Within-Bank Transmission of Real Estate Shocks

Vicente Cuñat♣
London School of Economics

Dragana Cvijanović[*]
University of North Carolina at Chapel Hill

Kathy Yuan♦
London School of Economics

First Draft: 15 April 2013
This Draft: 9th January 2014

Abstract

We estimate the reaction of banks to capital losses induced by reductions in real estate prices. We consider banks as portfolios of assets in different locations and exploit regional variation in real estate in order to control for local demand shocks and bank-location specific factors. The results show that banks recognize substantial capital losses associated with real estate prices. They also adjust their lending and financing policies. They reduce lending across all types of loans, indicating contagion both across geographical locations and business lines. Large-affected banks issue more equity and all banks use their available liquidity to accommodate the shock. Finally, we find evidence of more affected banks rolling over and failing to liquidate problematic loans.

JEL codes: G21, G01, R30

Keywords: Banks, Real Estate, Contagion, Crisis, Regulatory Capital.

♣ Vicente Cuñat: London School of Economics, Houghton Street, London WC2A 2AE, v.cunat@lse.ac.uk
[*] Dragana Cvijanović: UNC Chapel Hill, Kenan-Flagler Business School, 27599 Chapel Hill, NC, dragana_cvijanovic@kenan-flagler.unc.edu
♦ Kathy Yuan: London School of Economics, Houghton Street, London WC2A 2AE, k.yuan@lse.ac.uk

1 Introduction

Triggered by shocks in the real estate sector, the financial crisis of 2007-9 was associated with a substantial loss of real output, causing upheavals in economy. This has renewed academic interest in studying when and how real estate shocks transmit across geographic and business areas (generating contagion to other areas of the real economy). Evidence has pointed out that the reduction in the aggregate credit in the US economy comes mostly from the reduction of bank (or intermediated) credits rather than direct credit. For example, Adrian, et al. (2012) find that during 2007-9, the total amount of new issuance by firms decreased by 50%, while at the same time there was a 75% decrease in bank loans but a two-fold increase in bonds. This substitution suggests that banks' supply of credit may have been substantially reduced during the crisis and that banks may have played a major role in transmitting and potentially amplifying the shocks coming from the real estate sector. The main objective of our paper is to map out this interbank transmission, not only across geographical regions but also across banks' business area and financial policies. We focus explicitly on local real estate shocks that can generate losses in specific locations and business areas of banks' balance sheets and are transmitted within them to other locations and areas.

Specifically it is important first to assess the impact of sharp reductions in real estate prices on banks' capital, as it is a key determinant of their solvency. Through their impact on bank's capital, real estate shocks in particular geographical areas can have a ripple effect on a bank's overall portfolio of locations and types of lending. Identifying within bank contagion from local geographical real-estate shocks to generalized reductions in lending across business lines helps to understand the existence of transmission and amplification mechanisms through the banking sector. It is also important to identify whether more affected banks are more prone to rolling over loss-making loans, avoiding the recognition of losses, but, potentially, generating further problems in the future. Finally, it is also valuable to assess how banks may change their financing and commercial policies as a reaction to the shock to their solvency.

This paper estimates the reaction of the population of US banks to capital losses induced by decreases in real estate prices during the 2005-2010 period. We estimate both the effect of direct holdings of real estate and the indirect exposure to real estate prices via loans. To isolate the effect of capital losses from demand factors and local business conditions we use an identification strategy that considers banks as a portfolio of assets in different geographical locations. Given that the banks within one location also operate simultaneously in different combinations of other locations, we are able to include in the regressions time-location fixed effects and bank-location fixed effects. The time-location fixed effects absorb any local additive business conditions and in particular capture local credit demand shocks. The bank-location fixed effects control for any time-invariant conditions of each bank in each of its locations of operation. These include, importantly, the bank size and reputation, its areas of specialization or the customer composition specific to each bank in each of its geographical areas of operation. This approach allows us to estimate effects not only on lending, but also on other bank outcomes and policies such as the issuance of equity or the recognition of losses.

This identification strategy is combined with two further variations in the specification used. These additional specifications serve both as robustness checks and as a general test of the validity of the identification strategy. We use complementary specifications in which we replace the actual measure of local real estate price changes with a predicted measure that is a composition of aggregate countrywide real estate price changes and local land supply price elasticities. These local price elasticities are informative of the correlation between the real estate prices of a given area and the aggregate countrywide prices. However, these elasticities are driven exclusively by geographical considerations as in Saiz (2010). This implies that the predicted prices used are not driven by any residual reverse causality or omitted factors that may not be fully accounted for by the inclusion of time-location fixed effects. The second set of specifications uses estimates that consider the different exposure of various banks within a given location. The exposure measures are the aggregate level of real estate loans of the bank and the banks direct ownership of productive real estate in the form of property, plant and equipment.

As a first step, we show that banks' core capital reacts substantially to real estate shocks. That is, banks report capital losses associated with their exposure to real estate. We then show that they also change their policies according to these capital losses. They reduce their levels of aggregate lending. The reductions in lending are felt across the board, on all types of lending, including those that are not directly related to real estate. These reductions of lending across types of loans indicate that there is contagion stemming from the local housing shocks in the real economy, which affects and further spreads through the banking sector across geographical locations and business lines. More affected banks roll-over loans more frequently, recognizing less losses and liquidating less loans. As a consequence, they accumulate more non-performing loans. We also find effects in the operational decisions of banks. Banks that are more affected by real estate shocks reduce both their operational and financial expenses. They also reduce their cash and reserves and downsize their investment in liquid securities. Larger and better capitalized banks are also able to issue more equity when they are affected. Overall, the results show how banks reduce their operations, search for additional capital and utilize their different sources of liquidity. The size of the changes in the lending and financing decisions is commensurate with the reported capital losses. The results are very consistent across the different specifications, lending support to the validity of the main identification strategy.

These outcomes are important to understand the transmission of economic shocks through the banking system, but also to understand how banks cope internally with shocks that deplete their regulatory and economic capital. They are also relevant for the understanding of banking crises induced by the exposure of banks to real estate investments. The recent banking crises of Spain and Ireland stem from direct and indirect exposure of banks to real estate shocks. Norway, Sweden and Japan also experienced banking crises in the 1990s of similar characteristics. Although there is abundant literature focused on these crises, it is often difficult in these settings to isolate credit supply and credit demand factors while keeping a broad sample of banks. Our approach measures the reaction of US banks during the current crisis and sheds some light on the forces underlying these crises.

The paper contributes to a growing literature on the transmission of shocks through the balance sheet of banks in several ways. First, we are able to identify the transmission of real estate shocks by the population of banks in the US during the current crisis, thus achieving a good balance between estimating a causal effect and applying it to a broad population of banks. This contributes to establish the external validity of some of the pre-existing results in the literature. Second, the effect of negative real estate shocks on banks is a recurrent macroeconomic issue, but it is relatively unexplored at a bank level.[1] Given the relevance of the banks' exposure to real estate risks during the current crisis, it is important to understand the magnitude of this exposure and their reaction in this particular event. Third, we explore the effects on bank capital and show reactions in lending and financing decisions that are aligned with the capital losses that banks report. Fourth, we document substantial contagion across business areas and geographical locations within bank. This transmission, that is likely to operate through the depletion of bank's capital and the recognition of losses, has important implications for the overall transmission of shocks in the US economy. Fifth, we document that more affected banks are more likely to accumulate non-performing loans and less likely to liquidate them and recognize losses. Finally, we are able to relate the capital losses induced by real estate shocks to a rich set of outcome variables that includes a detailed disaggregation of the different types of lending present in the balance sheet of US banks.

The paper explores the effect using direct holdings of real estate held by banks and using their exposure to real estate loans. These are both assets within the banks' balance sheet. Nonetheless, the particular choice of these two bank assets is mainly due to the identification strategy used. Our results have broader applicability to other real estate shocks and, in particular to those off balance sheet too and also, more broadly, to generic shocks that affect banks' capital.

[1] See for example Gan (2007) for a related analysis of the Japanese experience in the 1990s or Puri et al (2011) for Germany during the current crisis.

2 Related Literature

At a broader level, our paper is related to the macro literature that shows how shocks to the financial system affect the supply of credit (Peek and Rosengren (1997), Kashyap et al. (1993), Kashyap and Stein (2000) among others).[2] Recently, Adrian, et al. (2013) show that during the 2007-2009 crisis there is a sharp contraction in supply of intermediated credit through banks that contrasts with the inelastic demand for credit from firms. The shortfall is made up of direct credit such as bond financing, indicating that financial frictions operate mainly through supply of the credit. This raises a question why a dollar of credit through the banking system behaves differently from a dollar of direct credit. Our paper contributes to the existing understanding of the sharp reduction of intermediated credits by finding how intermediaries such as banks react to adverse shocks and how various constraints they are facing affect their responses.

At the micro level, our paper is closely related to the literature that studies how shocks to banks affect the lending relationship between banks and their borrowers (i.e. firms): amount and terms of the lending (Gan (2007); Paravisini (2008); Khwaja and Mian (2013); Jimenez et al. (2012), Iyer at al. (2014)). These pre-existing papers rely on within-firm estimators to partial out demand driven effects. Instead, we use the geographical span of banks as a rich source of variation that allows us to control for demand-side effects. The within-firm approach has the appeal of dealing easily with the selection of firms into given banks as long as selection effects are constant and additive within firm and across banks. To approach this issue, we rely on a combination of a very saturated model, instrumental variables, and exposure measures that are less likely to be driven by selection. Conversely, the within bank approach has the drawback that it cannot be used for other bank policies outside lending. In particular any aggregate policy of the bank cannot be identified within firm. We provide complementary evidence to this literature by showing how banks cope with adverse shocks to their capital by implementing a menu of policy changes that go beyond lending including financial and commercial policies. Relative to these two previous streams of the literature our approach allows us to document the transmission of real estate shocks on the full population of US banks for a broad period of years.

Our analysis parallels the work that studies how real estate shocks affect capital structure choice (Cvijanović, 2013) and real investment (Chaney et al., 2012) at the firm level. Unlike firms, banks are highly leveraged. We show that in addition to affecting their lending decisions, banks also reduce their operational costs, cut down cash reserves and issue more equity to cope.

Our paper joins the recent emerging literature understanding the extent of the effect of real estate shocks on intermediated credit. Chakraborty, et al. (2013) study the effect of housing prices on commercial lending from

[2] The literature also argue that adverse shocks may operate through the demand of credit by affecting borrower net worth and collateral value of assets (Bernanke and Gertler (1989); Kiyotaki and Moore (1997)). Studies such as Ashcraft and Campello (2007) have also shown that there is a firm balance-sheet channel of monetary policy.

1988 through 2006, using a similar identification strategy to ours that considers banks as a portfolio of assets in different geographical locations. In contrast with our results for the years with decreasing housing prices, they look at the period of rising house prices which ended in 2006 and find evidence of substitution of some banks' lines of business in response to house price increases. The other studies in this area attempt to find out how securitization affects the response of the banking industry to the shocks (Ramcharan et al., 2013 among others), how home equity based financing contributes to household leverage and defaults (Mian and Sufi, 2011). We instead attempt to quantify the impact of direct real estate shocks on bank policies.

3 Data

We collect bank balance sheet data from the Federal Reserve's Report of Condition and Income ("Call Reports"). Our sample consists of quarterly data on all deposit insured commercial banks. We include only bank-quarter observations with non-missing information on total assets, total loans, and equity. The data covers the time period spanning from the first quarter of 2005 until the last quarter of 2010, giving in total 98,497 observations, covering 2435 banks. Information about the geographical distribution of bank deposits is obtained from the Federal Deposit Insurance Corporation's (FDIC).[3] House prices are obtained from the Federal Housing Finance Association's (FHFA). They are calculated at the level of a Core Based Statistical Area (CBSA).[4] The data contains a CBSA-level house-price index, for 369 CBSAs. We obtain MSA-level land supply elasticities from Saiz (2010). Elasticities are available for 269 Metropolitan Statistical Areas (MSA) in our sample. The MSA level elasticities are then converted to the new CBSA definitions by employing a zip-code matching procedure.

Summary statistics for the bank balance sheet data are shown in Table 1 (Panel A and B). Table 1 Panel C contains summary statistics on house prices and land supply elasticities, while Panel D contains the details of our sample banks' geographical dispersion

[Table 1 about here]

The mean bank in our sample has $107 billion in total assets in the last quarter of 2005, with $57 billion in total loans (corresponding to 67% of total assets). The median bank had $724 million in total assets, with $495

[3] More specifically, we obtain the data from the Summary of Deposits. FDIC reports data on total deposits, location and ownership of all bank branches from 1994 onwards (See http://www2.fdic.gov/sod/).
[4] A CBSA is a geographic area defined by the Office of Management and Budget (OMB) based around an urban centre of at least 10,000 people and adjacent areas. CBSAs largely overlap with Metropolitan Statistical Areas (MSA) also defined by the OMB.

million in total loans (corresponding to 70% of total assets). The mean total equity capital to total assets ratio is almost 11% (with the median being 9.5%). Average tier 1 capital ratio is 9.2%, with a median of 8.1%. Real estate loans as a fraction of total assets average 46.3% in our sample, with a median of 47.1%. Property, plant and equipment constitute 1.7% of total assets on average.

As shown in Panel C, the CBSA level land supply inelasticities range from 1 (least inelastic –Indianapolis) to 4.40 (most inelastic –Miami). Here, we define land supply inelasticity e_m as [1+max(elasticity.) - elasticity$_m$]; where elasticity$_m$ is obtained from Saiz (2010). The national real estate price indices obscure the variation in the regional/CBSA real estate market conditions. In the period between the first quarter of 2006 and the end of the sample in the last quarter of 2010, the highest drop in local house prices was witnessed in San Diego (-48% over the five year period). Over the same period, house prices in Portland fell by a mere 1.95%. Figure 1 shows the aggregate change in house prices for all the CBSA in the sample. At the same time, the Case-Schiller US House Price index recorded a drop of 31% in the national house price levels.

As shown in Panel D, there are 1601 single-MSA banks and 834 multi-MSA banks in our sample, giving 30,918 (67,579 respectively) bank-MSA-quarter observations. Conditional on operating in more than one MSA, the median number of MSAs in which a bank operates is 11.

4 Empirical Strategy

We aim to explain the effect of losses induced by decreasing real estate prices on banks' policies. The challenge is to isolate the effect of such losses from other mechanisms, and, in particular, from demand factors while maintaining a broad applicability of our results. In particular, our object of study is the whole of the US banking sector during the 2005-2010 period.

The empirical strategy considers banks as conglomerates of local branches, in which the branches in each location operate as a division. Each branch is influenced by shocks that affect the bank as a whole and shocks that affect the specific location in which the branch operates. However, given that multiple banks have branches in a given location we can partial out the local shocks that homogeneously affect all banks in a given location in an additive way. To perform this analysis, we use three sources of data. The first one is bank level data from CALL reports with a quarterly frequency. The second one is information about real estate prices (quarterly) and price elasticities (cross sectional). The final one, used to relate the two previous sources are deposits and number of offices for each location obtained from the FDIC. We construct weights w_{mit} for each bank-location combination according to the relative weight at the beginning of the sample of the deposits of a bank in a given location (CBSA) as a fraction of all the deposits of a bank. Using these weights, we consider each bank as a portfolio of locations and we proxy the activity of each bank in each location by splitting its aggregate activity across all the locations using these weights. Note that our definition of a branch, is basically a bank-location pair, and it may include different bank offices (that are also commonly known as branches) that operate in a given location. All the estimations are then performed at a bank-location-quarter level.

Consider a dependent variable y_{itm} defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank i, at time t (quarter) and a bank-location weight w_{mit}. For example y_{mit} may represent the loans outstanding of bank i in period t in location m or any other outcome variable. The weight w_{mit} is constructed as the fraction of deposits of bank i in location m with respect to the total deposits of the bank. If loans are, on average, proportional to the deposit activity of the bank $y_{it}w_{mit}$ is a proxy of the loans of the bank in a given location at a given point in time y_{mit}.

The main independent variable that captures the real estate shock that a given bank is facing can be written as $\sum_{j=1}^{M} w_{ji0} P_{jt}$. . It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. The measure uses cross sectional weights determined at t=0 (fourth quarter of 2005) to avoid introducing endogeneity via the weighting procedure.[5] This measure measures the real estate prices that affect a given bank on a given quarter.

A first specification of our regressions can then be written as:

$$\log(y_{mit}) = \alpha + \beta_1 \log(\sum_{j=1}^{M} w_{ji0} P_{jt}) + \delta_{mt} + \gamma_{mi} + \varepsilon_{mit} \quad (1)$$

Where the natural logarithm of the dependent variable y_{imt} (e.g. loans in a given location) is regressed against the real estate shock that the bank experiences across different locations. The variable y_{mit} is constructed by weighting the aggregate dependent variable according to the bank exposure in a given location. That is, y_{mit} = $y_{it}w_{mi}$. The term δ_{tm} represents a collection of time-location specific dummy variables that should capture any unobserved heterogeneity that affects a given location in a given quarter. In particular, these dummies should absorb any location-specific demand fluctuations. Note that, the set of δ_{mt} associated with a given location also have the implicit role of a location fixed effect. This implies that β_1 is only identified by those banks that operate in more than one location. However, we include all banks in the specification, as single-location banks improve the precision in estimating δ_{mt} . The term γ_{mi} is a bank-location fixed effect. Implicit in the specification we are assuming that there are local effects and bank-specific effects that are proportional to all branches of a location or bank respectively. Balance-sheet fixed effects are assumed to be proportional to the relative exposure of each bank to each location. Given that the specification is in natural logs, β_1 can be interpreted as the elasticity of the dependent variable (capital, different forms of lending, equity issuance...) to real estate shocks, after controlling for location-time specific and bank-specific effects. The coefficient β_1

[5] The specification in (1) can be interpreted as the reduced form of an IV specification in which price exposure is calculated using running weights and then instrumented with a price variable that uses fixed cross-sectional weights.

therefore can be seen as the difference in lending of two banks that operate in the same location, but have different exposures to other locations.

A second set of specifications interacts the real estate shock variable with measures of exposure to it. This second set of regressions identifies the effect across two banks that operate in the same location and have similar shocks in the rest of their portfolio, but different exposures to real estate shocks. An advantage of this second specification is that it is robust to omitted variables that are simultaneously correlated with the bank's choice of the portfolio of locations and the outcome variable $y_{it:}$ This second specification takes the form:

$$(2) \qquad y_{imt} = \alpha + \beta_1 \sum_{j=1}^{M} w_{ij0} P_{jt} Assets_0 w_{mi} + \beta_2 \sum_{j=1}^{M} w_{ij0} P_{jt} Assets_0 Exp_{i0} w_{mi0} + \delta_{my} + \gamma_{mi} + \varepsilon_{mit}$$

The variable Exp_{i0} measures the overall exposure of bank i to real estate prices at the beginning of our sample. With a bit of abuse of notation the subindex 0 emphasizes that this is a cross-sectional measure.[6] The variable is again weighted at each location using w_{mi0} and interacted with the location weighted real estate prices. Therefore $Assets_0 Exp_{i0} w_{mi0}$ measures the total exposure of a given bank to real estate prices measured in thousands of dollars and re-scaled by its (static-cross-sectional) presence in a given location. We use two measures of exposure: the fraction of real estate loans over total assets and the fraction of property plant and equipment over total assets. The specification that uses as Exp_{i0} the fraction of real estate loans over total assets is similar to the one in Gan (2007), although we use real estate variation that is determined at a bank level, while Gan (2007) uses only aggregate variation in real estate prices. Our second exposure variable property plant and equipment over total assets, is a novel way to measure exposure to real estate for banks and it is also less likely to be correlated with the lending policies of banks.[7] We saturate the model using location-time dummies δ_{mt} and bank-location dummies γ_{mi} (or, in alternative specifications, a combination of location δ_m, bank γ_i and time λ_t dummies). This allows for an estimation at a bank-location-quarter level. However, given that there are interactions with variables determined cross-sectionally at a bank level, this implies that this second specification is run in levels and not logs. The bank-quarter measure of real estate prices also appears in the specification interacted with $Assets_0 Exp_{i0} w_{mi0}$

The main coefficient of interest is β_2, which measures the differential impact of real estate prices for two banks that experience similar real estate price fluctuations in their portfolio of assets, (i.e. the same $\sum_{j=1}^{M} w_{ji0} P_{jt}$) but have different levels of exposure to real estate prices in their balance sheet re-scaled by their presence in the location $Exp_{i0} w_{mio}$. The term $\sum_{j=1}^{M} w_{ji0} P_{jt}$ controls for the effect that general price fluctuations may have on the

[6] A running exposure Exp_{it} would have the advantage of tracking the exposure of the bank more closely throughout the sample. However, Exp_{it} could be determined endogenously and induce biases in the estimation. Instead, we opt for a fixed Exp_{i0} that may be a more imprecise proxy (especially for the later years of the sample) but has the advantage of being predetermined. A similar argument can be made about the bank-location weights w_{mio} that are determined at the beginning of the sample and kept constant.

bank's policies, in particular, it captures any bank-specific demand factors that are correlated with real estate price fluctuations and affect the bank as a whole. The term γ_{mi} controls for any time-invariant branch specific factors such as size, reputation. Note that the combination of all the γ_{mi} of a given bank and a given quarter also entails a bank fixed effect and aggregate quarter dummies. A specification without the term $\sum_{j=1}^{M} w_{ji0} P_{jt} Exp_{i0} w_{mi0}$ would have a similar interpretation as some of the conglomerates literature that estimates the reaction of one division to exogenous shocks to another division (see for example Lamont and Polk (2002); Chang and Dasgupta (2007) among others). More closely related is the work by Murfin (2012) and Chakraborty, et al. (2013) that also isolate the effects of shocks in a given location on bank outcomes in other locations.[8] By adding a further interaction with the level of cross-sectional exposure of the bank to real estate shocks, the effect is identified by banks with the same aggregate shocks, but different exposure to them.

A final set of specifications combines the previous two specifications with an alternative measure of local price variation. In this specification we instrument P_{jt} using the product of local real estate price elasticities and the aggregate countrywide variation in prices. The real estate elasticities are constructed on the basis of cross sectional geographical data from Saiz (2010) so the instrumented price, once we control for aggregate time effects, does not contain demand-side information.

5 Results

In the following section we examine the differential impact of real estate prices on bank financing, operating and liquidity policy decisions. To do this, we follow the empirical strategy described in the previous section. The first set of specifications is based on estimating the differential elasticities of two banks operating in the same location, but with different exposure to other locations. The identification strategy in this part assumes that all banks within the same portfolio of locations are, on average, affected by the real estate price fluctuations in the same way. In other words, the identification assumes that there is no systematic correlation between the bank's general exposure to the real estate market and its pre-determined choice of locations after controlling for bank-location fixed effects and time-location fixed effects.

A potential concern with this first method is that there may be time varying matching between lenders and borrowers that could be driving the effects. In the second part of this section, we take into account each bank's exposure to the real estate market, so that our identification is based on two otherwise identical banks, which operate in the same location and have similar asset-location portfolios, but different exposure to the real estate

[8] More specifically, Murfin (2012) focuses on unexpected liquidity shocks and Chakraborty, et al. (2013) on the rise in real estate prices during the housing bubble. Our identification strategy can also be seen as the mirror image of that in Ashcraft and Campello (2007). While they aim to isolate local effects, controlling for bank-aggregate effects, our objective is exactly the opposite.

market. In this way, we control for potential time varying selection effects within the same location and we are able to generate a more precise, bank-time-location estimate of the effect. Most importantly, by using a measure of banks' productive real estate (PP&E), we are able to capture this precise effect using an exposure measure that is exogenous to banks' financing and lending policies. We examine the effect of changes in values of banks' productive real estate assets on banks' capital, lending policies and loan composition.

In the third section we turn to examining this effect in terms of banks' financing and operation decisions. Finally, we explore the heterogeneous nature of this effect in terms of banks' size and solvency.

5.1 The effect of real estate prices on a bank's balance sheet

To establish the causal effect of real estate prices on a bank's balance sheet, we examine the effect of housing price depreciation on bank capital and bank lending. We also focus on other bank decisions such as issuing equity or generating liquidity among others. The results of estimation of Equation 1 for the above dependent variables are shown in Panel A of Table 2. It shows the results of Equation 1 controlling for both time-location δ_{tm} and bank-location γ_{mi} fixed effects. All specifications throughout the paper are specified at the branch level and use robust standard errors, which are clustered at the bank level.

[Table 2 about here]

By examining Panel A of Table 2, we see a significant impact of real estate prices on bank tier 1 capital, controlling for the location-time specific and bank specific shocks. The estimated coefficient in column 1 is positive and significant, indicating that banks suffered significant tier 1 capital losses in response to real estate price depreciation post-2006. Given the log specification in Equation 1, the estimated coefficient of 0.197 indicates that for every 1% decrease in local real estate prices, banks suffered a Tier 1 Capital depletion of 19.7 basis points relative to its previous level. [9] Column 2 reports the results for bank "branch" lending. The estimated coefficient is positive and significant, indicating that the real estate market induced bank capital losses translated onto their lending practices. The estimated coefficient of 0.228 indicates that for every 1% decrease in local real estate prices, banks reduced their lending by 22.8 basis points. This indicates a partial adjustment of banks via reductions of lending, the rest of the adjustment corresponds to lower capital ratios and potentially higher equity issuance. We find no effect of bank losses on Tier 2 capital. Column 4 shows a large negative coefficient on equity issuance, although it is not statistically significant. Other specifications in the

[9] Tier 1 capital is the core measure of a bank's financial strength from a regulator's point of view. It is composed of core capital, which consists primarily of common stock and disclosed reserves (or retained earnings), but may also include non-redeemable non-cumulative preferred stock. According to the Basel accord (http://www.bis.org/publ/bcbsc111.pdf?noframes=1), Tier 1 capital is composed of: Paid-up share capital/common stock and disclosed reserves. Tier 2 capital is composed of undisclosed reserves, asset revaluation reserves, general provisions/general loan-loss reserves, hybrid (debt/equity) capital instruments and subordinated debt.

paper show that the effect on equity issuance is quite heterogeneous, explaining the lack of significance. The estimated coefficients can be directly interpreted as elasticities, so we can also calculate the impact of an average reduction in real estate prices over the period (35%) as a reduction of 6.8% in Tier 1 capital, a reduction of 8% in lending and the issuance of 13% additional equity.

In Panel B of Table 2 we can see the effect on lending disaggregated by type of loan. A 1% decrease in real estate prices involves a decrease in real estate loans of 23.3 basis points, a decrease in individual loans of 27.2 basis points, a reduction in credit card loans of 34.7 basis points, and a reduction of leases to firms of 8.8 basis points. In terms of a typical reduction in real estate prices of 35% throughout the period, these translate into reductions of 8.1% in real estate loans, 9.5% in personal loans, 12.1% in credit card loans and 3% in leases to firms. Other types of loans seem to be unaffected.[10] These results show a reduction of loans across the most important types of loans and are evidence of within bank contagion. As a change in the conditions in the real estate sector is affecting the supply of non-real-estate loans.

5.2 Differential Exposure to Real Estate Holdings

So far, we have identified the effect of bank-level losses on local variables based on the different weights that each location represents for each bank and assuming bank and location effects that are proportional across branches in a given bank or location (additive in a log specification). A complementary approach to identifying the effect of real estate shocks on bank financing behavior at the bank-location (or 'branch') level is to interact the effect with cross sectional variation on how a bank is exposed to real estate market fluctuations in each of its operating locations. Using this idea, we estimate two different versions of Equation 2, where we add an interaction term with the bank's total exposure to real estate prices.

We use two different measures for Exp_{i0}: The first one is the property, plant and equipment (PP&E) scaled by total assets at the beginning of the sample. Most of the PP&E of banks is composed by real estate holdings in the form of offices. This makes banks directly exposed to real estate fluctuations through their holdings.[11] There are two characteristics that make PP&E appealing from an empirical point of view. First, although PP&E holdings are a low fraction of the banks' assets (1.7% on average) they represent a substantial exposure to real estate shocks. For example, the average real estate depreciation in our sample throughout the whole period is 35%, which would entail capital losses of 0.6%. Given that regulatory capital in our sample is on average 9.2% this implies a reduction in capital of about 6 percentage points. Second, PP&E varies quite a lot across banks for historical reasons or for strategic reasons unrelated to the banks' lending policies. PP&E over assets has a

[10] Note that due to some lack of information, our loan categories are not a fully exhaustive classification of all the possible loans given by banks.
[11] PP&E is normally reflected in banks' balance sheet at historical values. Banks are required to provision losses if the value of PP&E goes below its historical value. They also realize capital gains/losses when they sell their properties. Finally, the value of PP&E is implicitly taken into account whenever banks merge or go bankrupt.

within sample standard deviation of 1.7%, so banks are heterogeneously exposed to real estate through their PP&E for exogenous reasons, which helps identifying the effects.

The second measure of exposure to real estate fluctuations are the total real estate loans given by banks at the beginning of the sample. This specification is close to the one in Gan (2007) for Japan. With respect to Gan (2007) we use instrumental variables to predict real estate prices in order to avoid a reverse causality from loans to prices. We also use a lower disaggregation of the variation of real estate loans that comes from the geographical composition of loans, rather than aggregate nationwide variations in prices. We are therefore able to include time-location dummies and bank-location dummies in order to capture unobserved heterogeneity across banks and locations.

5.2.1 The effect of real estate prices on capital depletion

The estimation results for Tier 1 Capital using PP&E (scaled by total assets) as a measure of a bank's exposure to real estate market shocks are shown in Table 3. Columns 1-2 show the results of estimating Equation 2 using OLS. Identification shown in column 1 comes from two bank-locations which have a similar portfolio of assets in terms of their operating locations (i.e. the same $\sum_{j=1}^{M} w_{ji0} P_{jt} Assets_0$), but have different levels of exposure to real estate shocks, as measured by their total PP&E (scaled by w_{mi0}), at different points in time. Column 2 shows the OLS regression results of estimating Equation 2 for two otherwise identical bank-locations, with similar asset portfolios, operating at the same location-time, but with different real estate exposure, as captured by the total PP&E (scaled by w_{mi0}). This specification essentially allows for estimation at the bank-location-quarter level. The estimated coefficient is 0.031, implying that for a 10% decrease in aggregate real estate prices, for two banks that had been one standard deviation apart in terms of the level of their productive real estate, PP&E, in 2005, the average loss in Tier 1 capital was 10 per cent relative to the average Tier 1 capital in the sample.

[Table 3 about here]

A potential concern with using raw CBSA-level house prices in establishing the causal effect of real estate market shocks on the banks' balance sheets, is that both the dependent and independent variables are jointly determined by an omitted time-varying variable, for example changes in local demand. Although in the previous set of results we control for this potential endogeneity bias by using location-time and bank-location fixed effects, the Instrumental Variables approach allows us to gauge how successful this saturation approach was in the standard OLS setting in solving the potential endogeneity issues. Following Mian and Sufi (2010), Chaney et al. (2012) and Cvijanović (2013), to obtain an exogenous source of variation in local real estate prices, we use a measure of land supply elasticity interacted with aggregate (national) real estate prices (as measured by the Case-Shiller US House Price Index) as our instrument for local, CBSA-level real estate prices.

The motivation for this instrument is straightforward: MSAs with elastic land supply should experience small real estate price appreciation in response to increases in aggregate real estate demand (as proxied by the aggregate real estate prices), since land supply is relatively easy to expand. On the other hand, inelastic land supply MSAs should witness large real estate price appreciation in response to the same aggregate real estate demand shock (Glaeser, et. al, 2008).[12]

Columns 3 and 4 in Table 3 show the results of the IV estimation of specification shown in Equation 2. We can see that the estimated coefficients are very similar to the ones estimated using the OLS procedure in columns 1-2, indicating that specification in Equation 2 when estimated even by using a simple OLS regression produces coefficient estimates that abstract away from potential endogeneity issues.

Table 4 contains the results of Tier 1 Capital regressions using the aggregate level of a bank's real estate loans (scaled by total assets and by its relative location weights) as a measure of its exposure to the real estate market. A potential issue with using real estate loans as the exposure measure is that it could be endogenous to banks tier 1 capital. Namely, although our exposure measure is fixed, measured in the last quarter of 2005 prior to the estimation sample, the total amount of real estate loans held at the end of 2005 could reflect banks' aggressive lending policies in the run up to the crisis. However, as long as these policies are determined at a bank level and time invariant, they should not affect our results. The consistency between the elasticity results and those that use PP&E as exposure measure reinforces the validity of the results as driven by bank-level exposure to real estate shocks.

[Table 4 about here]

The coefficients of estimating Equation 2 using OLS are shown in column 1-2, and the IV estimates are shown in column 3-4. We can see that they are positive and similar in magnitude across the board. The estimated coefficient in column 2 of 0.0009 suggests that for a 10% decrease in real estate prices, two banks that had been one standard deviation away in terms of the value of their total real estate loan portfolio, on average experienced a differential loss of 8 percent of their tier 1 capital. The size of the effect in economic terms seems to be consistent when the banks' exposure is measured using real estate loans and when it is measured using its total productive real estate (PP&E), as shown in Table 3.

5.2.2 The effect of real estate prices on aggregate bank lending

[12] Two main factors restrict land supply: one, there may be topological constraints that impede real estate construction, such as steepness of terrain or presence of water bodies. Two, regulation plays an important role in restricting land development and new construction. Environmental regulation, urban planning, zoning are just a few issues that restrict the amount of land supply.

Following the evidence presented in the previous section on the significant capital losses banks experienced during the real estate market collapse, we next turn to examine the effects on banks' lending policies. Namely, we estimate the effect of real estate market spill overs on bank "branch" lending using Equation 2. The results of the estimation using PP&E (scaled by total assets and w_{mi0}) in the last quarter of 2005 as the measure of banks real estate exposure are shown in Table 5. As before, columns 1-2 show the results of the OLS estimation, while in columns 3-4 we employ the IV approach. The estimated coefficients are similar across the battery of specifications. The estimated coefficient in column 2 is 0.259. Similar results are obtained when using the IV to solve for any remaining endogeneity in CBSA-level real estate prices.

[Table 5 about here]

Table 6 shows the results of bank "branch" level lending using the aggregate real estate loans (scaled by total assets and w_{mi0}) in the last quarter of 2005 as the real estate exposure measure. The estimated coefficients are positive and highly significant, although roughly 4 times smaller than those reported in Table 5. The estimated coefficient in column 2 is 0.008.

[Table 6 about here]

5.2.3 The transmission of real estate shocks across business lines

In the previous section we showed evidence of significant bank capital depletion and a drop in lending that ensued when the real estate market collapsed. In the following few paragraphs we investigate whether this effect was felt across different types of loans. This is an important objective, as it would indicate a form of transmission of shocks across business areas that operates through the balance sheet of banks.

Table 7 contains the results of estimating Equation 2 using OLS regression on different types of lending: panel A shows the results when the real estate market exposure is measured using PP&E and panel B shows the results for real estate loans as the exposure measure. By looking at the results presented in panel A, we can see that the real estate market collapse had a rippling effect on various types of lending at the bank "branch" level. Not only can we see that their real estate lending went down (as expected), but the reduction was present across the board. Individual loans, agricultural loans and personal credit card loans all went down in response to the real estate induced capital losses. The effect was most significant for real estate loans (0.259), but all other forms of lending dropped significantly too. Similar results are obtained when using the real estate loans as the exposure measure, as shown in panel B.

[Table 7 about here]

These results draw a picture of how economic shocks are transmitted through the banking system back to the real economy. By construction, our paper establishes the contagion of shocks across geographical locations via banks; this is at the heart of our identification strategy. Moreover, this section also indicates a channel of contagion within the different business areas of a bank.[13] Given that we measure the real estate shocks at the aggregate bank level, our specifications allow for the real estate shocks to be transmitted from one bank location to another. The results shown in Table 7 indicate that there is not only a geographical transmission effect, but also a contagion of the real estate shock from one banking business area (i.e. real estate) to another (i.e. credit cards, personal loans, agricultural and farm lending).

In Table 8 we present the results for different loan types, using the IV estimation of Equation 2. By comparing the results to the ones presented in Table 7, we see a similar effect. This suggests that even our bank-location-quarter saturated OLS estimates are already controlling for a potential reverse causality between local bank lending and real estate prices

[Table 8 about here]

5.3 Financing, operations and liquidity

We have seen in the previous sections that in response to negative shocks to the value of its productive real estate (and its portfolio of real estate loans), banks experienced substantial capital losses which were also followed by a significant cut in their aggregate lending. This shock had a rippling effect not only on the bank business operations that deal with the real estate sector, but it also got transmitted to other bank business operations. In this section we explore this effect in terms of potential impact on other aspects of the way banks operate.

[Table 9 about here]

Table 9 contains the results of estimating Equation 2 on several different variables of interest. Column 1 reports the results for equity issuance. A positive coefficient (0.066) indicates that following capital losses induced by the real estate shocks, banks issued less equity capital. This suggests that, on aggregate the lower

[13] This result resembles similar effects in the literature of internal capital markets, (see for example Lamont and Polk (2002) or more recently Matvos and Seru (2013). It also contrasts with the results in Chakraborty, et al. (2013), which find a substitution effect across bank business lines during the real estate boom. However, both results are mutually consistent with standard financing constraints models in which firms are constrained either when their investment opportunities expand beyond their financing capabilities (as in Chakraborty et al. 2013) or when financing capabilities shrink faster than investment opportunities (our results). In both situations, non-real estate loans are expected to shrink.

supply of funds for more affected banks dominates the effect of higher need of capital. However, the overall effect is small and not statistically significant. As it will be evident in Section 5.5, the effect on equity issuance is very heterogeneous across banks.

A positive coefficient in column 2 (0.001) indicates a drop in the amounts spent on maintaining the existing premises and fixed assets, following real estate price depreciation. At the same time, both banks' non-interest and total (interest and non-interest) expense dropped significantly. Since a large portion of the banks' non-interest expense can be distributed as employee salaries and benefits, as well as fixed operating costs, this result indicates an overall reduction in operational spending. Positive coefficients (0.022) in column 7 and in column 8 (0.085) indicate a reduction in the trading assets and investment securities amounts. Trading assets typically contain a collection of securities that are held for the purpose of reselling for profit. They are typically recorded as a separate account, and can include U.S. Treasury securities, mortgage-backed securities, foreign exchange rate contracts and interest rate contracts. As shown in column 9, this within bank contagion effect was also felt in the level of cash and bank balances (the estimated coefficient is 0.026).

Overall, the results in Table 9 show a general inability of more affected banks to replenish core capital with the additional issuance of equity. Moreover, more affected banks reduce their operational costs and deplete their liquidity as part of their effort to deal with real estate shocks.

5.4 Non-performing Loans, Liquidations and Loss Recognition

In this section we measure how affected banks deal with problematic loans when they are more affected by real estate losses. While the economic impact of real estate prices on mortgages is determined by their exposure to real estate and real estate prices, banks may have an incentive to reduce the losses that they recognize. By rolling over loans with dubious prospects of repayment banks can postpone the recognition of losses from an accounting point of view as well as gamble on the improvement of the loans' repayment chances. Table 10 shows the effects on loss recognition, loan recoveries and non-performing loans.

Columns 1 and 2 in Panel A show lower loss recognition and loan recoveries by more affected banks. At the same time, the affected banks increased the amount of non-performing loans on their balance sheets (Column 3, Panel A).

[Table 10 about here]

Given that these are in addition to the local effects and related to the overall bank losses, this indicates that affected banks were postponing the recognition losses and not tidying up their balance sheet, even in locations in which they were not directly affected. This behavior is similar to the documented “zombie” lending activities of banks during the Japanese banking crisis as documented by Caballero et al. (2008). Moreover, as we can see from Panel B, banks in particular increased the total amount of outstanding restricted non-performing loans (Column 1), commercial and industrial non-performing loans (Column 2), commercial real estate non-performing loans (Column 4) and other non-performing assets (Column 6) indicating that the effort to recognize less losses is done across business lines and not restricted to new policies relative to mortgage lending. The evidence in the previous two sections jointly indicates that banks that are more affected by real estate shocks in given locations take actions in their overall business portfolio that allow them to postpone the recognition of losses and the need for additional capital. While we cannot directly observe the impact of these actions on bank profits, it is reasonable to conjecture that some of these policies are efforts to increase liquidity and current cash flows at the expense of future and aggregate discounted profits and that they may destroy value.[14]

5.5 The case of large banks

In this section we explore the cross-sectional heterogeneity in banks’ response to the real estate market collapse in terms of their size. Given that the top 20 US banks (bank holding companies - BHC) hold assets equal to 84.5% of the nation’s entire economic output, we examine whether the nature of the banks’ response to real estate shocks was driven by their size.

To identify the "mega banks" in our sample, we rank them in Q42005 based on their Total Assets. The top 99th percentile contains the 20 largest banks (BHCs).[15] For each bank-location combination ("branch") we then assign the value of 1 for the dummy variable LARGE if its parent holder (BHC) is one of the top 20 BHCs listed above. We interact the variable LARGE with the variables of the specification in (2).

[Table 11 about here]

The results of the OLS estimation of Equation 3 are shown in Table 11. Column 1 shows the results for tier 1 capital. We can see that the estimated coefficient on the interaction term (β_4) is negative, but very small and not statistically significant. Similarly, in columns 2 and 4, we see no statistically significantly different effect for large banks in terms of tier 2 capital depletion and equity issuance. These results suggest that the nature of the

[14] See Garicano and Steinwender (2013) for a detailed analysis of similar policies at a firm level.

[15] These are, in in descending order: JPMorgan Chase & Co, Bank of America Corporation, Citigroup Inc., Wells Fargo & Company, Goldman Sachs Group, Morgan Stanley, US Bancorp, Bank of New York Mellon, HSBC North America Holdings, PNC Financial Services Group, Capital One, TD Bank US Holding Company, State Street Corporation, Ally Financial, BB&T Corporation, Suntrust Banks, Principal Financial Group, American Express Company, Ameriprise Financial and RBS Citizens Financial Group.

real estate market price depreciation transmission on the banks' financing, operating and payout policy decisions was not driven by their relative size differences.

The specification in column 3 measures the effect on total lending and shows a slightly different picture. A large negative coefficient indicates that large banks were able to cut loans proportionally less than smaller banks. The effect is 27% of the size of the general effect. This is an interesting result: while the qualitative result is the same for both large and small banks it seems that the transmission of shocks via lending for large banks is much smaller than for small banks.. The smaller overall effect for large banks is important, given the trend towards a more concentrated banking market nationwide. One possible interpretation of the relatively smaller effect on lending for large banks could be that more affected banks are also the ones that are moving away from the originate and distribute mortgage business and returning to more traditional *on balance sheet* business. However, the results in Panel B of Table 11 seem to go against this hypothesis. The relatively lower reduction in lending operates across all business lines and is not restricted to lending.

5.6 Capital and size interplay

To understand better the forces at play, in this final section, we stratify our sample by levels of tier 1 capital and size, measured as total assets. Table 12 shows results for the main dependent variables (total loans, tier 1 capital, and equity issuance) double-sorting the sample into terciles of the ratio of capital over total assets and the level total assets.

[Table 12 about here]

The coefficients show a clear interaction between both dimensions that indicates that taking them in isolation may not provide the right picture. In terms of decreasing loans, the effects are most intense in the bottom part of the table. Large banks are the ones that react the most to real estate losses. The picture in terms of loss recognition is also similar. This pattern may reflect both the ability to raise new capital and the possibility of recognizing losses before running out of regulatory capital.

The bottom panel of the table gives us a hint of the differential effects for different types of banks. Large, low-capitalized banks are the ones that issue equity. The reaction of large-low-capitalized banks seems to be very dynamic, with large levels of loss recognition and equity issuance and sharp reductions in lending.

At the other extreme, small-highly-capitalized banks are the ones that are able to issue less equity. The contrast is quite sharp with other banks which are larger in size. The loan reduction and capital losses are quite intense among them, however, they do not seem to be able to issue equity and replenish their capital levels.

In general, the reductions in lending seem to be more intense among low capitalized banks large banks, for which equity issuance is also the highest. Our identification strategy is not well suited to identify amplification effects, but the intensity of the results on large low-capitalized banks suggests that these may be important.

6 Conclusion

We measure the reaction of banks to capital losses induced by real estate shocks. By considering banks as portfolios of locations we are able to partial out the effects of local business conditions and time invariant bank-location effects. Our approach allows us to extent the analysis of the effects of shocks to bank capital beyond lending, including equity issuance, operative costs and liquidity. It is also applicable to the whole population of US banks during the last financial crisis, although the effects across geographical regions is obviously calculated on those banks that operate in multiple locations only.

The results show that banks recognized substantial capital losses as a result of their direct and indirect exposure to real estate prices. Although it is hard to quantify the magnitude of these losses with precision, the elasticity of capital to real estate prices is about 22%. That is, a reduction of house prices of 10% would lead to a reduction of bank's capital of 2.2%. Banks have also changed their lending, capital structure and operational policies in accordance with this reduction in capital. More affected banks cut lending. This reduction in lending operates across all types of lending and not just real estate loans. Overall, the lending results show a considerable level of contagion of real estate price shocks within a bank. This contagion of real estate shocks operates across locations, but also across the different business lines within a bank. Moreover, the capital losses have impact in other decisions that affect bank's operations. In particular, banks that are more affected by real estate shocks issue more equity conditional on being large, used their available sources of liquidity and cut financial and operational costs. We also find evidence of affected banks rolling over problematic loans and failing to liquidate their real estate positions in ways that resemble some of the practices documented in the Japanese banking crisis.

The results are important to understand how banks deal with shocks that deplete their regulatory and economic capital. Part of the results show a transmission mechanism through bank lending to final borrowers, but also transmission mechanisms across locations and within banks. This is an important result in light of recent research that explores the geographic transmission of shocks in the US economy (Caliendo et al 2013, Fogli et al 2013); our results can be seen as suggestive of banks as one of the possible channels of such contagion. The results are also important for the understanding of the recent (Spain and Ireland) and not so recent (Norway, Sweden and Japan) banking crisis induced by the collapse of real estate prices and their subsequent transmission and expansion through bank policies

References

Adrian, Tobias, Paolo Colla, and Hyun Song Shi, "Which Financial Frictions? Parsing the Evidence from the Financial Crisis of 2007," **NBER Macroeconomics Annual**, 2013, **forthcoming.**

Ashcraft, Adam B. and Murillo Campello, "Firm balance sheets and monetary policy transmission," **Journal of Monetary Economics**, 2007, **54**, 1515–1528.

Bernanke, Ben and Mark Gertler, "Agency Costs, Net Worth, and Business Fluctuations," **American Economic Review**, 1989, **79**, 14–31.

Ricardo J. Caballero, Takeo Hoshi and Anil K. Kashyap, "Zombie Lending and Depressed Restructuring in Japan," American Economic Review, American Economic Association, 2008. vol. 98(5), pages 1943-77, December.

Caliendo, Lorenzo, Fernando Parro, Esteban Rossi-Hansberg and Pierre-Daniel Sarte "The Impact of Regional and Sectoral Productivity Changes on the U.S. Economy" 2013 **mimeo** Princeton University.

Chakraborty, Indraneel, Goldstein, Itay and **Andrew MacKinlay**, "Do Asset Price Bubbles Have Negative Real Effects?", 2013

Chaney, Thomas, David Sraer, and David Thesmar, "The Collateral Channel: How Real Estate Shocks Affect Corporate Investment," **American Economic Review**, 2012.

Chang, Yuk Ying and Sudipto Dasgupta, "Beyond internal capital markets: The in-house transmission of adverse sales shocks and the collateral channel," **Journal of Corporate Finance**, 2007, **13**, 743–770.

Cvijanović, Dragana, "Real estate prices and firm capital structure," 2013. University of North Carolina Working Paper Series.

Fogli, Alessandra , Enoch Hill and Fabrizio Perri "The Geography of the Great Recession" **2013 NBER International Seminar on Macroeconomics 2012**, University of Chicago Press

Gan, Jie, "The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel, "**Review of Financial Studies**, 2007, **20**, 1941– 1973.

Garicano. Luis and Claudia Steinwender "Survive Another Day: Does Uncertain Financing Affect the Composition of Investment?" **CEP Discussion Paper** No 1188, 2013

Glaeser, Edward, Joseph Gyourko, and Albert Saiz, "Housing Supply and Housing Bubbles,"2008. Harvard University Working Paper Series.

Iyer, Rajkamal, Samuel Lopes, Jose Luis Peydro and Antoinette Schoar "The Interbank Liquidity Crunch and the Firm Credit Crunch: Evidence from the 2007-09 Crisis", **Review of Financial Studies**, 2014, **27** (1): 347-372,

Jimenez, Gabriel, Steven Ongena, Jose-Luis Peydro, and Jesus Saurina, "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications," **American Economic Review**, 2012, **102**, 2301–26.

Kashyap, Anil and Jeremy Stein, "What do a Million Observations of Banks Say About the Transmission of Monetary Policy?," **American Economic Review**, 2000, **90**, 407–28.

Kashyap, Anil and Jeremy Stein and David Wilcox "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance," **American Economic Review** 1993, **83**, 78–98.

Khwaja, Asim Ijaz and Atif Mian, "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market," **American Economic Review**, 2013, **98**, 1413–42.

Kiyotaki, Nobuhiro and John Moore, "Credit Cycles, "**Journal of Political Economy**, 1997, **105**, 211–248.

Lamont, Owen A. and Christopher Polk, "Does diversification destroy value? Evidence from the industry shocks," **Review of Financial Studies**, 2002, **63**, 51–77.

Matvos, Gregor and Seru, Amit, Resource Allocation within Firms and Financial Market Dislocation: Evidence from Diversified Conglomerates Chicago Booth Research Paper No. 13-39; 2013

Mian, Atif and Amir Sufi, "Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis," **American Economic Review**, 2011, **101**, 2132– 2156.

Murfin, Justin, "The Supply-Side Determinants of Loan Contract Strictness," **The Journal of Finance**, 2002, **67**, 1565–1601.

Paravisini, Daniel, "Local Bank Financial Constraints and Firm Access to External Finance," **The Journal of Finance**, 2008, **63.**

Peek, Joe and Eric S. Rosengren, "The International Transmission of Financial Shocks: The Case of Japan," **American Economic Review**, 1997, **87**, 495–505.

Puri, Manju, Jörg Rocholl and Sascha Steffen "Global retail lending in the aftermath of the US financial crisis: Distinguishing between supply and demand effects" **Journal of Financial Economics** 2011, **100**, Issue 3, June, 556–578

Ramcharan, Rodney, Skander J. Van den Heuvel, and Stephane Verani, "From Wall Street to Main Street: The Impact of the Financial Crisis on Consumer Credit Supply," 2013. Federal Reserve Board Working Paper Series.

Saiz, Albert, "The geographic determinants of housing supply," **Quarterly Journal of Economics**, 2010.

Figure 1

CBSA Real Estate Price Growth 2005 - 2011

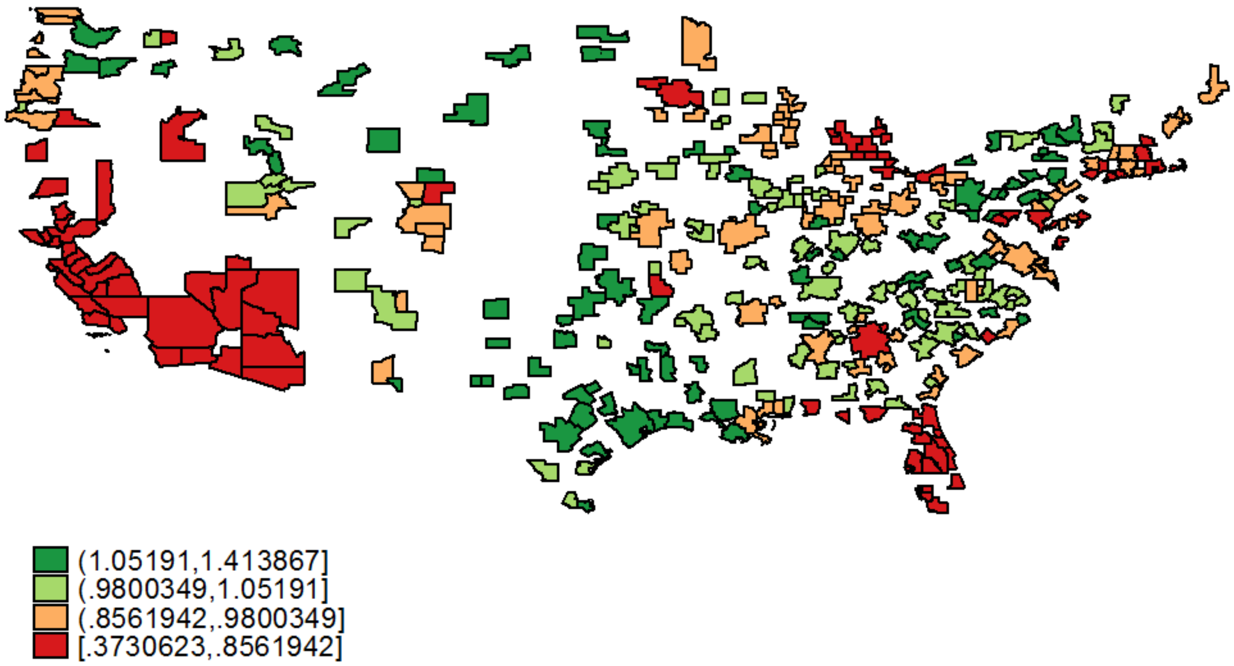

Table 1: Summary statistics

This table presents summary statistics of the sample of bank holding companies, obtained from Call Reports, merged with the geographical distribution of bank deposits as obtained from the Federal Deposit Insurance Corporation's (FDIC). House prices are obtained from the Federal Housing Finance Association's (FHFA). Our sample consists of quarterly data on all deposit insured commercial banks. We include only bank-quarter observations with non-missing information on total assets, total loans, and equity. The data covers the time period spanning from the first quarter of 2005 until the last quarter of 2010.

Panel A: Bank summary statistics (as of Q42005)

	mean	sd	min	p25	p50	p75	max
Total Assets	107,000,000	271,000,000	2,635	159,986	723,580	36,300,000	1,080,000,000
Total Loans	57,600,000	134,000,000	0	110,145	494,696	25,100,000	552,000,000
Real Estate Loans	32,600,000	75,100,000	0	76,306	343,090	15,400,000	314,000,000
Individ. Loans	6,390,506	15,800,000	0	3,326	21,753	1,917,595	123,000,000
Agri Loans	309,249	858,518	0	0	1,865	60,260	4,590,000
C&I loans	176	8,424	0	0	0	0	503,936
Lease fin. Rec.	1,917,389	4,668,876	0	0	0	330,923	18,500,000
Personal loans (Credit Card)	4,754,386	11,100,000	0	2,860	18,042	1,878,001	46,100,000
MBS	13,700,000	41,100,000	0	2,037	39,248	3,002,975	196,000,000
PP&E	841,408	1,934,679	0	2,890	12,304	411,273	8,102,000
Total Equity Capital	10,100,000	24,900,000	397	16,086	69,927	3,563,262	102,000,000
Tier 1 Capital	6,778,542	17,000,000	400	15,527	66,208	2,151,723	69,500,000
Tier 2 Capital	2,185,870	5,197,550	0	1,215	6,314	577,367	23,200,000

Panel B: Bank summary statistics, scaled by total assets (as of Q42005)

	mean	sd	min	p25	p50	p75	max
Total Loans	0.669	0.15	0	0.599	0.691	0.762	1.02
Real Estate Loans	0.463	0.17	0	0.337	0.471	0.577	0.952
Individ. Loans	0.059	0.094	0	0.015	0.037	0.077	1.018
Agri Loans	0.009	0.026	0	0	0.001	0.006	0.362
C&I loans	0	0.006	0	0	0	0	0.427
Lease fin. Rec.	0.009	0.02	0	0	0	0.009	0.504
Personal loans (Credit Card)	0.049	0.083	0	0.011	0.033	0.062	0.991
MBS	0.081	0.084	0	0.01	0.062	0.125	0.842
PP&E	0.017	0.014	0	0.008	0.013	0.022	0.251
Total Equity Capital	0.109	0.073	0.04	0.083	0.095	0.111	0.938
Tier 1 Capital	0.092	0.058	0.032	0.067	0.081	0.096	0.941
Tier 2 Capital	0.013	0.009	0	0.007	0.009	0.015	0.069

Panel C: Real estate prices summary statistics

	mean	sd	min	p25	p50	p75	max
Case-Shiller US house price index	162.68	22.61	130.84	135.98	170.49	186.26	190.5
MSA House Prices Index	186.43	39.84	114.94	159.14	175.01	200.14	365.1
Inelasticity	2.93	0.88	1	2.29	2.7	3.76	4.4

Panel D: Bank location summary statistics

	Avg number of MSAs	**Median number of MSAs**
Whole sample	29.8	2
Single-MSA banks	1	1
Multi-MSA banks	42.97	11

	Unique banks	**Total Observations (bank-MSA-quarter)**
Whole sample	2,435	98,497
Single-MSA banks	1,601	30,918
Multi-MSA banks	834	67,579

Avg MSA weight	0.448	
Median MSA weight	0.198	

Table 2: The effect of real estate prices on bank capital, lending policies and equity issuance (log specifications)

The dependent variables y_{itm} take the log forms of the following information obtained from the FDIC call reports: tier 1 capital (RCFD8274), total loans (RCFD2122), tier 2 capital (RCFD8275) and equity issuance (defined as the quarterly change in tier 1 capital) in **Panel A**; and real estate loans (RCFD1410), individual loans (RCFD1975), agricultural and farmers' loans (RCFD1590), credit card loans (RCON2011) and lease financing receivables (RCON2165) in **Panel B**. Due to brevity of discussion, we do not report the coefficient estimates on all individual loan types. Dependent variables y_{itm} are defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank i, at time t (quarter) and a bank-location weight w_{mi}. For example y_{itm} may represent the loans outstanding of bank i in period t in location m or any other outcome variable. The weight w_{mi} is constructed as the fraction of deposits of bank i in location m with respect to the total deposits of the bank. The independent variable *Log(House Prices$_{m,t}$)* is the main independent variable that captures the real estate shock that a given bank is facing. It can be written as $\sum_{j=1}^{M} w_{ij0} P_{jt}.$. It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. All specifications include bank-MSA and MSA-quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

Panel A

	(1) Log(Tier 1 Capital)	(2) Log(Loans)	(3) Log(Tier 2 Capital)	(4) Log(Equity issuance)
Log(House Prices$_{m,t}$)	0.197**	0.228***	0.0117	-0.381
	(2.472)	(2.807)	(0.106)	(-0.997)
Bank*MSA fixed effect	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes
Observations	97,565	97,239	97,048	49,680
R-squared	0.673	0.711	0.787	0.497

Panel B

	(1) Log(RE Loans)	(2) Log(Individual Loans)	(3) Log(Agri Loans)	(4) Log(Personal loans (credit card))	(5) Log(Lease financing receivables)
Log(House Prices$_{m,t}$)	0.233***	0.272***	0.0365	0.347***	0.0882*
	(4.883)	(5.628)	(0.726)	(4.960)	(1.716)
Bank*MSA fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	97,239	96,497	96,609	70,215	95,933
R-squared	0.710	0.700	0.813	0.764	0.808

Table 3: The effect of real estate prices on banks' tier 1 capital (PP&E exposure measure)

The dependent variable is the level of tier 1 capital (RCFD8274) of bank *i* in period *t* in location *m*. Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. The independent variable $House\ Prices_{m,t}$ can be written as $\sum_{j=1}^{M} w_{ij0} P_{jt}$. . It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. The variable $PPE_{branch,2005}$ (Exp_{i0}) measures the overall exposure of bank *i* to real estate prices at the beginning of our sample. With a bit of abuse of notation the sub-index 2005 emphasizes that this is a cross-sectional measure. Therefore $PPE_{branch,2005}$ measures the total exposure of a given bank to real estate prices re-scaled by its presence in a given location. In this table we use the fraction of property plant and equipment over total assets as our exposure measure. The variable is again weighted at each location using w_{mi} and then interacted with the location weighted real estate prices to give House $Prices_{m,t}$ * $PPE_{branch,2005}$, which is our main independent variable of interest. First two columns show the results of the OLS estimates, while in the third and fourth column we use an IV approach to instrument local real estate prices P_{jt} using the land supply inelasticity measure obtained from Saiz (2010). All specifications include bank, MSA and quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

	Tier 1 Capital (bank-location)				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	IV	IV
House $Prices_{m,t}$	-205.8***			-570.8	
	(-2.931)			(-1.614)	
House $Prices_{m,t}$ * $PPE_{branch,2005}$	0.0311***	0.0310***	0.0307***	0.0307***	0.0307***
	(14.11)	(13.63)	(14.85)	(14.30)	(14.06)
Bank fixed effect	Yes	Yes		Yes	Yes
MSA fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect		Yes	Yes		Yes
Bank*MSA fixed effect		Yes			
Observations	95,987	95,987	95,987	95,987	95,987
R-squared	0.673	0.850	0.458	0.672	0.699

Table 4: The effect of real estate prices on banks' tier 1 capital (real estate loans exposure measure)

The dependent variable is the level of tier 1 capital (RCFD8274) of bank *i* in period *t* in location *m*. Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. The independent variable *House Prices*$_{m,t}$ can be written as $\sum_{j=1}^{M} w_{ij0} P_{jt}$.. It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. The variable $RELoans_{branch,2005}$ (Exp_{i0}) measures the overall exposure of bank *i* to real estate prices at the beginning of our sample. With a bit of abuse of notation the sub-index 2005 emphasizes that this is a cross-sectional measure. Therefore $RELoans_{branch,2005}$ measures the total exposure of a given bank to real estate prices re-scaled by its presence in a given location. In this table we use the fraction of real estate loans over total assets as our exposure measure. The variable is again weighted at each location using w_{mi} and then interacted with the location weighted real estate prices to give House $Prices_{m,t}$ * $RELoa_{branch,2005}$, which is our main independent variable of interest. First two columns show the results of the OLS estimates, while in the third and fourth column we use an IV approach to instrument local real estate prices P_{jt} using the land supply inelasticity measure obtained from Saiz (2010). All specifications include bank, MSA and quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

	Tier 1 Capital (bank-location)				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	IV	IV
House $Prices_{m,t}$	-202.0***			-604.9*	
	(-2.817)			(-1.701)	
House $Prices_{m,t}$ * $RELoans_{branch,2005}$	0.000835***	0.000775***	0.000832***	0.000826***	0.000826***
	(13.78)	(2.821)	(10.48)	(13.55)	(13.39)
Bank fixed effect	Yes	Yes		Yes	Yes
MSA fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect		Yes	Yes		Yes
Bank*MSA fixed effect		Yes			
Observations	95,987	95,987	95,987	95,987	95,987
R-squared	0.672	0.897	0.450	0.671	0.698

Table 5: The effect of real estate prices on banks' total lending (PP&E exposure measure)

The dependent variable is the level of total loans outstanding (RCFD2122) for bank *i* in period *t* in location *m*. Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. The independent variable *House Prices$_{m,t}$* can be written as $\sum_{j=1}^{M} w_{ij0} P_{jt}$. . It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. The variable $PPE_{branch,2005}$ (Exp_{i0}) measures the overall exposure of bank *i* to real estate prices at the beginning of our sample. With a bit of abuse of notation the sub-index 2005 emphasizes that this is a cross-sectional measure. Therefore $PPE_{branch,2005}$ measures the total exposure of a given bank to real estate prices re-scaled by its presence in a given location. In this table we use the fraction of property plant and equipment over total assets as our exposure measure. The variable is again weighted at each location using w_{mi} and then interacted with the location weighted real estate prices to give House $Prices_{m,t}$ * $PPE_{branch,2005}$, which is our main independent variable of interest. First two columns show the results of the OLS estimates, while in the third and fourth column we use an IV approach to instrument local real estate prices P_{jt} using the land supply inelasticity measure obtained from Saiz (2010). All specifications include bank, MSA and quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

	Total loans (bank-location)				
	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV
House $Prices_{m,t}$	-1,733***			-1,541	
	(-3.380)			(-0.709)	
House $Prices_{m,t}$ * $PPE_{branch,2005}$	0.260***	0.259***	0.251***	0.255***	0.254***
	(6.596)	(6.446)	(7.671)	(6.628)	(6.611)
Bank fixed effect	Yes	Yes		Yes	Yes
MSA fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect		Yes	Yes		Yes
Bank*MSA fixed effect		Yes			
Observations	95,987	95,987	95,987	95,987	95,987
R-squared	0.697	0.810	0.544	0.697	0.714

Table 6: The effect of real estate prices on banks' total lending (real estate loans exposure measure)

The dependent variable is the level of total loans outstanding (RCFD2122) for bank *i* in period *t* in location *m*. Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. The independent variable *House Prices*$_{m,t}$ can be written as $\sum_{j=1}^{M} w_{ij0} P_{jt}$. . It measures the weighted average of the real estate prices P_{jt} of each of the locations in which the bank is located, using as weights the relative importance of each location in terms of deposits. The variable $\text{RELoans}_{\text{branch},2005}$ (Exp_{i0}) measures the overall exposure of bank *i* to real estate prices at the beginning of our sample. With a bit of abuse of notation the sub-index 2005 emphasizes that this is a cross-sectional measure. Therefore $\text{RELoans}_{\text{branch},2005}$ measures the total exposure of a given bank to real estate prices re-scaled by its presence in a given location. In this table we use the fraction of real estate loans over total assets as our exposure measure. The variable is again weighted at each location using w_{mi} and then interacted with the location weighted real estate prices to give House $\text{Prices}_{m,t}$ * $\text{RELoa}_{\text{branch},2005}$, which is our main independent variable of interest. First two columns show the results of the OLS estimates, while in the third and fourth column we use an IV approach to instrument local real estate prices P_{jt} using the land supply inelasticity measure obtained from Saiz (2010). All specifications include bank, MSA and quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

	Total loans (bank-location)				
	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	IV	IV
House $\text{Prices}_{m,t}$	-1,809***			-2,021	
	(-3.792)			(-0.926)	
House $\text{Prices}_{m,t}$ * $\text{RELoans}_{\text{branch},2005}$	0.00747***	0.00745***	0.00744***	0.00743***	0.00742***
	(32.08)	(30.05)	(20.91)	(34.05)	(32.49)
Bank fixed effect	Yes	Yes		Yes	Yes
MSA fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect		Yes	Yes		Yes
Bank*MSA fixed effect		Yes			
Observations	95,987	95,987	95,987	95,987	95,987
R-squared	0.770	0.858	0.622	0.770	0.786

Table 7: The effect of real estate prices on banks' loan composition (OLS estimates)

The dependent variables y_{itm} are: total loans outstanding (RCFD2122), real estate loans (RCFD1410), individual loans (RCFD1975), agricultural and farmers loans (RCFD1590), credit card loans (RCON2011) and lease financing receivables (RCON2165). Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. In panel A we report the results for the PP&E (scaled by total assets) exposure measure and in Panel B for real estate loans (scaled by total assets) exposure measure. All specifications report panel OLS estimates that include bank and MSA-quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

'anel A: PP&E exposure measure

	Total Loans	RE Loans	Individual Loans	Agri Loans	Personal loans (credit card)	Lease financing receivables
House Prices$_{m,t}$ * PPE$_{branch,2005}$	0.259***	0.145***	0.0309***	0.000916**	0.0236***	0.00715***
	(6.446)	(5.116)	(11.51)	(2.251)	(7.906)	(2.878)
Bank fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	95,987	95,987	95,987
R-squared	0.810	0.769	0.752	0.551	0.784	0.587

Panel B: Real estate loans exposure measure

	Total Loans	RE Loans	Individual Loans	Agri Loans	Personal loans (credit card)	Lease financing receivables
House Prices$_{m,t}$ *RELoansbranch,2005	0.00745***	0.00432***	0.000833***	2.89e-05***	0.000648***	0.000217***
	(30.07)	(32.09)	(10.72)	(2.625)	(16.22)	(6.053)
Bank fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	95,987	95,987	95,987
R-squared	0.858	0.868	0.752	0.584	0.795	0.671

Table 8: The effect of real estate prices on banks' loan composition IV estimates

The dependent variables y_{itm} are: total loans outstanding (RCFD2122), real estate loans (RCFD1410), individual loans (RCFD1975), agricultural and farmers loans (RCFD1590), credit card loans (RCON2011) and lease financing receivables (RCON2165). Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. In panel A we report the results for the PP&E (scaled by total assets) exposure measure and in Panel B for real estate loans (scaled by total assets) exposure measure. All specifications report panel IV estimates that include bank and MSA-quarter fixed effects. House $Prices_{m,t}$ are instrumented using the land supply inelasticity measure obtained from Saiz (2010). In all specifications we report robust standard errors that cluster at the bank level.

Panel A: PP&E exposure measure

	Total Loans	RE Loans	Individual Loans	Agri Loans	Personal loans (credit card)	Lease financing receivables
House $Prices_{m,t}$ * $PPE_{branch,2005}$	0.255***	0.143***	0.0297***	0.000915**	0.0232***	0.00723***
	(6.628)	(5.195)	(11.60)	(2.331)	(8.352)	(2.956)
Bank fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	95,987	95,987	95,987
R-squared	0.697	0.727	0.107	0.336	0.591	0.529

Panel B: Real estate loans exposure measure

	Total Loans	RE Loans	Individual Loans	Agri Loans	Personal loans (credit card)	Lease financing receivables
House $Prices_{m,t}$ *RELoansbranch,2005	0.00743***	0.00432***	0.000822***	2.89e-05***	0.000637***	0.000221***
	(34.05)	(35.53)	(10.84)	(2.771)	(16.37)	(6.331)
Bank fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	95,987	95,987	95,987
R-squared	0.770	0.841	0.108	0.384	0.609	0.625

Table 9: The effect of real estate prices on banks' financing and operating activities.

The dependent variables y_{itm} are: equity issuance (defined as the quarterly change in tier 1 capital), expenses on premises (RIAD4217), non-interest expense (RIAD4093), interest and non-interest expense (RIAD4130), trading assets (RCFD3545), investment securities (RCFD0391) and cash and balances (RCFD0010). Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. All specifications report panel OLS estimates that include bank-quarter and MSA-quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

	Equity issuance	Expenses on premises	Non interest expense	Interest and non-interest expense	Trading assets	Investment securities	Transfer risk reserves	Cash and balances
House Prices$_{m,t}$ * PPEbranch,2005	0.000658*	0.00118***	0.00847***	0.0140***	0.0545***	0.0694***	3.62e-07**	0.0213***
	(1.875)	(22.16)	(20.91)	(21.61)	(2.874)	(6.487)	(2.083)	(10.39)
Observations	91,436	95,987	95,987	95,987	95,987	91,522	95,987	95,987
R-squared	0.027	0.687	0.756	0.752	0.611	0.704	0.082	0.420

Table 10: The effect of real estate prices on loan loss recognition, recoveries and non-performing loans

The dependent variables y_{itm} are: loan recoveries (RIAD4605), loan charge offs (RIAD4635) and total non-performing loans (defined as the sum of total loans past due 90 or more and non-accruals) in Panel A. In Panel B, we show the results by type of non-performing loans: restructured non-performing loans, commercial and industrial non-performing loans, farmer non-performing loans, commercial real estate non-performing loans, credit card non-performing loans and other non-performing bank assets. Dependent variable y_{itm} is defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank *i*, at time *t* (quarter) and a bank-location weight w_{mi}. The weight w_{mi} is constructed as the fraction of deposits of bank *i* in location *m* with respect to the total deposits of the bank. All specifications report panel OLS estimates that include bank-quarter and MSA-quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

Panel A:

	Loan recoveries	Loan charge offs	Non-performing loans
House Prices$_{m,t}$ * PPEbranch,2005	0.000197***	0.00151***	-0.00591**
	(6.291)	(6.890)	(-2.118)
Observations	95,987	95,987	95,987
R-squared	0.655	0.476	0.756

Panel B:

	Non-performing loans by type					
	Restructured loans	Commercial and Industrial	Farmer	Commercial real estate	Credit card	Other non-performing assets
House Prices$_{m,t}$ * PPEbranch,2005	-0.000288***	-0.00168***	-4.76e-05	-0.000126***	-0.00274	-0.000116**
	(-4.137)	(-2.885)	(-0.628)	(-3.666)	(-1.366)	(-2.001)
Observations	95,987	95,987	95,987	95,987	95,987	95,987
R-squared	0.061	0.021	0.063	0.091	0.036	0.024

Table 11: The effect of real estate prices on banks' operations: large banks

The dependent variables y_{itm} are (in Panel A): tier 1 capital (RCFD8274), total loans (RCFD2122), tier 2 capital (RCFD8275) and equity issuance (defined as the quarterly change in tier 1 capital). In Panel B, the dependent variables are: real estate loans (RCFD1410), individual loans (RCFD1975), agricultural and farmers loans (RCFD1590), credit card loans (RCON2011) and lease financing receivables (RCON2165). Dependent variables y_{itm} are defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank i, at time t (quarter) and a bank-location weight w_{mi}. Dummy variable *Large* takes on the value 1 if the bank-branch belongs to a top-20 bank holding company in terms of its total assets. All specifications include bank-MSA and MSA-quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

Panel A:

VARIABLES	(1) Tier 1 capital	(2) Tier 2 capital	(3) Total loans	(4) Equity issuance
House Prices$_{m,t}$ * PPE$_{branch,2005}$	0.0312***	0.0135***	0.270***	0.000713***
	(13.31)	(8.457)	(7.221)	(3.053)
Large	-6,503	-585.5	323,198**	11,838**
	(-0.419)	(-0.0677)	(2.049)	(1.979)
Large*House Prices$_{m,t}$ * PPE$_{branch,2005}$	-0.000818	-0.00166	-0.0724***	-0.000348
	(-0.828)	(-0.888)	(-3.060)	(-0.293)
MSA fixed effect	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes
Bank	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	91,436
R-squared	0.850	0.784	0.814	0.027

Panel B:

VARIABLES	(1) RE Loans	(2) Individual Loans	(3) Agri Loans	(4) Personal loans (credit card)	(5) Lease financing receivables
House Prices$_{m,t}$ * PPE$_{branch,2005}$	0.153***	0.0318***	0.00104**	0.0245***	0.00799***
	(5.668)	(10.94)	(2.297)	(8.110)	(3.410)
Large	253,786**	9,489	4,285*	18,780	30,203***
	(2.101)	(0.656)	(1.884)	(1.209)	(3.192)
Large*House Prices$_{m,t}$ * PPE$_{branch,2005}$	-0.0536***	-0.00627**	-0.000783*	-0.00565**	-0.00550***
	(-3.199)	(-2.208)	(-1.800)	(-2.431)	(-2.917)
MSA fixed effect	Yes	Yes	Yes	Yes	Yes
Quarter fixed effect	Yes	Yes	Yes	Yes	Yes
MSA*quarter fixed effect	Yes	Yes	Yes	Yes	Yes
Bank	Yes	Yes	Yes	Yes	Yes
Observations	95,987	95,987	95,987	95,987	95,987
R-squared	0.779	0.753	0.561	0.788	0.614

Table 12: Capital and size

The dependent variables y_{itm} are: tier 1 capital (RCFD8274), total loans (RCFD2122) and equity issuance (defined as the quarterly change in tier 1 capital). Dependent variables y_{itm} are defined at a bank-location level that is created as the product of an outcome variable y_{it} defined for bank i, at time t (quarter) and a bank-location weight w_{mi}. We split the banks into terciles based on their total assets (*TA low*, *TA middle* and *TA high*) and tier 1 capital (*T1 Cap Low*, *T1 Cap Middle* and *T1 Cap High*). We report the results of panel OLS estimates for the tercile intersections that include bank, MSA and quarter fixed effects. In all specifications we report robust standard errors that cluster at the bank level.

Loans

Interactions	T1Cap Low	T1Cap Middle	T1Cap High
TA low	0.0616*	0.0579	0.0130
	(1.797)	(1.156)	(0.0963)
TA middle	0.133***	0.107***	0.0523***
	(10.17)	(4.634)	(4.877)
TA high	0.269***	0.0718**	0.188***
	(6.276)	(2.269)	(14.28)

Tier 1 Capital

Interactions	T1Cap Low	T1Cap Middle	T1Cap High
TA low	0.00745*	0.00579	0.00107
	(1.794)	(0.636)	(0.0462)
TA middle	0.0131***	0.0135***	0.0124***
	(7.409)	(5.449)	(18.12)
TA high	0.0315***	0.0159***	0.0316***
	(12.36)	(10.44)	(15.57)

Equity Issuance

Interactions	T1Cap Low	T1Cap Middle	T1Cap High
TA low	-8.99e-05	0.000548	0.000233
	(-0.356)	(0.903)	(0.216)
TA middle	-7.86e-05	-0.000408*	0.000304***
	(-0.583)	(-1.914)	(3.879)
TA high	-0.000735*	0.000165	-0.000707***
	(-1.948)	(0.737)	(-10.79)