House prices, bank balance sheets, and bank credit supply *

Mark J. Flannery † Leming Lin ‡

October 3, 2017

Abstract

We examine the effect of house price appreciation on bank loan portfolios during the 1996—2006 period. While most previous research in this area has concentrated on loan demand effects, we evaluate how house prices affect a bank's credit supply. Controlling for possible simultaneity between house prices and bank loan portfolio growth, we find that banks affected by greater house price appreciation became larger and increase their business lending as well as their mortgage lending. Next, we use county-level data to decompose small business loan growth into supply and demand shocks, and find that house prices have a significantly positive impact on an affected bank's supply of small business loans. Furthermore, house price booms have a positive effect on the employment growth of small establishments at the county level through the bank balance sheet channel.

JEL Classification: G21,R31

Keywords: Bank lending, credit supply, house prices, real estate, small business loans

*For helpful comments we thank Vitaly Bord, Marco Di Maggio, Isil Erel, Ari Kang, Andrew MacKinlay, Mike Qinghao Mao, Kwangwoo Park, Sascha Steffen, Rossen Valkanov, and participants at the 2015 Mid-Atlantic Research Conference in Finance, 2015 FMA Asian Conference, 2015 China International Conference in Finance, European Finance Association 2015 Annual Meeting, Northern Finance Association 2015 Conference, FIRS 2016, and the George Washington University. All errors are our own responsibility.

†Contact: University of Florida, Gainesville, FL 32611-7160. Tel: 352-392-3184, email:flannery@ufl.edu.

‡Contact: University of Pittsburgh, Katz Graduate School of Business, Pittsburgh, PA, 15206, telephone: 1-412-648-1642, e-mail:llin@katz.pitt.edu.

1 Introduction

Many believe that a credit boom and a housing boom together laid the foundation for the recent financial crisis (Acharya, Philippon, Richardson, and Roubini (2009)). Figure 1 shows that credit to the private sector ranged from 100% to 120% of GDP for over 30 years before it took off in the mid-1990s and reached over 180% of GDP before the financial crisis. House prices exhibit a similar pattern. An extensive literature evaluates the causes of the pre-crisis housing and credit booms, citing easy monetary policy, a global savings glut, and securitization, among other things.[1] The relationship between the credit and housing booms remains unclear:

> Is it that financial intermediaries lower their lending standards and fuel house price increases? Or, are house prices going up (for some other reason) and intermediaries are willing to lend against collateral that is then more valuable? This is an area for future research. —(Gorton and Metrick, 2012, P. 137)

The causal effects between credit and house prices could go both ways, which complicates hypothesis testing. When financial intermediaries increase credit supply, cheaper and more plentiful mortgage lending may raise house prices.[2] In the other direction, higher house prices may encourage further lending for either of two reasons. First, higher collateral (real estate) values may increase customers' borrowing capacities. We call this demand side effect the "collateral channel". Most of the literature examining the effect of the recent house price boom on bank credit focuses on the collateral channel (e.g. Chaney, Sraer, and Thesmar (2012), Adelino, Schoar, and Severino (2015), Loutskina and Strahan (2015), Cvijanovi (2014), and Lin (2016)). Second, real estate price appreciation may affect a bank's value in ways that increase its supply of loans. Existing bank loans secured by real estate become less risky when pledged collateral rises in value, and banks may earn higher profits from securitization (Loutskina and Strahan (2015)). Banks may therefore be more willing to take on the risk of additional loans. We call this supply-side effect the "bank balance sheet channel"; the most novel feature of our paper is testing for this credit supply effect.

[1] Diamond and Rajan (2009), Brunnermeier (2009), Taylor (2009).

[2] A few recent studies have attempted to identify the causal effect of credit supply on house prices by using instruments for variation in credit supply, including changes in annual conforming loan limit (Adelino, Schoar, and Severino (2014)), state anti-predatory laws (Di Maggio and Kermani (2016)), and bank branching deregulation (Favara and Imbs (2015)).

We begin by showing that real estate booms significantly affect banks' size and asset/liability structures. For identification, we use the land supply constraints from Saiz (2010) as an instrumental variable for regional house prices. The identification assumption is that the land supply constraints do not systematically influence bank behavior other than through house prices. We show that during our 1996—2006 sample period, local land supply constraints are highly correlated with local house prices, but are not significantly correlated with possible non-housing influences on loan demand (local income or population growth).

Our two-stage least squares estimates indicate that an increase in house prices leads local banks to grow larger and to change their balance sheet compositions. To begin with, a simple cross-sectional regression indicates that, over our sample period, a 1% increase in local house prices increases local banks' asset size by about 0.83%. Real estate lending expands more at banks in areas with greater house price inflation, but so does "commercial and industrial" (C&I) lending (to a lesser extent). On the liability side, non-core liabilities increase much more than core deposits or equity. Similar findings are obtained in our panel estimation. We also find that deposit rates increase with house prices as banks attempt to attract more deposits to fund their asset growth. These findings partially answer the question raised by Gorton and Metrick (2012) by showing that real estate booms have a significant causal impact on bank credit.

The increased commercial lending we associate with house price appreciation could reflect either a supply or a demand effect. To distinguish between these two possibilities, we turn to Community Reinvestment Act (CRA) data, which provides county-level information about new loans to small businesses. Using a within-county estimation to control for demand effects permits us to estimate the effect of house price increases on the supply of small commercial loans.[3] We find that during the ten years from 1997 to 2006, a 1% increase in house prices leads to a significant 1.3% increase in the bank supply of small business loans, consistent with the bank balance sheet channel.

We next assess whether the expansion in bank credit supply induced by a housing boom affects the real economy. By examining banks with branches in multiple regions of the country, we find that a positive house price shock in one region where a bank operates

[3] This approach is similar to the estimations in Khwaja and Mian (2008), Jimenez, Ongena, Peydro, and Saurina (2012), and Schnabl (2012). In particular, we adopt a methodology developed by Amiti and Weinstein (2016) to decompose loan growth into supply shocks and demand shocks.

causes significantly higher growth in small business employment in other regions where the bank operates. Specifically, a one standard deviation (3.7%) increase in remote house prices leads to a 0.3% increase in small business employment (compared to the mean growth rate of 1.7%).

There are few papers examining the effect of house price *booms* on the real economy through the bank balance sheet channel. Chaney et al. (2012) and Adelino et al. (2015) find that the housing boom before the financial crisis led to a credit expansion and a positive real effect on the economy through the collateral channel. Gan (2007), Huang and Stephens (2015), Cunat, Cvijanovic, and Yuan (2014), and Bord, Ivashina, and Taliaferro (2015) examine housing market's impact on bank credit supply, but their focus is the decline in house prices and the credit crunch caused by the housing bust. These studies find that banks cut lending after suffering from negative real estate shocks.

But the effect of a house price increase may be qualitatively different. When there is a negative house price shock, banks are under pressure to reduce all sorts of loans to meet liquidity or capital needs. During housing market booms, in addition to a wealth effect, which should increase a bank's ability to expand all sorts of loans, there could also be a substitution effect—a bank has an incentive to devote new lending to the real estate sector because of potential greater profitability. In this spirit, Chakraborty, Goldstein, and MacKinlay (2016) find that the balance sheet channel leads relatively large bank holding companies located in stronger housing markets to reduce their commercial lending over the period of 1988 to 2006. They further demonstrate that Compustat firms borrowing from these banks had significantly lower investment expenditures, consistent with house price inflation having a negative effect on the real economy.

Over the course of our 1996—2006 sample period, we also find that banks operating in areas with greater house price appreciation shifted their loan portfolio composition toward real estate loans and away from C&I loans. However, we also find that banks' total assets increased with house prices: a 1% increase in house prices across a bank's operating area was associated with a 0.83% increase in asset size. Although real estate loans grew faster than C&I loans with house prices, the dollar amounts of both loan types increased. Our evidence suggests that although real estate loans seem to crowd out C&I loans in relative terms during house price booms, banks are able to fund larger dollar amount of C&I loans with greater deposits by paying higher deposit rates and increasingly relying on non-core liabilities. Overall, our findings of a positive effect of house price booms on C&I credit through the bank balance sheet channel and the real effect associated with it are new to the literature.

The paper is organized as follows. Section 2 discusses the theoretical background of our research question. Section 3 describes data and presents summary statistics. Section 4 discusses the econometric methodology. Section 5 presents the effect of house prices on bank balance sheets. In Section 6, we estimate the effect of house price booms on bank supply of small business loans. Section 7 presents the effect of house prices on small business employment through the bank balance sheet channel, and Section 8 concludes.

2 Property prices and bank credit supply: theoretical background

Existing theories of property prices and bank lending focus almost exclusively on the collateral channel, which simply specifies that banks will lend more on the strength of more valuable collateral (e.g. Kiyotaki and Moore (1997)). A large recent empirical literature (including Loutskina and Strahan (2015), and Lin (2016)) provides empirical evidence that an increase in real estate prices expands the demand for bank loans secured by property assets. Previous researchers have demonstrated positive effects of house prices on firm investment (Chaney et al. (2012)), household consumption (Mian and Sufi (2011)), and small business employment (Adelino et al. (2015)) through this collateral channel.

But house price increases may also affect bank credit supply, for several reasons. First, existing bank loans secured by real estate become less risky when pledged collateral rises in value, leading banks to take on more portfolio risk by making new loans. Herring and Wachter (1999)'s simple portfolio model of real estate prices and bank lending illustrates this effect. Their bank chooses how much to invest in real estate loans; other loans are exogenous. The bank wishes to maintain a low probability of default. Herring and Wachter (1999) argue that higher real estate prices strengthen a bank's balance sheet either because the bank's own real estate rises in value or the market value of collateral on outstanding loans increases.

A stronger balance sheet encourages greater real estate lending by making it possible to expand loans without substantially increasing the bank's default probability. Ozhan (2016) develops a model with similar implications. Banks lend to tradable and non-tradable sectors. An increase in the valuation of non-traded sector assets raises a bank's net worth through its holding of these assets. Banks therefore expand credit to both the tradable and non-tradable sectors, although the proportion of total lending to non-tradable sector is bigger. Second, rising real estate prices could also affect a bank's access to funding. A stronger balance sheet should reduce the cost of uninsured liabilities. Third, a house price boom encourages securitization of mortgage loans, which provides banks with additional funding and profits, perhaps permitting them to expand credit supply (Loutskina and Strahan (2009) and Justiniano, Primiceri, and Tambalotti (2014)).

While we lack a unified theory of how bank credit supply reacts to property prices, existing studies suggest two things. First, rising house prices encourage banks to expand their overall loan portfolios by strengthening bank balance sheets and reducing bank financing costs. Second, house price appreciation tends to encourage mortgage lending relative to other loan types, such as C&I loans. The net impact of house prices on banks' C&I loan supply thus depends on the relative strengths of the balance sheet effect and the composition effect.

3 Data and summary statistics

3.1 Bank balance sheet data

Bank balance sheet data are taken from the December Consolidated Report of Condition and Income filed by banks, commonly known as "call reports". Call reports contain detailed balance sheet information about a bank, rather than a bank holding company (BHC).[4] Our sample includes mostly commercial banks (RSSD9048=200) and a small number of savings banks (RSSD9048=300). Each bank is uniquely identified by the call report item RSSD9001. We require the banks in our sample to have at least one depository branch located in an MSA where residential house prices and Saiz (2010)'s housing supply elasticities are

[4]Our estimates of bank lending may underestimate the impact of house prices on bank credit supply if holding companies shift loan resources or capital from subsidiaries in strong housing markets to subsidiaries in weak housing areas (Houston, James, and Marcus (1997))

available. We exclude banks that exist only for one year during the 1996 to 2006 sample period. Although the call reports are available from 1984, our sample period starts in 1996 because the analysis also requires two additional data sources. The CRA small business loan data became available only in 1996, and the FDIC Summary of Deposits data begin in June 1994. We therefore start our sample period in 1996. Our sample includes 34,018 bank-year observations for 4,442 unique banks, of which 3,577 belong to 3,049 bank holding companies (identified by RSSD9348). The number of banks declines over time during this period as a result of consolidation.

[Insert Table 1 near here]

Panel A of Table 1 reports the summary statistics of bank balance sheets during the 1996 to 2006 period. The Appendix A provides definitions of the balance sheet items. Real estate loans and C&I loans averaged 44% and 11% of a bank's total assets respectively. Liquid assets, defined as the sum of cash, held to maturity securities, available for sale securities, and Federal funds sold account for 30% of a bank's total assets. On the liability side, core deposits and non-core liabilities average 69% and 20% of bank assets respectively, while shareholders' equity constitutes 10%.

Panel B describes the compound annual growth rates of the major balance sheet items in Panel A for all banks in the sample, over the 1996—2006 period. The growth rates are winsorized at the 1st and 99th percentile. The real estate boom is clearly reflected in the 22% mean growth rate of real estate loans on these banks' balance sheets, but the mean C&I loans grow nearly as fast (20%). Given the rapid growth in the indicated asset classes, the sample banks' 17% annual growth rate of total assets is unsurprising. On the liability and equity side, non-core liabilities grow much more quickly (a mean of 28% per year) than core deposits (15%) or equity (15%).

Panel C describes the change in balance sheet composition between 1996 to 2006 for the subset of 1,783 banks that survive the whole sample period. Again, the real estate boom is clearly reflected in the 13 percentage points increase in real estate loans' share of total assets. At the same time, C&I loans' share of bank assets falls slightly (a mean of 1%) even while the dollar value of such loans expanded at an average of 20% per year (in Panel B). The higher real estate loan share is offset almost exactly by a reduction in liquid assets. On the liability side, core deposits fall 12% as a fraction of total assets, while non-core liabilities offset nearly all of this fall. The asset growth and portfolio changes at sample banks are accompanied by little change in equity's mean or median share of the balance sheet.

3.2 Bank exposure to house price shocks

The Federal Housing Finance Agency (FHFA) reports a set of indices for residential house prices in 402 U.S. MSAs. These constitute the most comprehensive house price indices available for the 1996—2006 sample period. We assume that each MSA's index applies equally to all of its constituent counties and link each county's house price index to each bank's deposits at branches in that county, as reported in the FDIC's annual Summary of Deposits data. We then construct a set of house price shocks for each bank by weighting each bank's county-level price shocks by the deposits it holds in that county.

3.3 Local economic conditions

To focus on the impact of real estate shocks, we control for local economic conditions in our estimations. We obtain total personal income and population data at the MSA level from the Bureau of Economic Analysis. For banks that operate in more than one MSA, we construct a deposits-weighted income and population for each bank using its deposits in each MSA as the weights.

We obtain annual county level employment data from the County Business Patterns (CBP) released by the Census Bureau. The CBP employment data include the number of employees by establishment size and industry. In order to focus on the type of firm most likely to be affected by local bank behavior, we collected employment data only for small establishments: those with one to four employees, five to nine, ten to 19, and 20 to 49. Because the Census Bureau only reports the number of establishments by size category but not the total employment for each category, we follow Adelino et al. (2015) to estimate the employment in each category by multiplying the number of establishments by the mid-point of employees in each category. We then aggregate the employment of all establishments with 49 or fewer employees to represent total employment by small businesses in each sample county.

3.4 Summary statistics of main regression variables

Table 2 reports the summary statistics of the main dependent and independent variables used in our panel estimations. The sample size drops from 34,018 in Table 1 to 29,507 because we lag some of the bank variables in our regressions. *Delta* denotes the growth rate of each variable. The growth rates of bank balance sheet items are winsorized at the 1st and 99th percentiles. On average, house prices grow at a 6.5% annual rate during the sample period. Total income and population grow by 5.7% and 1.2% per year on average.

[Insert Table 2 near here]

4 Econometric methodology

Estimating the causal effect of a house price boom on bank credit supply encounters two challenging econometric issues: reverse causality and the confounding credit demand channel. We adopt an instrumental variable (IV) approach to deal with reverse causality and a within-borrower estimation approach to control for credit demand. We focus our discussion in this section on the IV approach, and leave our treatment of credit demand effects to Section 6.

4.1 Simultaneous relationship

The simultaneous relationship between house prices and bank lending can be characterized as:

$$L_{i,m,t} = \mu_i + \beta_1 Price_{m,t} + \beta_2 X_{m,t} + \beta_3 W_{i,m,t} + Year_t + \epsilon_{i,m,t}, \tag{1}$$

$$Price_{m,t} = \eta_m + \alpha_1 L_{i,m,t} + \alpha_2 X_{m,t} + \alpha_3 Z_{m,t} + Year_t + u_{m,t}, \tag{2}$$

where $L_{i,m,t}$ is a dependent variable of interest at the bank level for bank i in MSA m at time t,[5] $Price_{m,t}$ is house price, μ_i is bank fixed effects, η_m is MSA fixed effects, $Year_t$ is year fixed effects, $X_{m,t}$ are factors that affect both house prices and bank lending, $W_{i,m,t}$ are factors that only affect bank lending, and $Z_{m,t}$ are factors that only affect house prices.

[5] In the estimation, for banks that have branches in more than one MSAs, we will use the deposits-weighted house prices and local economic variables across all the MSAs where a bank has a depository branch.

We are interested in the impact of house prices on bank balance sheets and bank credit supply, i.e., β_1 in Eq. (1). Unfortunately, estimating Eq. (1) by OLS would yield biased coefficients if loan supply affects house prices (i.e., if $\alpha_1 \neq 0$).[6] To estimate β_1 consistently, we need at least one exogenous variable (instrument) that can predict house prices in Eq. (2) but is uncorrelated with the error term $\epsilon_{i,m,t}$ in Eq. (1). This is the $Z_{m,t}$, which (as usual) must be highly correlated with $Price$, but affect bank behavior only through its effect on house prices.

Saiz (2010) has developed a measure of housing supply elasticities at the MSA level, which plausibly satisfy these conditions. Using satellite-generated geographic data on land use, Saiz (2010) measures the fraction of undevelopable[7] area within 50-km radius from the metropolitan central city within each MSA. He emphasizes that this measure of exogenously undevelopable land represents an ex ante physical constraint on housing supply, as opposed to ex post ease of development. He then shows that land constrained cities have lower housing supply elasticities—a given change in housing demand causes the house prices in MSAs with more undevelopable area to increase more. Saiz (2010) provides the estimates of housing supply elasticities for 95 MSAs with population over 500,000 in the 2000 Census. For example, coastal cities like Miami and San Francisco generally have low housing supply elasticities, whereas inland cities like Atlanta and Indianapolis tend to have relatively high elasticities. Figure 2 plots the residential house prices for three MSAs—Miami, Atlanta, and Indianapolis—from 1996 to 2006. Miami's very low elasticity (0.6) is associated with a huge house price increase; Indianapolis experienced only a modest house price run-up on account of its very elastic (4.0) housing supply. The elasticities for other MSAs are available in Table VI (p.1283–1284) of Saiz (2010). Because the MSAs in Saiz (2010) are sometimes classified differently than MSAs in the FHFA house price data and the local economic data, merging these data sets results in a 1,067 year-MSA observations for 97 MSAs from 1996 to 2006, which are used in our preliminary stage regression.

[6]The importance of adjusting for endogeneity in (1) may therefore vary across asset categories. The estimated coefficients for loans secured by real estate may be substantially affected while C&I loan coefficients, which are generally not secured by real estate in the call reports data, may be relatively immune. Still, any demand-side effects of house prices on C&I credit supply will be largely eliminated by our within-borrower (county) estimation in Section 6 so that the effect of house prices on bank credit supply (holding credit demand constant) can be identified.

[7]Prominent influences on undevelopable land include the distance to oceans or big lakes and the presence of steep-sloped terrain.

Saiz' elasticities would not constitute a valid instrument if they are correlated with $\epsilon_{i,m,t}$. How might that occur? Two possibilities come to mind. First, similar to a point emphasized by Mian and Sufi (2011), differential trends in inelastic and elastic MSAs during this time period might lead to differential bank behavior even in the absence of differential house price growth. For example, if inelastic MSAs experienced larger positive economic shocks during this period than elastic MSAs, the Saiz elasticity measures might be correlated with some part of loan demand in (1). This concern is partially addressed by including local economic indicators (such as total income and population) as control variables when we estimate Eq. (1). Furthermore, Table 3 indicates that Saiz' elasticities are not significantly correlated with MSA-level income growth or population growth, despite their ability to explain a large portion of house price growth from 1996 to 2006. Similarly, Mian and Sufi (2011) report that Saiz' housing supply elasticities are not significantly correlated with local payroll or employment growth over the 2002 to 2006 period. Therefore, even though the housing supply constraints could be correlated with productivity shocks during our sample period (Davidoff (2016)), the evidence does not support the presence of a systematic relationship between Saiz' elasticities and non-housing-induced local loan demand shocks during the recent real estate boom.

[Insert Table 3 near here]

The second reason why the Saiz elasticities might be invalid instruments would be if banks that are located in low-elasticity MSAs differ fundamentally from those located in high-elasticity MSAs. In other words, if banks chose their locations in part reflecting local real estate supply elasticities, there might be a correlation between elasticities and $\epsilon_{i,m,t}$ in Eq. (1). We address this possibility by including among the explanatory variable in Eq. (1) observed bank characteristics that have been shown in the literature to affect bank loan growth such as bank size, equity ratio, and income. The identification threat is then that unobserved bank characteristics cause banks in high- and low-elasticity MSAs to behave differently even in the absence of differential house price cycles.

4.2 Preliminary stage regression

Saiz provides one house (real estate) supply elasticity for each MSA. These elasticities provide the usual type of instrument for our cross-sectional regressions (reported in Table 5), which examine the average annual growth rates of banks that survive the full sample period. In these cases, we weight MSA-level elasticities by each bank's proportion of deposits raised in the associated MSA. We also estimate panel regressions, for a larger set of banks, in which the unit of observation is the bank-year. For these regressions, we adopt a "generated instrument" approach to create a time-varying instrument from the cross-sectional elasticities (Wooldridge (2010, p. 124–125.)). Specifically, we estimate a standard two-stage least squares model in which the IV is constructed as the fitted values from a preliminary stage regression:

$$REprice_{m,t} = \alpha_m + \rho_t Elasticity_m \times Year_t + \mu_t Year_t + u_{m,t} \tag{3}$$

where $REprice_{m,t}$ is the annual residential house price index of MSA m in year t, $Elasticity_m$ is the housing supply elasticity of MSA m, $Year_t$ is an indicator variable for year, α_m is MSA fixed effects, and μ_t is year fixed effects. The rationale behind this regression is that the house prices of MSAs with low elasticities tend to fluctuate more with aggregate house prices. Regardless of why overall house prices were rising, MSAs with inelastic land supply tended to experience larger house price run-ups than MSAs with elastic land supply. For ease of interpretation, we demean the elasticity values so that the year dummies coefficients reflect the house prices in MSAs that have an average housing supply elasticity.

[Insert Table 4 near here]

Table 4 reports the results of estimating (3) with a base year of 1996. Two obvious patterns emerge from Table 4. First, house prices increased every single year, about doubling between 1996 and 2006. Second, house prices increased significantly faster in low-elasticity MSAs than in high-elasticity MSAs in every year after 1999. For example, the coefficient of $2006 \times Elasticity$ is -37.87, implying that a difference in elasticity of 3.4 (between Miami and Indianapolis) leads to a difference in price appreciation of 128.8 from 1996 to 2006 (relative to the 1996 value of 106.5 across all MSAs).[8] The fitted value of the preliminary stage

[8] As can be seen from Figure 2, the implied difference in price growth (128.8) is actually much smaller than actual difference between Miami and Indianapolis, suggesting that the huge real estate boom in Miami from

estimation, $\widehat{REprice}_{m,t} = \widehat{\rho}_t Elasticity_m \times Year_t + \widehat{\mu}_t Year_t$, is then used as the IV for house price where our main regression (1) is estimated in panel form.

It may appear that including year fixed effects in the preliminary regression (3) makes the fitted value $\widehat{REprice}$ correlated with $\epsilon_{i,m,t}$ in (1). However, Eq. (1) also includes year dummies. So the standard assumption that the expected value of $\epsilon_{i,m,t}$ is zero conditional on exogenous variables implies that $E(\epsilon_{i,m,t}|Elasticiy_m, Year_t) = 0$, which in turn implies the expectation of $\epsilon_{i,m,t}$ is zero conditional on $\widehat{REprice}$. To see this, by law of iterated expectations, $E(\epsilon_{i,m,t}|\widehat{REprice}) = E[E(\epsilon_{i,m,t}|Elasticiy_m, Year_t)|\widehat{REprice}] = 0$, because $\widehat{REprice}$ is a function of $Elasticity_m$ and $Year_t$ (Wooldridge (2010, p. 19.))

5 Bank balance sheets and house prices

In this section, we estimate the impact of house prices on the growth and composition of bank balance sheets. We also examine bank deposit rates to shed light on how banks finance balance sheet expansion when house prices increase. For these estimates, we need to measure the extent of house price changes and local economic conditions applicable to each bank, including those operating in more than one MSA.

We measure the house price shocks affecting a bank as the change in the weighted average of house prices across MSAs where a bank has depositary branches, with the weight being the amount of deposits in each MSA. To control for economic conditions affecting financial firms, we assign each bank a similarly-weighted average of the total personal income and population values across MSAs in which the bank operates. More importantly, we use a similarly-weighted average housing supply elasticity as an IV for house price changes in cross-sectional regressions and the weighted predicted house prices ($\widehat{REprice}$) defined in Section 4.2 as an IV for the weighted house prices in the panel estimation.

5.1 House prices and bank growth

Cross-sectional results

1996 to 2006 was also due in part to other factors (unrelated to land constraints), which could be correlated with bank activities. The idea of the IV estimation is designed to exclude these potential endogenous factors from biasing the estimated impact of real estate shocks on the banking sector.

Our starting point is a simple cross-sectional estimation of the effect of house prices on bank balance sheets:

$$\Delta Y_i = \alpha + \beta_1 \Delta(REprice_i) + \beta_2 \Delta(Inc_i) + \beta_3 \Delta(Pop_i) + \gamma X_{i,1996} + \epsilon_{i,t} \quad (4)$$

where the compound annual growth rate of bank balance sheet items from 1996 to 2006 is regressed on the compound annual growth rates of house prices, total personal income, and population in bank i's deposit market area. We include in $X_{i,1996}$ a set of variables that capture cross-sectional differences in the banks' initial features: the initial value of the dependent variable over total assets, the initial values of bank characteristics that have been shown in the literature to affect bank credit supply such as (logged) bank assets, capitalization, net income, and a dummy variable indicating ownership by a multi-bank holding company. All growth rates are winsorized at the 1st and 99th percentiles. Mian and Sufi (2011) employed a similar regression framework to analyze the effect of house price growth on household leverage growth. A bank is included in the analysis only if it appears in the sample continuously from 1996 to 2006. This leaves us with 1,783 banks.

[Insert Table 5 near here]

Panel A of Table 5 reports the results of the IV estimation using the housing supply elasticity as an instrument for annual house price growth. (For comparison, Panel B reports the OLS estimation results.) Both panels show that house price appreciation leads to substantial growth in all the indicated balance sheet components, but we confine our discussion to the IV results in Panel A. In column (1), a 1% increase in house prices raised bank assets in that market by 0.83%. Within the asset portfolio, when house prices increase by 1%, real estate loans, C&I loans, and liquid assets increase by 1.19%, 0.35%, and 0.46% respectively. Even though real estate loans grow faster than C&I loans when house prices rise, the positive coefficient on $\Delta REprice$ in column (3) indicates that real estate price inflation does not reduce C&I credit available to businesses in a typical bank's market area.

The last three columns in Panel A of Table 5 indicate how banks financed their increased asset growth during the real estate boom. In column (6), a 1% increase in house prices was associated with a 0.68% increase in core deposits, which could not completely finance their

0.83% increase in total assets. The additional funding came predominantly from non-core liabilities (column (7)), which grew by 1.39% in response to a 1% house price increase. Column (5) indicates that equity also contributed in about the same proportion. It thus appears that in the years leading up to the financial crisis, banks from regions with bigger house price increases became more reliant on non-deposit funding sources that are sometimes categorized as relatively unstable and risky (Demirgüç-Kunt and Huizinga (2010) and Hahm, Shin, and Shin (2013)).

Pooled OLS estimation

Table 5 presents strong evidence that banks in real estate booming areas grew faster and made more loans in the years leading up to the financial crisis. Next, we examine whether this effect exists in the time series as well as across geographic locations by exploiting the panel nature of our data. Analogous to Eq. (4), we now estimate the following model,

$$\Delta Y_{i,t} = \alpha + \beta_1 \Delta REprice_{i,t} + \beta_2 \Delta(Inc_{i,t}) + \beta_3 \Delta(Pop_{i,t}) + \gamma X_{i,t-1} + \mu_t + \epsilon_{i,t} \qquad (5)$$

where $\Delta Y_{i,t} = \frac{Y_{i,t} - Y_{i,t-1}}{Y_{i,t-1}}$ is the annual growth rate of a relevant bank balance sheet item. $\Delta REprice$ is the annual growth rate of bank i's deposit-weighted house price index, ΔInc is the annual growth rate of bank i's deposit-weighted total personal income, and ΔPop is annual growth rate of bank i's deposit-weighted population growth rate. $X_{i,t-1}$ is a vector of the control variables, and μ_t is year fixed effects. This model specification is similar to those used in other studies of loan growth (e.g., Kashyap and Stein (2000), Campello (2002), and Cetorelli and Goldberg (2012))[9].

The next set of regressions (reported in Tables 6, 7, and 9) model the determinants of annual growth rates in some balance sheet item. We exclude from these growth rates any changes directly due to mergers. Specifically, following Greenstone, Mas, and Nguyen (2015) and Amiti and Weinstein (2016), we compute annual changes for banks making an acquisition as the (percentage) increase in its balance sheet (e.g. total assets, real estate loans, etc.)

[9] As in Kashyap and Stein (2000), we do not further control for bank fixed effects in Model (5) for two reasons. First, the variation in house prices is primarily cross-sectional as opposed to within banks over time. Second, we have an instrument (land supply elasticity) for the *cross-sectional* variation in house prices, which alleviates the concerns about biases caused by omitted bank effects.

relative to the asset's value the prior year end at a "pro forma" bank that combines the two merging entities. We obtain bank merger and acquisition data from the Federal Reserve Bank of Chicago. Fortunately, we find that how or whether we adjust for mergers has no significant impact on our empirical results.

[Insert Table 6 near here]

Table 6 reports the results of estimating Eq. (5) using the growth rate of the weighted ($\widehat{REprice}$) defined in Section 4.2 as an IV for $\Delta REprice$. The estimated effect of house prices on bank growth is qualitatively similar to that in Panel A of Table 5: total assets grow with house prices, especially real estate loans in column (2). C&I loans also increase strongly with house prices, but to a lesser extent. Non-core liabilities (column (7)) expand much faster than core deposits (column (6)) when house prices rise.

[Insert Table 7 near here]

Because house prices have a non-uniform impact on the growth of bank balance sheet items, it changes bank asset and liability structure. In Table 7, we examine how asset and liability shares of the bank balance sheet vary with house prices. The model specification is the same as Eq. (5) and the dependent variable is the change in the ratio of some asset or liability category to bank total assets. The first column indicates that higher house prices increase the real estate loans share of an affected bank's balance sheet. Consistent with the relative growth rates estimated in Table 6, columns (2) and (3) of Table 7 indicate that this shift into real estate loans is approximately offset by a decline in the C&I loans and liquid assets. The C&I loan results in Tables 6 and 7 are particularly interesting in light of Chakraborty et al. (2016)'s conclusion that the housing price boom negatively affected the real economy by reducing the affected banks' commercial loans.[10] Although column (2) of Table 7 does indicate that house price appreciation reduces the portfolio share of C&I loans, column (3) of Table 6 indicates a significantly positive correlation between real estate prices and total commercial loans outstanding. The apparent contradiction is readily explained

[10] Chakraborty et al. (2016) describe their result, significant at the 10% level, in Table X: "When instrumented, C&I loans decrease in dollar terms in response to increasing housing prices." (P. 32). This conclusion emerges from examining a much larger set of banks (8,214) than played a role in their examination of borrower investment behavior. See also our discussion at the end of Section 6 below.

by the house-price-related growth in total assets shown in column (1) of Table 6: banks more affected by house price inflation devote a smaller share of a larger balance sheet to C&I lending. On the liability side of bank balance sheets, core deposits become a smaller proportion of bank assets, and that difference is almost completely offset by the increase in non-core liabilities. We again see (in column (4)) that the effect of house prices on equity is small.

5.2 House prices and deposit costs

We investigate further the relative decline in bank deposit funding by evaluating the impact of house prices on the interest rates paid on bank deposits. The Klein-Monti model of bank operations indicates that if the supply of retail deposits is perfectly elastic, deposit rates should not change in response to a bank's need for investable balances. Rather, the bank should satisfy higher loan demand by reducing its stock of liquid assets and/or increasing its issuance of perfectly elastic deposits. The optimal deposit rate changes only if the supply elasticity of those balances changes, or if the bank has no access to elastically supplied non-core liabilities.

We use two types of proxies for core deposit rates. First, we measure the average interest rate paid by banks as the ratio of annual interest expenses to the average of beginning and end-of-year deposit balances. (This method has been used by many previous researchers, including Loutskina and Strahan (2009) and Acharya and Mora (2015).) Over our sample period, this deposit rate measure averages 2.6%, after being winsorized at the 1st and 99th percentiles. Second, we use RateWatch data on the rates actually offered by banks for two popular depository products: a 12-month CD of $10,000 and $25,000 money market account. These RateWatch data are used by a large number of banks and credit unions, as well as the FDIC. Recent academic studies using the RateWatch data include Drechsler, Savov, and Schnabl (2016) and Egan, Matvos, and Hortacsu (2016). The rates are available weekly at the branch level. We average these weekly rates across branches within a bank during a given year to obtain an annual measure of the the bank-level deposit rate paid. The rates paid on the 12-month CD average 3.5% in our sample, while the rate on the money market account averages 2.0%.

[Insert Table 8 near here]

Table 8 reports the results of estimating the model analogous to Eq. (5), where the dependent variables are the changes in deposit rates, measured in percentage points. We handle mergers in the same way as in Tables 6 and 7–by comparing the post-merger institution's deposit rate to a pro forma deposit rate computed for the combination of the two merging banks in the prior year. The estimation results clearly indicate that all three measures of deposit rates exhibit a significantly positive relationship with house prices. When house prices increase by 10%, the implicit deposit rate, the CD rate, and the money market account rate increases by 9.7, 9.6, and 4.9 basis points, respectively. These findings suggest that during house price booms at least some banks find it optimal to pay higher interest rates to attract more deposits, in addition to expanding non-core liabilities.

6 Bank supply of small business loans

Taken together, the findings in Tables 5–7 partially answer the Gorton and Metrick (2012) question by showing that a real estate boom causes growth in both real estate credit and C&I credit. A real estate boom has a positive impact on banks' extension of C&I loans even after controlling for the growth in the bank's local economy. However, this increase in C&I loan balances could reflect increased demand, increased supply, or a combination of both. In order to determine the impact of real estate prices on bank credit supply, we need to control for credit demand factors. The bank balance sheet data underlying Tables 5–7 do not permit us to separate supply from demand effects in the C&I loan market.

This challenge has been confronted previously in the literature. One approach has been to compare loans to an individual borrower from multiple banks (Khwaja and Mian (2008) and Schnabl (2012)). Holding constant the borrower's identity, variations in the amount lent by two alternative lenders should reflect variations in the lenders' credit supply functions. Our identification of supply effects comes from county-level data on small business loans, rather than from borrower-level information. We compare new lending for multiple banks that lend to the same counties, and assess whether a bank's exposure to house price shocks affects its supply of new loans.

6.1 Small business loans data

Community Reinvestment Act (CRA) data, from the Federal Financial Institutions Examination Council (FFIEC), records each bank branch's small business loans initiated or renewed during the prior calendar year. "Small" business loans are those with an original principal amount of $1 million or less, which are assumed to help finance small businesses. We obtained small business loan information from the FFIEC web site and use this county-level information to separate loan demand from loan supply shocks.[11] During the 1996 to 2006 sample period, 3,275 banks (of which 1,594 banks are in our main sample) report small business lending under CRA, yielding 972,520 bank-county-year observations. Figure 3 shows the time-series variation in the total amount of small business loan originations in the US from 1997 to 2011. Note the remarkably sharp rise and fall of small business loans before and after the recent financial crisis. The median assets of reporting institutions in our main sample is about $666 million, which substantially exceeds our overall sample's median assets ($169 million) because CRA reporting requirements exempt smaller banks.[12] While some banks report loans in only a few counties, a small fraction of large banks lend to as many as several hundred counties: the annual mean and median number of counties in which a bank lends are 50 and 15 respectively.

6.2 Estimation and results

We follow the literature (e.g., Greenstone et al. (2015) and Amiti and Weinstein (2016)) to write the growth in small commercial loans as,

$$y_{i,j,t} = \alpha_{i,t} + \beta_{j,t} + \epsilon_{i,j,t} \tag{6}$$

[11]The CRA data on new or renewed loans may be more suitable to identifying bank supply shocks than balance sheet data about the outstanding stock of loans (e.g. from Call Reports). Although the CRA information does not indicate a bank's total exposure to small borrowers, the flow of new or renewed loans does accurately represent a bank's voluntary supply of loan funds.

[12]Before 2005, CRA reports were required from all depository institutions belonging to a holding company with assets exceeding $1 billion, and from any depository institution with assets exceeding $250 million. The size cutoffs were raised in 2005 to require CRA reporting only from banks with assets over $1 billion, although smaller banks retain the option to report voluntarily. According to June call reports, small C&I loans account for about 60% of all C&I loans for an average bank in our sample.

where $y_{i,j,t}$ is the growth rate of small business loans extended by bank i to borrowers in county j during the year ending at t, $\alpha_{i,t}$ captures the bank credit supply shocks, and $\beta_{j,t}$ captures the county firms' credit demand shocks. By comparing banks' differential loan growth to the same counties, the estimated bank supply shocks are purged of banks' exposure to regional variation in the demand for small business loans.

To estimate the bank supply shocks $\alpha_{i,t}$, one could estimate Eq. (6) using a large set of time-varying county and bank fixed effects. The estimated supply shocks can be then used to examine how certain shocks affect bank credit supply (e.g., Khwaja and Mian (2008), Jimenez et al. (2012), and Schnabl (2012)) or how bank supply shocks affect the real economy (e.g., Greenstone et al. (2015) and Amiti and Weinstein (2016)). In estimating Eq. (6), it is common practice to weight observations by the loan amount at the bank-borrower level so that the growth rates of larger loans have larger impact in identifying the loan supply and demand effects (Greenstone et al. (2015)). We label the resulting estimates "WLS".

Amiti and Weinstein (2016) (henceforth, "AW") derive necessary conditions for the estimation of Eq. (6) to produce bank and borrower shocks whose loan-weighted averages will exactly match the bank, county, and economy-wide loan growth rates of existing loan relationships: the loan growth rates in Eq. (6) must be defined as percentage changes and the data must be weighted by lagged loan amounts. However, AW point out that a simple WLS procedure cannot accommodate new lending activity. (The rate of growth for new loan relationships is infinite.) They develop a methodology that accommodates new lending relationships while at the same time producing bank and firm shocks that aggregate to match the macro moments in the data. By imposing the moment conditions that the actual loan growth at the bank-borrower level is equal to the (loan-weighted) sum of supply and demand shocks. They show that the following equations can be solved for the $\alpha_{i,t}$s and $\beta_{j,t}$s:

$$D^B_{i,t} = \alpha_{i,t} + \phi_{i,j,t-1}\beta_{j,t} \tag{7}$$

$$D^C_{j,t} = \beta_{j,t} + \theta_{i,j,t-1}\alpha_{i,t} \tag{8}$$

where $D^B_{i,t}$ is the growth rate of lending of bank i to all of its clients, $D^C_{j,t}$ is the growth rate of borrowing of county j from all of its banks, $\phi_{i,j,t-1} = \frac{L_{i,j,t-1}}{\sum_j L_{i,j,t-1}}$ is the share of bank i's loans obtained by county j, and $\theta_{i,j,t-1} = \frac{L_{i,j,t-1}}{\sum_i L_{i,j,t-1}}$ is the share of county j's loans obtained from bank i, B is the total number of banks, and C is the total number of counties in each period. Eq. (7) and (8) provide a system that can be solved for a unique set of bank and county shocks in each time period (up to the choice of *numéraire*).[13]

We compute alternative estimates of individual banks' loan supply shocks using the WLS and the AW methodologies. The WLS estimation cannot handle the formation of new loan relationships and we ignore the termination of existing lending relationships. The AW methodology accommodates both terminations and new loan relationships. The two approaches are applied on the sample of 972,520 bank-county-year observations, which yields estimated bank credit supply shocks for 8,104 bank-years that overlap with our main call report sample from 1997 to 2006. We then estimate the impact of house prices on the growth of small business loan supply.

$$\widehat{\alpha_{i,t}} = \alpha + \beta_1 \Delta(REprice_{i,t}) + \beta_2 \Delta(Inc_{i,t}) + \beta_3 \Delta(Pop_{i,t}) + \boldsymbol{\gamma} \boldsymbol{X}_{i,t-1} + \mu_t + \epsilon_{i,t} \qquad (9)$$

where $\widehat{\alpha_{i,t}}$ is the estimated loan supply shock at bank i in year t. The results are presented in Table 9, where the dependent variable is the loan supply shocks estimated by WLS in column (1), and loan supply shocks estimated by AW's methodology in columns (2). For both estimated supply shocks, house prices have a significantly positive impact on bank credit supply. In words, more rapid house price appreciation shifts the supply curve outward for affected banks' small C&I loans. The effect is much larger in column (2), for which credit supply shocks were computed using a method that recognizes new and terminated loan relationships. It thus seems that banks are more likely to expand small business lending into new counties when house price rises. In column (2), a 1% increase in house prices causes banks to increase the supply of small business loans by nearly 1.3%. This finding implies that the real estate boom preceding the recent financial crisis did not crowd out bank lending to small businesses. On the contrary, it suggests that house price appreciation strengthened bank balance sheets and allowed banks to take more risks and increase their credit supply.

[Insert Table 9 near here]

Our conclusions in Table 9 about C&I lending differ from those in Chakraborty et al.

[13] For detailed illustration of the decomposition, see P.10 and Appendix D of Amiti and Weinstein (2016).

(2016), who find that the (log of) a bank's C&I loans falls with house price appreciation in the bank's operating areas. We can think of four possible causes of this fundamental difference. First, the two papers examine different time periods: (1988-2006) vs. (1996-2006). Second, Chakraborty et al. (2016) examine DealScan relationships involving relatively large banks: their bank-firm sample includes only 436 bank subsidiaries of 106 bank holding companies. Their sample banks averaged $12 billion in total assets, compared with $666 million total assets for the average of 1,594 banks in our Table 9. 40% of their observations come from three "national" holding companies (Citigroup, Bank of America, and JPMorgan Chase), which are known to sell off a large proportion of the loans they originate. Perhaps large and small banks are affected differently by house prices. Third, their borrowers are considerably larger than the small borrowers in the sample underlying Table 9: a mean (median) loan size of $281 ($79) million vs. our CRA loans that are capped at $1 million. The real estate boom may have differentially affected bank lending to large vs. small businesses. Fourth, the two papers utilize FHFA's house price indices differently. Our analysis assigns an MSA's house price index to all the counties within that MSA, while Chakraborty et al. (2016) apply statewide real estate prices to all counties within each state. Similarly, we assume that all counties within an MSA have the same (Saiz) housing supply elasticity, while Chakraborty et al. (2016) convert MSA-level elasticities to state-level measures by combining population-weighted elasticity measures for the MSAs within each state. (In their footnote 18, Chakraborty et al. (2016) report that they obtained similar results when they replicated their analysis at the MSA-level, rather than the state level.)

Overall, the results in Section 5 and 6 provide novel evidence of a bank lending channel for property prices. We now examine whether the loan supply effects documented in Table 9 are associated with the activities of small businesses.

7 The real effect of house price booms through bank balance sheet channel

County level data permit us to test whether the bank balance sheet channel has real effects on the local economy, which we measure as an increase in employment at businesses with 49 or fewer employees. We focus on small businesses' employment growth because large corporations are less likely to be restricted by local credit supply shocks. To see the relevance of this question, consider three specific counties: Pueblo, CO, Outagamie, WI, and McLennan, TX. Wachovia, Marshall & Ilsley, and Guaranty Bank had the largest deposit shares in these three counties during our sample period. All three banks had aggressively expanded beyond their traditional market areas, into regions with large house price booms. Wachovia's effort to expand its footprint in the West Coast culminated in 2006 when it acquired the Golden West Financial for $25.5 billion, a deal that eventually brought down the once fourth-largest bank in the US. Less notably, both Marshall & Ilsley Bank, and Guaranty Bank were based in states with relatively quiet real estate markets (Wisconsin and Texas, respectively), but also operated in one of the hot real estate markets (Arizona for Marshall & Ilsley Bank and California for Guaranty). Although their exposure to a hot housing market strengthened these banks in the short run, their geographic expansions ultimately proved disastrous (Barr (2009) and Spivak (2011)). Our question here is whether the house price appreciation in Arizona and California affected the local economies of Wisconsin and Texas through the bank balance sheet channel. In particular, we examine whether a bank's exposure to house price shocks in one region affected employment growth in other regions where the bank was lending.

Our approach is similar to that in Murfin (2012), who shows that banks write tighter contracts with borrowers after suffering defaults by borrowers who are in different industries or geographic regions. Here, we examine whether small business employment is affected by house prices in other counties that are relevant to the banks operating in the small business' home counties. Through the balance sheet channel, a bank made stronger by conditions in other counties should increase its loan supply in all the counties where it operates. We avoid the possible correlation of loan demand conditions across nearby counties by considering only counties outside the current countys state. The approach allows us to test the real effect of house price booms through the bank balance sheet channel as opposed to the collateral channel that has been examined in the literature (Adelino et al. (2014) and Loutskina and Strahan (2015)). Our bank housing shock at the county level is constructed in two steps. First, we compute each bank's deposit-weighted house price shocks:

$$Bank\ housing\ shock_i = \sum_{s \neq j} \omega_s House\ price\ growth_s$$

where s indicates a county outside of county j's state where bank i has operations (deposits), and ω_s is the share of bank i's deposits in county s. These bank-level price shocks are then aggregated across all banks within each county

$$Remote\ housing\ shock_j = \sum \rho_{i,j} Bank\ housing\ shock_i$$

where $\rho_{i,j}$ is the share of bank i's deposits in county j. Our county-level *Remote housing shock* has a mean of 0.075 and standard deviation of 0.037. The three counties mentioned above are the ones with the highest average *Remote housing shock*. We also construct *Remote pop shock* and *Remote inc shock* in a similar manner, which will serve as controls to make sure the remote house prices are not simply picking up local economic growth in other areas that banks operate.

[Insert Table 10 near here]

Table 10 presents the results. Column (1) shows that small business employment significantly increases in counties where deposit-taking banks have out-of-state branches in areas with larger house price shocks. This finding is consistent with the balance sheet hypothesis that higher house prices strengthen an affected bank's credit condition, encouraging additional lending to small businesses. Column (2) adds *Own housing shock* to the specification, where this variable is defined as house price growth in the MSA where the county is located. We expect *Own housing shock* to carry a positive coefficient because it, too, has balance sheet effects. The question is whether the *Remote housing shock* variable is significant in column (1) only because it may be positively correlated with *Own housing shock*. If so, the significant coefficient on *Remote housing shock* in column (1) might reflect only the collateral channel commonly shown in the literature. The estimated effect of *Remote housing shock* remains statistically significant, although its magnitude falls to 0.11 from 0.17 when we add *Own housing shock*. In column (3), we further control for the the population shocks and income shocks in other states where a bank operates, along with the lagged population, total income, and small business employment. Adding these controls further reduces the estimated effect of *Remote housing shock* to 0.08. A one standard deviation (3.7%) increase in remote house prices leads to a 0.3% increase in small business employment (compared to the mean annual growth rate of 1.7%). Population growth in different regions that banks are exposed to also has a significant positive effect on a county's employment growth.[14]

8 Conclusion

Credit booms and housing booms often go hand in hand. Economic theory clearly indicates that credit and house prices could impact and reinforce one another, but empirical evidence on causal effects has been limited. This paper estimates the impact of house prices on bank lending, financing, and credit supply by exploiting the cross-sectional variation in the change of house prices across major US MSAs during the period 1996—2006. To establish causality, we rely on the cross-sectional variations in house prices associated with natural geographical constraints on developable land (Saiz (2010)). We find that housing booms have a large positive impact on bank asset size, beyond the impact of local economic conditions. House prices also affect banks' asset composition, increasing the growth of both real estate credit and C&I loans. The positive effect of house prices on mortgage lending seems natural. The similar, albeit smaller, impact on commercial loans could reflect either a collateral channel (firms with appreciated real estate collateral demand more bank credit when real estate prices rise) or a bank balance sheet channel (strengthened bank balance sheets allow banks to take more risk and extend more credit). Banks finance the house-price-related growth in credit by increasing non-core liabilities such as federal funds, foreign deposits, and brokered deposits. Banks exposed to more rapid house price appreciation also pay higher rates of interest on several types of retail deposits.

In order to test for the presence of a bank balance sheet channel in commercial lending, we analyze small business loan originations by banks at the county level. Our tests indicate that

[14] Our results complement the finding by Loutskina and Strahan (2015) that house price growth in other financially connected markets have a negative effect on local economic growth. Loutskina and Strahan (2015) focus on the transmission of collateral shocks through financial integration. In their Table 6, in constructing the "external house price growth", they use weights equal to the relative fraction of commonly owned deposits between markets, whereas our weights are the amount of deposits (within a bank) in different counties. To the extent that the collateral channel (demand shocks) tends to pull money from markets with weaker house price growth and the supply effect tends to boost supply of loans in all markets, Loutskina and Strahan (2015)'s weighting scheme allows them to capture mostly the effect of demand shocks (collateral channel) in other markets, and our weighting scheme allows us to capture the effect of the balance sheet channel, through which house price growth in other markets has a positive effect on local loan supply and economic growth.

the supply of these loans is positively related to house price inflation in a bank's operating markets. In other words, house price appreciation has a positive causal effect on bank credit supply. Lastly, we show that a county's small business employment (at firms with fewer than 50 employees) rises when the county's banks are affected by more rapid house price appreciation in other counties. In addition to its direct effects on the real sector, a housing boom seems to have a positive effect on at least the "small business" component of the real economy through a bank balance sheet channel.

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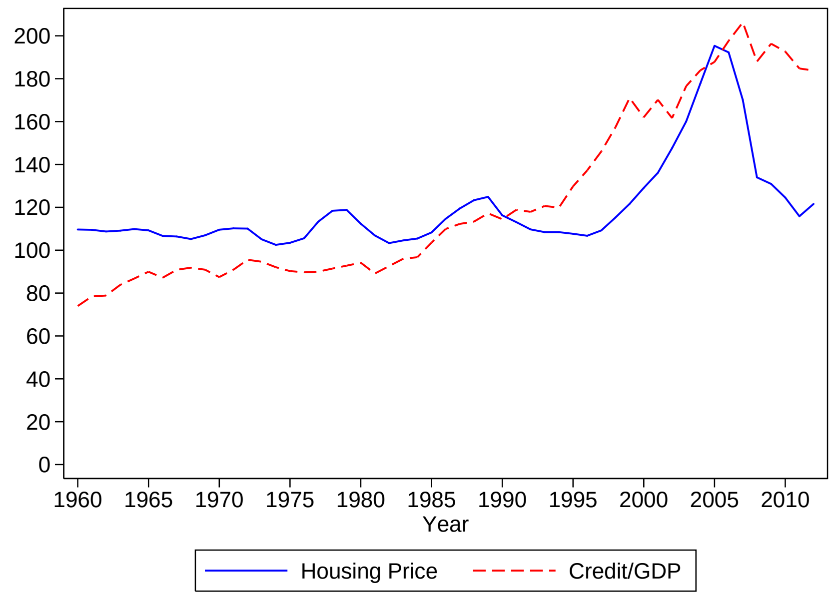

Fig. 1. U.S. Domestic credit to private sector (% of GDP) and house prices from 1960 to 2012. Source: World Bank and S&P/Case-Shiller Home Price Indices.

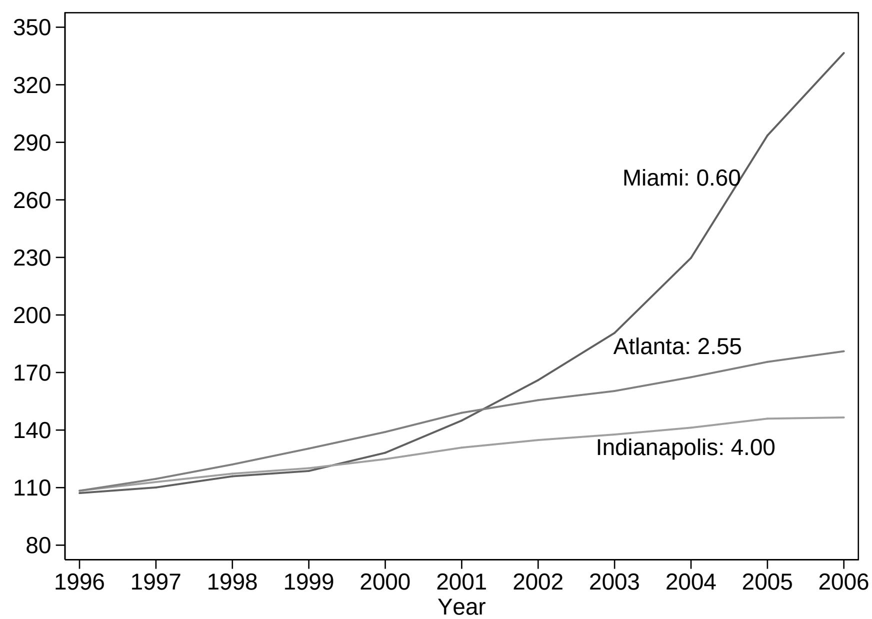

Fig. 2. House price index: 1996—2006. The house price index is the quarterly residential house price index at the MSA level from the FHFA. The number after each city name is the city's housing supply elasticity estimated by Saiz (2010).

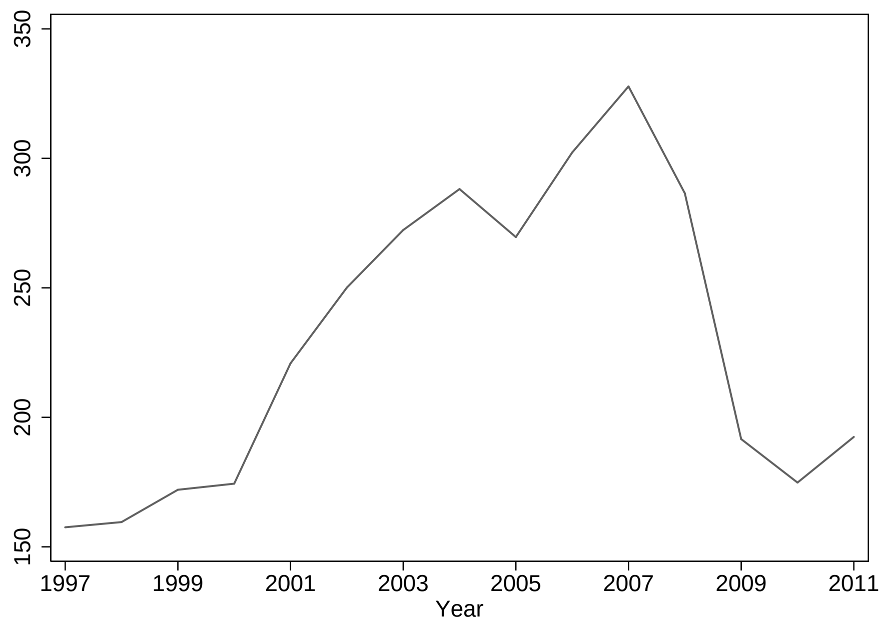

Fig. 3. Amount of small business loans originated (in $ billion): 1997–2011. Source: Federal Financial Institutions Examination Council (FFIEC). Small business loans are defined by FFIEC as loans whose original amounts are $1 million or less.

Table 1. Summary statistics of bank balance sheets

This table presents the summary statistics of bank balance sheet items. The sample period is from 1996 to 2006. Variables are defined in Appendix A.

	Mean	*SD*	Percentile 10	Percentile 50	Percentile 90	*N*
Panel A: Balance sheet composition (% of total assets)						
Assets						
Loans	0.64	0.15	0.45	0.66	0.81	34018
Real estate loans	0.44	0.17	0.23	0.44	0.65	34018
C&I loans	0.11	0.09	0.02	0.09	0.22	34018
Personal loans	0.06	0.07	0.01	0.04	0.13	34018
Other loans	0.03	0.05	0.00	0.01	0.07	34018
Liquid assets	0.30	0.15	0.13	0.29	0.50	34018
Fixed assets	0.02	0.01	0.01	0.02	0.04	34018
Other assets	0.04	0.05	0.00	0.02	0.09	34018
Liabilities plus equity						
Core deposits	0.69	0.14	0.50	0.72	0.83	34018
Non-core liabilities	0.20	0.14	0.07	0.17	0.38	34018
Equity	0.10	0.04	0.07	0.09	0.14	34018
Other liabilities	0.01	0.02	0.00	0.01	0.02	34018
Panel B: Compound annual growth rate of balance sheet items						
Assets	0.17	0.19	0.02	0.11	0.39	4442
Real estate loans	0.22	0.25	0.03	0.15	0.52	4442
C&I loans	0.20	0.34	-0.04	0.13	0.49	4442
Liquid Assets	0.11	0.24	-0.07	0.06	0.30	4442
Liabilities plus equity						
Core deposits	0.15	0.19	0.01	0.09	0.35	4442
Non-core liabilities	0.28	0.40	0.02	0.18	0.58	4425
Equity	0.15	0.16	0.02	0.11	0.31	4442
Panel C: Change in balance sheet composition between 1996 and 2006						
Assets						
Δ Real estate loans	0.13	0.14	-0.04	0.12	0.30	1783
Δ C&I loans	-0.01	0.07	-0.09	-0.00	0.06	1783
Δ Liquid assets	-0.13	0.14	-0.31	-0.12	0.03	1783
Liabilities plus equity						
Δ Core deposits	-0.12	0.13	-0.26	-0.10	0.01	1783
Δ Non-core liabilities	0.11	0.13	-0.02	0.09	0.26	1783
Δ Equity	0.01	0.04	-0.03	0.00	0.04	1783

Table 2. Summary statistics

REprice is the weighted average of house prices in MSAs where a bank has depository branches, with the weight being the amount of deposits in each MSA. *Inc* is the weighted total personal income. *Pop* is the weighted population. Δ denotes the growth rate of the variable. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company that owns more than one banks, and 0 otherwise.

			Percentile			
	Mean	*SD*	10	50	90	*N*
ΔAssets	0.131	0.179	-0.017	0.088	0.316	29507
ΔRE loans	0.188	0.301	-0.044	0.122	0.455	29507
ΔC&I loans	0.184	0.475	-0.193	0.096	0.585	29507
ΔLiquid Assets	0.095	0.340	-0.227	0.038	0.463	29507
ΔCore deposits	0.113	0.214	-0.047	0.066	0.310	29507
ΔNon-core liabilities	0.288	0.562	-0.166	0.159	0.830	29507
ΔEquity	0.122	0.198	-0.020	0.082	0.282	29507
ΔREprice	0.065	0.044	0.026	0.054	0.121	29507
ΔInc	0.057	0.031	0.021	0.056	0.091	29507
ΔPop	0.012	0.019	0.000	0.010	0.028	29507
Ln(Assets)	12.267	1.473	10.680	12.054	14.054	29507
Capitalization	0.098	0.034	0.069	0.090	0.135	29507
Net Income	0.010	0.009	0.003	0.010	0.017	29507
BHC	0.199	0.399	0.000	0.000	1.000	29507

Table 3. Housing supply elasticity and house prices, income, and population growth

The dependent variable is the growth of real estate price, total personal income, and population at the MSA level from 1996 to 2006. *Elasticity* is the housing supply elasticity estimated by Saiz (2010). Standard errors are in parentheses.

	(1) *REprice growth*	(2) *Income growth*	(3) *Population growth*
Elasticity	-0.36^{***}	-0.03	0.01
	(0.05)	(0.02)	(0.01)
Constant	1.65^{***}	0.81^{***}	0.11^{***}
	(0.10)	(0.05)	(0.03)
R-squared	0.397	0.024	0.004
N	97	97	97

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Preliminary-stage regression: the impact of local housing supply elasticity on house prices

The dependent variable is the annual residential real estate price index at the MSA level for 97 MSAs from 1996 to 2006. *Elasticity* is the demeaned housing supply elasticity defined by Saiz (2010). Standard errors are in parentheses.

	(1)	
	$HousingPrice$	
Constant	106.5***	(1.881)
(Year=1997)	4.76*	(2.661)
(Year=1998)	10.35***	(2.661)
(Year=1999)	15.67***	(2.661)
(Year=2000)	24.25***	(2.661)
(Year=2001)	33.18***	(2.661)
(Year=2002)	42.10***	(2.661)
(Year=2003)	52.33***	(2.661)
(Year=2004)	69.40***	(2.661)
(Year=2005)	90.45***	(2.661)
(Year=2006)	99.40***	(2.661)
$(Year = 1997) \times Elasticity$	-0.28	(2.663)
$(Year = 1998) \times Elasticity$	-1.04	(2.663)
$(Year = 1999) \times Elasticity$	-2.53	(2.663)
$(Year = 2000) \times Elasticity$	-5.30**	(2.663)
$(Year = 2001) \times Elasticity$	-7.18***	(2.663)
$(Year = 2002) \times Elasticity$	-10.70***	(2.663)
$(Year = 2003) \times Elasticity$	-15.32***	(2.663)
$(Year = 2004) \times Elasticity$	-24.06***	(2.663)
$(Year = 2005) \times Elasticity$	-34.65***	(2.663)
$(Year = 2006) \times Elasticity$	-37.87***	(2.663)
MSA fixed effects	Yes	
R-squared	0.842	
N	1,067	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Bank balance sheet growth from 1996 to 2006: cross-sectional

The dependent variables in column (1) through (7) are the compound annual growth rate of the amount of total assets, real estate loans, C&I loans, liquid assets, equity, core deposits, and non-core liabilities, from 1996 to 2006. The main independent variable is the compound annual growth rate of weighted average of house prices where a bank has depository branches, with the weight being the amount of deposits in each branch. *Inc* is the weighted total personal income. *Pop* is the weighted population. Housing supply elasticity is used as an instrument for house price growth in the IV estimation (Panel A). $Y/Assets$ denotes the ratio of each bank balance sheet item indicated in the table header over total assets. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company that owns more than one banks, and 0 otherwise. Δ denotes the growth rate of the variable.

Panel A: IV estimation

	Assets				Liabilities		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Assets	*RE Loans*	*C&I Loans*	*Liquid*	*Equity*	*Core deposits*	*Noncore liabilities*
$\Delta REprice$	0.83***	1.19***	0.35**	0.46***	0.95***	0.68***	1.39***
	(0.10)	(0.13)	(0.17)	(0.11)	(0.11)	(0.10)	(0.17)
ΔInc	−0.48*	−1.14***	0.75	0.28	−0.45	−0.15	−1.76***
	(0.29)	(0.36)	(0.46)	(0.30)	(0.31)	(0.27)	(0.46)
ΔPop	1.23***	2.11***	−0.30	0.12	1.26***	0.83***	2.57***
	(0.33)	(0.42)	(0.53)	(0.35)	(0.36)	(0.32)	(0.53)
$Ln(Assets_{1996})$	0.00	−0.00**	0.01***	0.01***	0.00	−0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Y/Assets_{1996}$		−0.14***	−0.34***	−0.17***		−0.06***	−0.36***
		(0.01)	(0.03)	(0.01)		(0.02)	(0.03)
$Capitalization_{1996}$	−0.09*	−0.10	0.11	0.03	−0.67***	−0.06	−0.01
	(0.05)	(0.07)	(0.08)	(0.06)	(0.06)	(0.05)	(0.08)
$Net\ Income_{1996}$	−1.52***	−2.19***	−2.71***	−1.03***	−1.41***	−1.28***	−1.68***
	(0.28)	(0.36)	(0.45)	(0.30)	(0.31)	(0.27)	(0.46)
BHC_{1996}	0.01	0.01	−0.00	0.01**	−0.00	0.01*	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
R-squared	0.126	0.169	0.096	0.155	0.195	0.117	0.147
N	1783	1783	1783	1783	1783	1783	1783

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: OLS estimation							
		Assets			Liabilities plus equity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Assets	*RE Loan*	*C&I Loan*	*Liquid*	*Equity*	*Core Deposits*	*Noncore Liabilities*
$\Delta REprice$	0.62***	0.89***	0.38***	0.39***	0.72***	0.45***	1.20***
	(0.07)	(0.09)	(0.11)	(0.07)	(0.07)	(0.07)	(0.11)
ΔInc	−0.24	−0.77**	0.72*	0.37	−0.17	0.12	−1.54***
	(0.27)	(0.34)	(0.44)	(0.29)	(0.29)	(0.26)	(0.44)
ΔPop	0.96***	1.71***	−0.27	0.03	0.96***	0.54*	2.32***
	(0.31)	(0.40)	(0.51)	(0.33)	(0.34)	(0.30)	(0.51)
$Ln(Assets_{1996})$	0.00	−0.00	0.01***	0.01***	0.00*	−0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Y/Assets_{1996}$		−0.13***	−0.35***	−0.17***		−0.07***	−0.35***
		(0.01)	(0.03)	(0.01)		(0.02)	(0.03)
$Capitalization_{1996}$	−0.08	−0.08	0.11	0.04	−0.66***	−0.05	−0.00
	(0.05)	(0.07)	(0.08)	(0.05)	(0.06)	(0.05)	(0.08)
$Net\ Income_{1996}$	−1.69***	−2.44***	−2.69***	−1.09***	−1.60***	−1.45***	−1.83***
	(0.27)	(0.35)	(0.44)	(0.29)	(0.30)	(0.27)	(0.45)
BHC_{1996}	0.01	0.00	−0.00	0.01*	−0.00	0.01*	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
R-squared	0.130	0.175	0.096	0.155	0.199	0.123	0.149
N	1783	1783	1783	1783	1783	1783	1783

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Bank balance sheet growth 1996—2006: panel estimation

This table reports the IV estimation of the impact of real estate prices on the annual growth of bank balance sheet items. The dependent variables in column (1) through (7) are the annual growth rate of total assets, real estate loans, C&I loans, liquid assets, equity, core deposits, and non-core liabilities. The construction of the dependent variables are in the Appendix. The main independent variable is the growth rate of weighted average of house prices where a bank has depository branches, with the weight being the amount of deposits in each branch. ΔInc is growth rate of weighted total personal income. ΔPop is the growth rate of weighted population. The growth rate of weighted predicted house prices from Eq. (3) is used as an IV in the estimation. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company, and 0 otherwise. Standard errors clustered by bank are reported in the parentheses.

	(1) *Assets*	(2) *RE Loans*	(3) *C&I Loans*	(4) *Liquid*	(5) *Equity*	(6) *Core Deposits*	(7) *Noncore Liabilities*
$\Delta(REprice_{i,t})$	0.94***	1.25***	0.74***	0.66***	0.99***	0.86***	1.60***
	(0.08)	(0.11)	(0.15)	(0.10)	(0.08)	(0.08)	(0.20)
$\Delta(Inc_{i,t})$	−0.49***	−0.73***	−0.55***	−0.04	−0.35***	−0.29***	−1.10***
	(0.09)	(0.13)	(0.21)	(0.16)	(0.10)	(0.10)	(0.25)
$\Delta(Pop_{i,t})$	1.05***	1.56***	0.73***	0.55***	0.72***	0.81***	1.56***
	(0.11)	(0.17)	(0.26)	(0.20)	(0.13)	(0.13)	(0.31)
$Ln(Assets_{i,t-1})$	−0.01***	−0.02***	−0.01***	−0.01***	−0.00***	−0.01***	−0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Captalization_{i,t-1}$	0.92***	1.61***	2.15***	0.63***	−0.95***	1.23***	3.03***
	(0.07)	(0.11)	(0.15)	(0.08)	(0.05)	(0.07)	(0.19)
$Net\ Income_{i,t-1}$	−4.49***	−8.44***	−8.21***	−2.15***	−1.78***	−5.24***	−7.62***
	(0.46)	(0.82)	(0.84)	(0.51)	(0.22)	(0.54)	(0.94)
$BHC_{i,t-1}$	−0.00	0.00	−0.01	−0.00	−0.01***	0.01	0.02**
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R-squared	0.181	0.202	0.097	0.048	0.062	0.191	0.112
N	29507	29507	29507	29507	29507	29507	29507

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7. Bank balance sheet composition 1996—2006: panel estimation

This table reports the IV estimation of the impact of real estate prices on the composition of bank balance sheets. The dependent variable in column (1) through (6) are ratios of various asset and liability categories to a bank's total assets. The definition of each balance sheet item is in the Appendix. The main independent variable is the growth rate of weighted average of house prices where a bank has depository branches, with the weight being the amount of deposits in each branch. ΔInc is growth rate of weighted total personal income. ΔPop is the growth rate of weighted population. The growth rate of weighted predicted house prices from Eq. (3) is used as an IV in the estimation. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company, and 0 otherwise. Standard errors clustered by bank are reported in the parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
	RE Loans	*C&I Loans*	*Liquid*	*Equity*	*Core Deposits*	*Noncore Liabilities*
$\Delta(REprice_{i,t})$	0.10***	−0.06***	−0.08***	0.01*	−0.06***	0.05**
	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)
$\Delta(Inc_{i,t})$	−0.09***	0.02	0.11***	0.01	0.11***	−0.12***
	(0.03)	(0.02)	(0.03)	(0.01)	(0.03)	(0.03)
$\Delta(Pop_{i,t})$	0.15***	−0.04**	−0.14***	−0.04***	−0.08***	0.11***
	(0.03)	(0.02)	(0.04)	(0.01)	(0.03)	(0.03)
$Ln(Assets_{i,t-1})$	−0.00***	0.00***	0.00***	0.00	−0.00	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
$Captalization_{i,t-1}$	0.09***	0.05***	−0.10***	−0.31***	0.15***	0.16***
	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
$Net\ Income_{i,t-1}$	−0.74***	−0.13***	0.67***	0.53***	−0.35***	−0.14**
	(0.09)	(0.03)	(0.06)	(0.06)	(0.08)	(0.06)
$BHC_{i,t-1}$	0.00	0.00	−0.00	−0.00***	0.00***	−0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year fixed effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R-squared	0.050	0.018	0.071	0.351	0.040	0.035
N	29507	29507	29507	29507	29507	29507

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8. House prices and the cost of deposits

This table reports the IV estimation of the impact of real estate prices on the cost of deposits. In column (1), the dependent variable is change in implicit interest rate paid on core deposits, defined as interest expense on core deposits over core deposits. In column (2) and (3), the dependent variable is change in the average rate a bank pays on its 12-month CD of $10,000 and $25,000 money market account across its branches during the year. The rates are measured in percentage points. The main independent variable is the growth rate of weighted average of house prices where a bank has depository branches, with the weight being the amount of deposits in each branch. ΔInc is growth rate of weighted total personal income. ΔPop is the growth rate of weighted population. The growth rate of weighted predicted house prices from Eq. (3) is used as an IV in the estimation. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company that owns more than one banks, and 0 otherwise. Standard errors clustered by bank are reported in the parentheses.

	(1)	(2)	(3)
	Average	$12mCD$	$MM25k$
$\Delta(REprice_{i,t})$	0.97***	0.96***	0.49***
	(0.12)	(0.18)	(0.17)
$\Delta(Inc_{i,t})$	−1.85***	−0.37	−0.07
	(0.23)	(0.24)	(0.33)
$\Delta(Pop_{i,t})$	1.86***	0.59**	0.09
	(0.29)	(0.28)	(0.38)
$Ln(Assets_{i,t-1})$	−0.01***	−0.01***	−0.00**
	(0.00)	(0.00)	(0.00)
$Captalization_{i,t-1}$	1.44***	0.09	0.47***
	(0.13)	(0.09)	(0.12)
$Net\ Income_{i,t-1}$	−7.71***	1.19***	2.09***
	(0.66)	(0.37)	(0.53)
$BHC_{i,t-1}$	0.02**	−0.01	−0.01
	(0.01)	(0.01)	(0.01)
Year fixed effects	Yes	Yes	Yes
R-squared	0.695	0.913	0.614
N	29507	11884	11627

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9. Bank supply of small business loans

This table reports the IV estimation of the impact of real estate prices on the supply of small business loans. The dependent variables in column (1) is the loan supply shock from estimating Eq. (6) using WLS, and columns (2) the estimated loan supply shock using the methodology developed by Amiti and Weinstein (2016). The main independent variable is the growth rate of weighted average of house prices where a bank has depository branches, with the weight being the amount of deposits in each branch. ΔInc is growth rate of weighted total personal income. ΔPop is the growth rate of weighted population. The growth rate of weighted predicted house prices from Eq. (3) is used as an IV in the estimation. *Capitalization* is equity to assets ratio. *Net income* is the income to assets ratio. *BHC* is a dummy variable equal to one if a bank belongs to a bank holding company that owns more than one banks, and 0 otherwise. Standard errors clustered by bank are reported in the parentheses.

	(1) Supply: WLS	(2) Supply: AW
$\Delta(REprice_{i,t})$	0.53^{*}	1.27^{***}
	(0.31)	(0.39)
$\Delta(Inc_{i,t})$	-0.12	0.29
	(0.37)	(0.55)
$\Delta(Pop_{i,t})$	0.17	-0.16
	(0.41)	(0.61)
$Ln(Assets_{i,t-1})$	-0.04^{***}	-0.02^{**}
	(0.01)	(0.01)
$Captalization_{i,t-1}$	0.45	0.82
	(0.33)	(0.56)
$Net\ Income_{i,t-1}$	-1.65^{*}	-3.19^{**}
	(0.95)	(1.50)
$BHC_{i,t-1}$	-0.05^{***}	-0.10^{***}
	(0.02)	(0.03)
Year fixed effects	*Yes*	*Yes*
R-squared	0.306	0.355
N	8104	8104

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10. Remote housing shocks and employment growth

The dependent variable is annual growth of employment of small businesses at the county level. Remote housing shock, remote population shock, and remote income shocks are the deposits weighted growth rate of house prices, population, and total income in MSAs outside of the state where the county is located. Own housing shock is the house price growth in the MSA where the county is. *Pop* and *Inc* are the population and total income of the MSA the county is, and *Emp* is the county small business employment. Standard errors clustered by year are reported in the parentheses.

	(1)	(2)	(3)
Remote housing shock	0.17***	0.11***	0.08**
	(0.03)	(0.02)	(0.03)
Remote pop shock			0.53***
			(0.14)
Remote inc shock			−0.04
			(0.09)
Own housing shock		0.12***	0.12***
		(0.02)	(0.02)
$Ln(Pop_{t-1})$			0.01
			(0.01)
$Ln(Inc_{t-1})$			−0.00
			(0.01)
$Ln(Emp_{t-1})$			−0.00**
			(0.00)
Year fixed effects	*Yes*	*Yes*	*Yes*
R-squared	0.027	0.037	0.050
N	7950	7950	7950

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix A Data Sources and variable definition

The following bank balance sheet data are obtained from the call reports: total assets (RCFD2170), total loans (RCFD2122), real estate loans (RCFD1410), C&I loans (RCFD1766), Personal loans (RCFD1975), fixed assets (RCFD2145), equity (RCFD3210), net income (RIAD4340).

Liquid assets equals the sum of cash (RCFD0010) + held to maturity securities (RCFD1754) + available for sale securities (RCFD1773) + Federal funds sold (RCFD1350). (Definition follows Kashyap, Rajan, and Stein (2002).)

Core deposits equals the sum of all transaction accounts (RCON2215) + non-transaction money market deposit accounts (RCON6810) + non-transaction other savings deposits (excludes MMDAs) (RCON0352) + non-transaction time deposits of less than $100,000 (RCON6648) - fully insured brokered deposits $100,000 and less (RCON2343+RCON2344). (Definition follows FFIEC's Uniform Bank Performance Report.)

Non-core liabilities equals the sum of total time deposits of $100,000 or more (RCON2604) + other borrowed money (RCFD3190) + foreign office deposits (RCFN2200) + securities sold under agreements to repurchase + federal funds purchased (RCFD2800+RCONB993+RCONB995) + insured brokered deposits of less than $100,000 (RCON2343) + brokered deposits of $100,000 (RCON2344). (Definition follows FFIEC's Uniform Bank Performance Report.)

Deposits by county

FDIC Summary of Deposits https://www5.fdic.gov/sod/dynaDownload.asp?barItem=6

Small Business Loan Data

Community Reinvestment Act data (Source: Federal Financial Institutions Examination Council web: https://www.ffiec.gov/cra/craproducts.htm)

Real Estate Prices

MSA-level residential housing price index (Source: Federal Housing Finance Agency: http://www.fhfa.gov/DataTools/Downloads/pages/house-price-index.aspx)

Link between MSA and county

BEA http://www.nber.org/data/cbsa-msa-fips-ssa-county-crosswalk.html

Housing Supply Elasticity

Estimated elasticity by MSA from Saiz (2010)

Local Economic Conditions

MSA level income and population (Source: BEA http://www.bea.gov/iTable/index_regional.cfm)

County Employment

Employment in the county (annual). (Source: Census Bureau County Business Patterns: http://www.census.gov/econ/cbp/)

Bank Mergers

Federal Reserve Bank of Chicago https://www.chicagofed.org/banking/financial-institution-reports/merger-data