 06Q1-07Q4)		(.292)**	(.28)	(.294)**	(1.072)**
Number of banks:	68	68	68	68	68
R-squared	.202	.268	.244	.294	.362
F-test (H0: Exposure=Exposure*Price change=0)		2.39	3.55	6.63	2.1

Columns (1)-(4) show OLS regressions of bank-specific growth of the share of dubious loans. Column (5) shows WLS (asset size in 1995-97 are the weights)

Table 4: The impact of the doubtful loans ratio and capital growth on business credit growth in 2009

Estimation method:	OLS	TSLS				TSLS		
	Including industries related to real-estate					Excluding industries related to real-estate		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Δ doubtful loans ratio in 2009	1.601	-.69	-.90	-1.34	-1.34	-1.44	-1.973	-1.96
	(.553)**	(1.884)	(1.57)	(1.73)	(1.81)	(1.50)	(1.38)	(1.51)
2. Δ log(Capital tier 1)	.0047	.707	.733	.796	.638	.601	.698	.61
2009Q4 vs 2008Q4	(.180)	(.236)**	(.247)**	(.279)**	(.309)**	(.246)**	(.230)**	(.277)**
3. Δ Housing prices		-.5302	-.533	-.487	-.32	-.31	-.295	-.215
06Q1-08Q4		(.35)	(.35)	(.365)	(.35)	(.308)	(.324)	(.300)
Savings bank	-.0299	.015	-.015	.018	.002	-.014	-.006	-.003
	(.034)	(.036)	(.036)	(.039)	(.039)	(.039)	(.038)	(.036)
Total lending 95-97				-.003	-.0024	--	--	-.002
(million euro)				(.0018)	(.0018)			(.002)
log Capital -asset ratio 1995-1997				.002	-.0315	--	--	-.004
				(.0035)	(.0378)			(.034)
log dudosity 1995-1997					-.019			-.0004
					(.025)			(.022)
Constant	-.088	-.007	-.055	-.025	-.177	-.0106	-.0296	-.026
	(.081)	(.094	(.097)	(.097)	(.16)	(.080)	(.150)	(.149)
F-test all instruments in Δ doubtful loans ratio=0:		8.18	8.36	14.12	14.5	8.18	8.36	14.12
F-test all instruments in Δ capital =0:		7.57	5.88	7.3	7.9	7.57	5.88	3.88
Industry dummies?	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Region dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1415	1357	1357	1357	1357	1033	1033	1033

Each column shows OLS and TSLS coefficients of a regression of credit growth of each of the 65 banks to each of the 23 industries in the sample on the bank's doubtful loans ratio and capital growth over the same period. The First stage of capital growth in Table 2 and that of doubtful loans ratio growth in Table 3.

1. Bank-industry cells where credit to business increased by more than the 98th centile or less than the 2th centile are excluded

2. Capital growth and doubtful loans ratio growth instrumented both with share of real estate development in total business lending between 1995 and 1997 instrumented with the interaction between real estate development and provincial growth in housing prices between 2006Q1 and 2008Q4

3. Standard errors corrected for generated regressors, heteroscedasticity and arbitrary correlation between observations from the same bank

Table 5: The exposure to real estate in 1995-1997 and various bank-level outcomes in 2009Q4 and 2008Q4

Dependent variable:	Tier 2 - Capital growth		Deposits over total assets -growth	Change in liquidity
	2008:Q4-2009:Q4	2007:Q4-2008:Q4	2008Q4-2009:Q4	2008Q4: 2009Q4
	(1)	(2)	(4)	(5)
1. Exposure to real estate	-1.619	-.9268	-1.142	-.084
development (1995-1997)	(.671)**	(1.029)	(.596)*	(.0944)
2. Exposure to real estate	5.77	3.79	5.461	.244
* (Δ housing prices 06Q1-08Q4)	(3.023)*	(4.00)	(3.400)	(.629)
3. Savings bank	-.026	-.011	-.049	-.0213
	(.034)	(.033)	(.024)**	(.001)**
4. Δ housing prices 06Q1-08Q4	-.144	.53	.026	.0006
	(.319)	(.38)	(.28)	(.098)
5. Asset size, 1995-1997	.0004	0	.001	.0007
	(.0015)	(.03)	(.001)	(.00047)
6. Capital-asset ratio	-.004	-.044	.038	-.0071
in 1995-1997	(.025)	(.037)	(.033)	(.005)
7. Log dudosity (as of 1998)	.040	.047	.002	.0046
	(.032)	(.025)	(.027)	(.0018)
8. Constant	.3204	.089	.087	.0339
	(.13)	(.125)	(.12)	(.024)
Number of observations	55	55	55	55
R-squared	.257	.40	.31	.293

1. Each observation belongs to a "consolidated group presenting balances both in 2008Q4 and 2009Q4
2. Estimation method: Ordinary Least Squares. 9 Region dummies included in all specifications -see notes to Table 2.
3. Total asset size as of 1995-1997 is measured in million euros.
4. Standard errors corrected for heteroscedasticity. ***,**,* over the standard error imply that the coefficient is significantly different from zero at the 1, 5 and 10 percent confidence level.
5. Change in liquidity proxied as the change between 2009Q1 and 2008Q1 of the difference between the amount of reverse repos held and the amount of assets sold under repurchase agreements.

Table 6: The relationship between credit growth and exposure to real estate development in 1995-1997: specification checks

Estimation method:	OLS -excluding largest two banks		WLS		Median	
Dependent variable:	log(Cred 09Q4) -log(Cred 08Q4)	log(Cred 08Q4) -log(Cred 07Q4)	log(Cred 09Q4) -log(Cred 08Q4)	log(Cred 08Q4) -log(Cred 07Q4)	log(Cred09Q4) -log(Cred08Q4)	log(Cred 08Q4) -log(Cred 07Q4)
	(1)	(2)	(3)	(4)	(5)	(6)
1. Exposure to real estate development (1995-1997)	-.76	.10	-1.07	.678	-.13	-.28
	(.26)**	(.33)	(.62)*	(.55)	(.39)	(.22)
2. Exposure to real estate * (Δ housing prices 06Q1-08Q4)	4.55	11.9	4.71	18.5	9.74	8.46
	(2.36)**	(3.84)**	(5.31)	(10.9)*	(8.760)	(13.253)
3. Savings bank	-.052	.04	-.033	.077	-.059	.0146
	(.032)*	(.41)	(.027)	(0.036)	(0.036)	(0.042)
4. Δ housing prices 06Q1-08Q4	-.496	.739	-.52	.71	-1.202	-.1556
	(.34)	(.58)	(.38)	(.83)	(.513)	(.732)
5. Constant	.042	.31	-.035	.176	.2307	.0881
	(.15)	(.18)	(.13)	(.210)	(.110)	(.150)
Number of cases	997	1011	1033	1046	1086	1100
Industry dummies	yes	yes	yes	yes	yes	yes
Region dummies	yes	yes	yes	yes	yes	yes
R-squared	.13	.11	.21	.07		

Each column shows OLS (columns 1 and 2), WLS (columns 3 and 4) and Quantile Regression models (columns 5 and 6) estimates of the impact on bank-industry credit growth of exposure to real estate development between 1995 and 1997 and its interaction with local housing prices growth between 2005 and the previous year. Housing prices is the deviation from .20 (housing growth beween 2005 and 2007). The QR model is run on the full (non-trimmed) sample of business lending from each bank to each industry. In the WLS models, the weights used are total lending. Standard errors corrected for heteroscedasticity and clustered at the level of the bank

Table 7: Did firms reshuffle their debt portfolios?

	Bank-industry level regression OLS log(Cred09Q4)-log(Cred08Q4) (1)	Bank-industry level regression OLS log(Cred09Q4)-log(Cred08Q4) (2)	Industry-level regression OLS log(Cred09Q4)-log(Cred08Q4) (3)
1. Exposure to real estate development	-.777	-.882	
in 1995-1997	(.297)**	(.308)**	
1a. Mean exposure to real			-10.25
estate development (industry average)			(6.501)*
2. Savings bank	-.071	-.071	
	(.032)**	(.032)**	
2a. Mean of savings bank lending to the industry			-.088
(industry average)			(.015)**
3. Constant	.0428	.0154	.834
	(.026)	(.034)	(.233)
Sample size	1033	1033	22
Industry fixed-effects?	No	Yes	No

1. The sample used in Columns 1 and 2 has as many observations as bank-industry cells we observe in 2009Q4 (65 banks, 23 industries). The sample excludes cells where lending was above the 98th centile or below the 2nd centile

2. The coefficients in columns (1) and (2) are estimated by OLS in the bank-industry sample. We include the rest of the regressors mentioned in Table 4, columns 6 (no industry fixed effects) and 7 (including industry fixed effects)

3. The sample used in Column 3 has as many observations as industries we observe in our sample (22 after excluding real estate development)

4. The coefficients of column 3 are OLS estimates of a regression of industry credit growth in 2009 on the average exposure to real estate development among lenders to the industry and the fraction of lenders that are savings banks

TableA.1.: The exposure to real estate in 1995-1997 and interest rates on new loans to firms: 2009Q1 and 2008Q1

Dependent variable:	Interest rate -unadjusted		Share of loans below 1 million (1 year)		Interest rate -adjusted	
	2009:Q1	2008:Q1	2009:Q1	2008Q1	2009Q1	2008Q1
	(1)	(2)	(3)	(4)	(5)	(6)
1. Exposure to real estate development (1995-1997)	4.64 (4.25)	-3.13 (4.25)	3.87 (2.03)*	8.34 (6.87)	7.26 (4.21)*	-1.17 (4.92)
2. Exposure to real estate * (Δ housing prices 06Q1-08Q4)	-128 (64)**	92 (89)	-24 (16)	-37 (36)	-150 (73)*	-17 (96.3)
3. Savings bank	-.02 (.37)	-.075 (.25)	-.096 (.062)	-.16 (.06)**	-.17 (.36)	.176 (.233)
4. Δ housing prices 06Q1-08Q4	14.17 (3.26)	8.41 (3.20)	.20 (.93)	-.74 (.85)	11.75 (3.18)	7.01 (.23)
8. Constant	3.90 (.36)	5.71 (.25)	.45 (.19)	.64 (.189)	4.09 (.40)	5.84 (.244)
Number of observations	45	45	45	45	45	45
R-squared	.53	.39	.58	.37	.498	.35

Panel B: Predicted interest rate

	(1)	(2)	(3)–(4)	(5)	(6)
1. At the 10th centile exposure (0.7%)	3.79 (.35)	5.78 (.22)	--	3.925 (.37)	5.86 (.22)
2. At the average exposure and housing price	3.90 (.36)	5.71 (.25)	--	4.09 (.40)	5.83 (.24)
2. At exposure evaluated at 90th centile (3.3%)	4.05 (.54)	5.61 (.34)	--	4.324 (.475)	5.80 (.34)

1. Each observation belongs to a lending institution. Exposure to real estate (housing prices) are the deviation from sample (sample-year) average
2. Estimation method: Ordinary Least Squares. 9 Region dummies included in all specifications -see notes to Table 2.
3. The unadjusted interest rate is the weighted average by maturity (3 leves: below 1 year, between 1 and 5 and over 5 years) and loan size (below and above 1 million euro). The adjusted interest rate keeps constant the contribution of the weights in their 2006:Q1 levels.
4. Total asset size in 1995-1997, the capital asset ratio and the log of dudosity included in all specifications but not shown

Figure 1: The relationship between the weight of real estate development in 1995-1997 and the exposure in 2007Q4

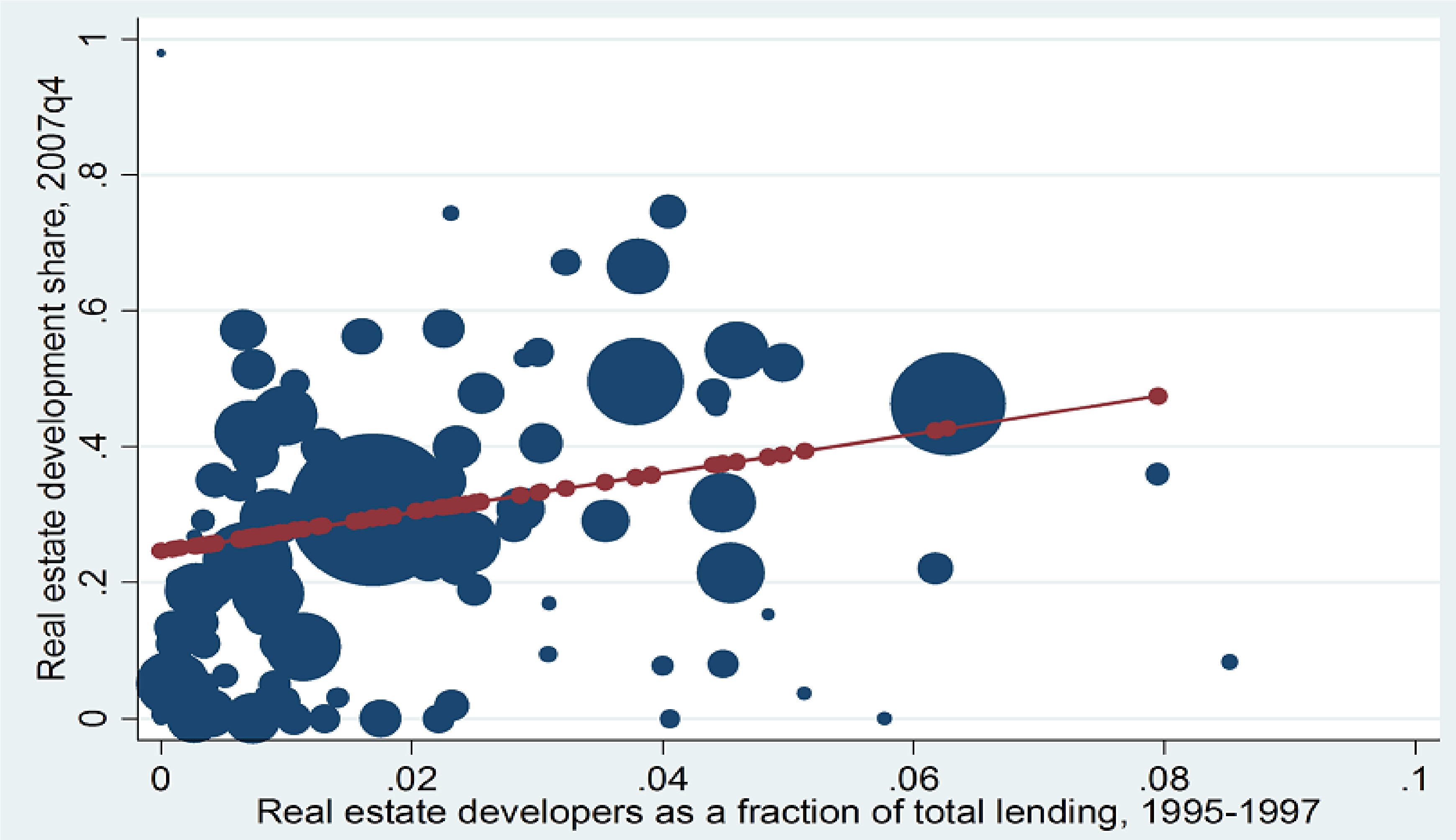
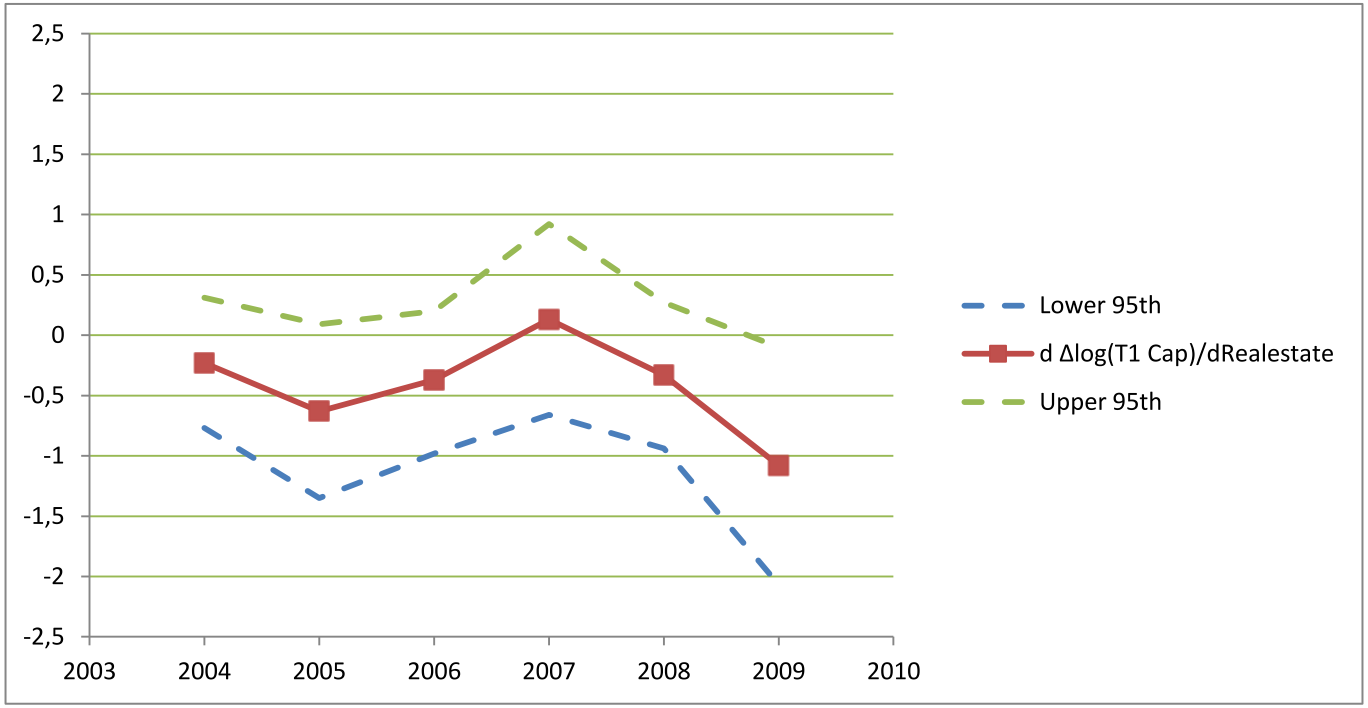
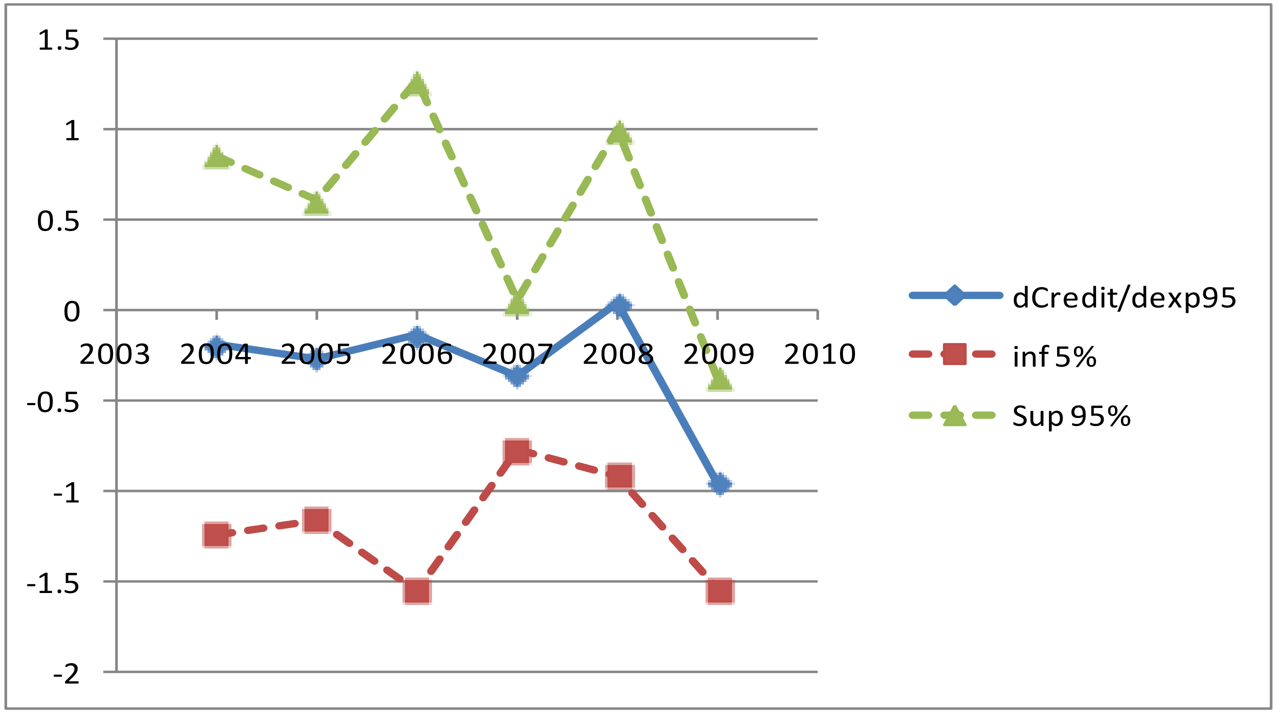


Figure 2: The impact of exposure to real estate development on Tier 1 capital growth, by year



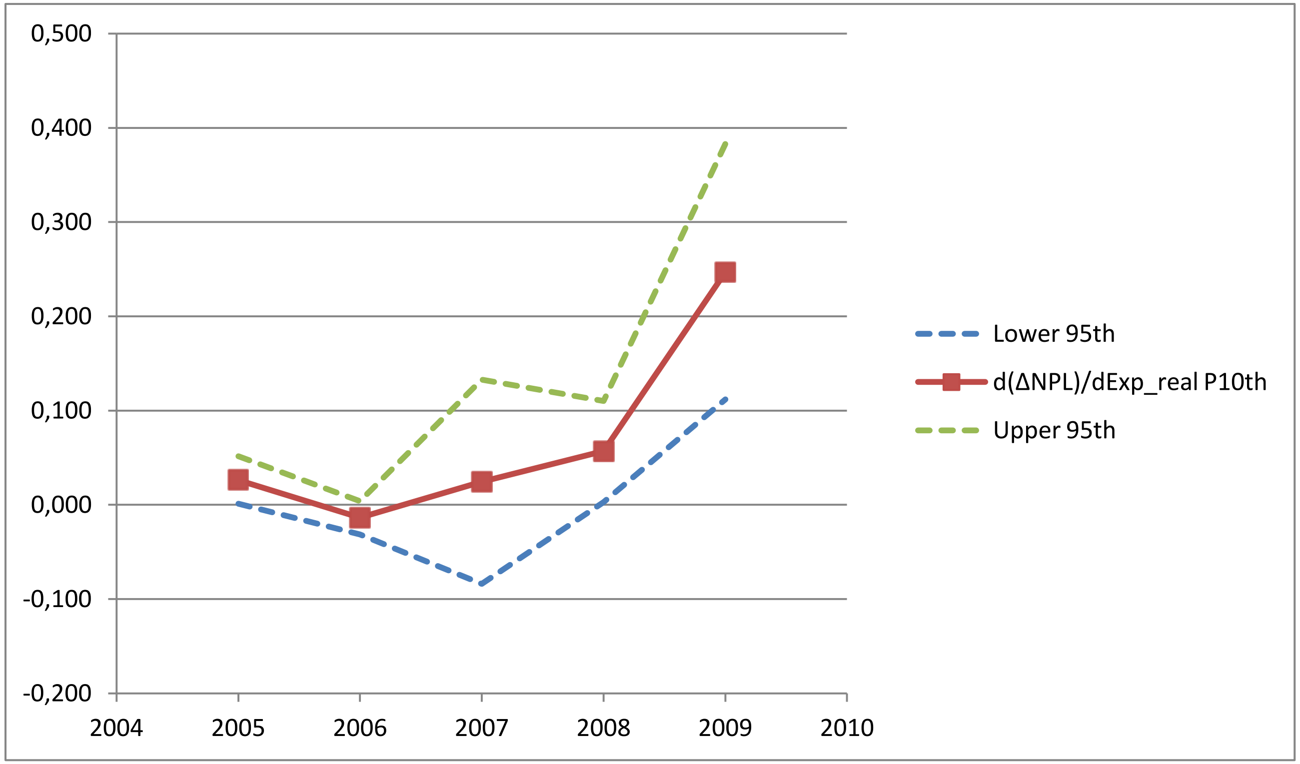
Each dot is the OLS response of Tier 1 capital growth to historical exposure to real estate development for each year between 2004 and 2009
Point estimates are obtained from year-specific OLS regressions of Tier 1 capital growth on historical exposure
to real estate development (1995-1997), 9 region dummies, a dummy for savings bank and log of bank assets as of 1995. The dashed lines are the limits of the 95th confidence interval.

Figure 3: The impact of exposure to real estate development on y-o-y growth in business lending, by year



Each dot is the response of credit growth to historical exposure to real estate development for each year between 2004 and 2009 Point estimates are obtained from year-specific OLS regressions of credit growth to a specific industry on historical exposure to real estate development, 9 region and 23 industry dummies and a dummy for savings bank. The dashed lines are the limits of the 95th confidence interval.

Figure 4: The impact of exposure to real estate development on the growth rate of the NPL ratio, by year



a. Each dot is the predicted level of dudosity evaluated at the median exposure to real estate development and the 10th centile of the distribution of bank specific change of housing prices between 2005Q1 and the year previous to the regression. We run the following yearly regression for all years between 2005Q4 and 2009Q4

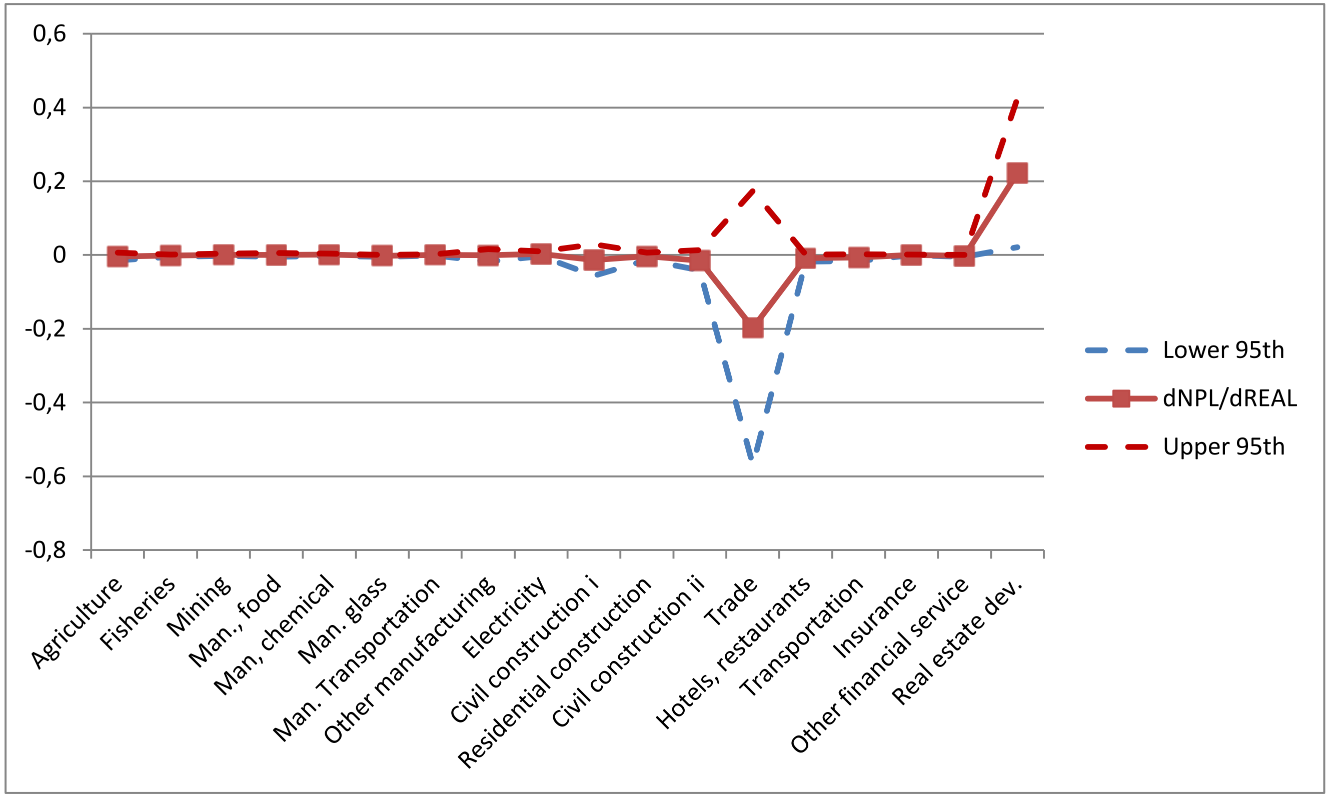
$$\Delta DOUBT_{i,t} = \delta_0 + \delta_1 (EXP\_REAL)_i + \delta_2 (EXP\_REAL)_i \Delta HPRICE_{i,t} + \Delta HPRICE_{i,t} + \sum_s REGION_s + Savings + u^2_{i,t}$$

b. Each dot is the point prediction

$$\hat{\delta}_1 ExpReal_{95-97}. + \hat{\delta}_2 ExpReal_{95-97} * \Delta HPrice$$

Dashed lines are the limits of the 95th confidence interval around each point estimate

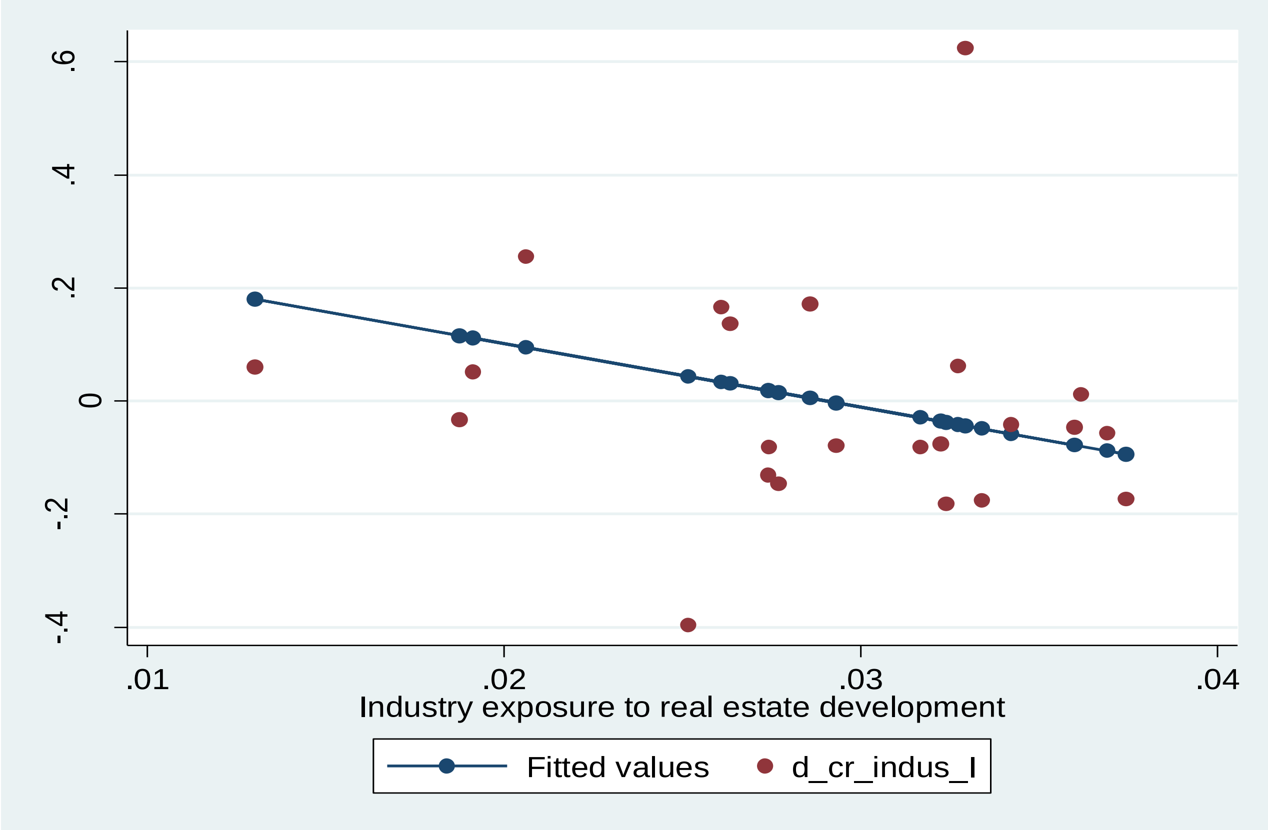
Figure 5: The impact on the NPL ratio of real estate exposure to real estate development in 1995-1997 interacted with an price drop of 10 percent between 2006Q1 and 2008Q4.



a. Each dot is the predicted level of dudosity evaluated at the median exposure to real estate development and the 10th centile of the distribution of bank specific change of housing prices between 2005Q1 and the year previous to the regression

b. Point estimates are predicted values from 23 industry-specific OLS regressions of industry-specific share of NPLs on historical exposure to real estate development, the growth between 2006Q1 and 2008Q4 of provincial housing prices, region dummies and a dummy for savings bank. Dashed lines are the limits of the 95th confidence interval

Figure 6: Credit growth in 2009 and average exposure to real estate development of bank lenders -by industry



The variable in the X axis is an average of exposure to real estate in 1995-1997 across all banks that lent to the industry in 2008Q4. The Y-axis contains yearly credit growth at the industry level in 2009Q4. The solid line are the fitted values of a regression of credit growth to an industry on the share of savings banks lending to that industry and the average exposure to real estate development among banks in the industry.

The coefficient of exposure to real estate development is -.10 (.06), shown in Table 7