Housing Bust, Bank Lending & Employment: Evidence from Multimarket Banks*

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Abstract

Using geographic variation in bank lending, I study how bank real estate losses affected the supply of credit and employment during the Great Recession. Banks exposed to distressed housing markets cut mortgage and small business lending relative to other banks in the same county. This lending contraction had real effects, as counties whose banks were exposed to adverse shocks in other markets suffered employment declines, especially in young firms. This finding is robust to instrumenting for bank exposure to housing shocks using shocks in distant markets, exposure based on historical lending, or exposure to markets with inelastic housing supply. *JEL* Codes: E24, E44, G21.

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1 Introduction

How did bank exposure to distressed housing markets affect credit and employment during the Great Recession? Losses on real estate loans can force banks to deleverage by contracting credit, potentially disrupting the local economy (Peek and Rosengren, 2000; Ashcraft, 2005; Gan, 2007). However, recent work has highlighted numerous other ways that real estate shocks affect the economy, including by reducing housing wealth (Mian and Sufi, 2014), impairing the value of a firm's collateral (Chaney et al., 2012) or discouraging construction activity (Hoffmann and Lemieux, 2014). Consequently, it is difficult to determine the extent to which a deterioration in bank balance sheets was responsible for the lending and employment declines in weak real estate markets.

This paper examines the significance of the bank credit channel using variation in the exposure of multimarket banks to falling house prices in other markets. If adverse housing shocks trigger bank losses, then borrowers located in strong markets may still face a contraction in credit if their bank is exposed to falling house prices elsewhere. Alternatively, if exposed banks cut lending solely because of low demand in distressed markets, then it would only be local housing shocks that influence credit and employment instead of shocks elsewhere where local banks lend.

The analysis proceeds in two steps: the first demonstrates that banks exposed to falling house prices contract credit, and the second demonstrates that the credit contraction adversely affects employment. Supporting the first point, banks that did more pre-crisis mortgage lending in counties with severe house price declines have more non-performing loans, have greater declines in equity and commercial lending, and are more likely to ultimately fail. This balance sheet contraction and increased risk of failure is most pronounced for banks with a high concentration in construction loans, whose performance is highly sensitive to real estate shocks.

Within county variation confirms that the decline in lending isn't due to weaker demand in distressed housing markets. Instead of banks cutting lending in distressed markets, banks which are exposed to real estate losses are found to cut lending everywhere. A 10% decline in house prices across a bank's markets is found to result in a 16% decline in lending to small businesses and an 11% decline in mortgage originations. The magnitude of these estimates is little changed when controlling for the house price decline in the county itself or when including county fixed effects. That loan growth depends on the multimarket exposure of a bank to house price declines, as opposed to local conditions, indicates that house price shocks impact credit supply.

The second part of the paper tests whether this contraction in credit has real effects. If borrowers can frictionlessly switch to healthier banks or non-bank lenders, employment might not respond to these shocks. However, given previous work demonstrating that real activity is significantly affected by bank failures (Ashcraft, 2005) and shocks to firm credit (Chodorow-Reich, 2014), bank real estate losses have the potential to explain some of the employment losses in distressed housing markets.

Counties whose banks are exposed to other weak housing markets are found to experience declines in employment. In a county level regression of employment growth on the average multimarket exposure of local banks to house price appreciation, controlling for local house price appreciation, I find that a one standard deviation greater bank exposure to house price declines reduces local employment by 1.3% between 2007 and 2010. Furthermore, controlling for bank exposure reduces the estimated elasticity between employment and local house price appreciation by more than a third, indicating that bank distress accounts for some of the dramatic employment declines in distressed housing markets.

To increase confidence that the relationship between local employment declines and the multimarket exposure of local banks to house price shocks indeed reflects changes in credit supply, I use several instruments for county level bank exposure to address endogeneity concerns. First, to address concerns about spillovers from neighboring markets, I instrument for bank exposure using only the exposure of local banks to declines in geographically distant counties. Second, to address concerns about the endogeneity of bank market shares, I instrument for bank exposure using marketshares which predate the worst of the rise in subprime lending and private label securitization. Finally, to address concerns about the endogenity of the real estate shocks themselves, I instrument for bank exposure using the Saiz (2010) housing supply elasticity in the bank's markets.[1] Coefficients are found to be undiminished in IV specifications relative to the OLS specifications.

Two supplemental findings provide further clarification of the role that deteriorating bank balance sheets had in reducing the demand for labor. First, young firms experience significantly larger employment declines in counties with exposed banks. This is consistent with a shock to the supply of bank credit since young firms are more bank dependent (Black and Strahan, 2002; Cetorelli and Strahan, 2006; Robb and Robinson, 2014). Second, adverse bank shocks cause wages to fall, especially for younger or less educated workers. With flexible wages, a shock to the supply of credit reduces the relative demand for locally non-tradable goods and results in a shift of employment into the tradable sector (Kehoe et al., 2016). Thus, this decline in wages may have contributed to the muted response of tradable employment to housing shocks documented by Mian and Sufi (2014).

Overall, my findings suggest that these effects are economically large. Even under conservative assumptions regarding the strength of general equilibrium effects, I find that credit supply shocks due to bank exposure to house price declines caused about a 1.6% decline in aggregate employment. The findings suggest that the bank credit channel accounts for about a fifth of the total employment losses during the financial crisis, and accouts for about a third of the relationship between local house price declines and employment.

1.1 Relation to Previous Literature

This paper contributes to several strands of the macroeconomics and finance literature. I add to a vast literature identifying how shocks to the supply of bank credit impact the economy.[2]

[1] I also address concerns about reverse causality by moving to a panel specification and showing that bank exposure to housing shocks over the prior year impacts employment growth in the next year.

[2] Gertler and Gilchrist (1994); Peek et al. (2003); Ashcraft (2005); Bassett et al. (2014) find that bank credit supply shocks impact employment, income or investment, Driscoll (2004); Ashcraft (2006); Jiménez

Additionally, I contribute to work studying the transmission of shocks through the internal capital markets of geographically dispersed banks.[3]

First and foremost, this paper fits into the literature studying the effect of credit market frictions on employment in the Great Recession. Other studies of how bank losses affected employment have found mixed results. Chodorow-Reich (2014), using data on bank relationships in the syndicated loan market, estimate that contracting bank lending explains roughly 40% of the decline in small/medium sized firm employment following Lehman's bankruptcy. In contrast, Greenstone et al. (2014) study regional loan supply shocks and find that falling small business lending explains less than 3% of the decline in small business employment. This discrepency may partly reflect the different submarkets studied. The rare small firm borrowing in the syndicated loan market may be more financially dependent than the typical small firm. Greenstone et al. (2014) use nationally representative employment data, however they study the effect of a shock to a narrow loan category (lending to firms with less than $1 million in revenue from banks with over $1 billion dollars in assets) which is likely to affect the local economy less than a shock to overall bank lending.[4] I advance this work by using nationally representative employment data, while studying a shock to bank capital, which would affect lending more generally and thus has the capability of being more influential than a decline within a particular category.

Evidence on whether housing shocks affected the economy through the bank balance sheet channel is also mixed. Similar to this paper, Huang and Stephens (2015); Bord et al. (2014); Berrospide et al. (2016) use geographic variation in bank locations to show that banks exposed to housing shocks contracted lending.[5] However, it is debatable whether

et al. (2014) on the other hand find no real effects.

[3] Peek and Rosengren (2000); Chava and Purnanandam (2011); Cetorelli and Goldberg (2012) for example study spillovers through multinational banks, while Morgan et al. (2004); Huang and Stephens (2015); Berrospide et al. (2016); Bord et al. (2014) focus on transmission within the United States.

[4] A concern with studying one loan category is that some of the contracting banks could be redeploying loans from small firms to either larger firms or to households instead of reducing lending in general. This reorientation of lending would only have real effects to the extent that small business lending impacts employment more than other types of lending.

[5] Relatedly, Chakraborty et al. (2016); Flannery and Lin (2015) study the effects of banks being exposed to house price growth during the boom and Giroud and Mueller (2017b) studies the propagation of house

this had real effects as Mian and Sufi (2014); Giroud and Mueller (2017a) demonstrate that house price shocks predominantly affected non-tradable employment, indicating that the shock may influence consumption rather than bank health. This paper similarly exploits geographic variation in bank locations, but does so with an eye towards real effects more so than bank market shares.[6] By comparing counties with similar house price shocks, but differently exposed banks, I can distinguish the employment losses due to the bank balance sheet channel from the direct effects of falling house prices.

The remainder of the paper proceeds as follows: Section 2 describes the data. Section 3 shows that banks in weak housing markets reduce lending. Section 4 demonstrates that house price declines result in falling employment in other counties with common banks. Section 5 concludes.

2 Data Sources

This section first describes how bank and county level measures of bank exposure to real estate shocks are constructed. It then discusses the data sources used for outcome variables pertaining to lending and employment growth.

2.1 Real Estate Shocks

The key ingredients to measuring bank exposure to real estate shocks are geographic data on where banks operate, and local real estate shocks affecting bank health. The real estate shock studied in this paper is county level house price appreciation between 2006 and 2009:

$$\Delta ln(HP)_c = ln(House\ Price)_{c,09} - ln(House\ Price)_{c,06}$$

price shocks through the internal networks of non-financial firms.

[6] Huang and Stephens (2015); Bord et al. (2014); Berrospide et al. (2016) use market fixed effects to control for demand, making the primary object of study changes in market shares instead of county level effects. Bord et al. (2014), however, also show that counties unaffected by house price declines experience employment losses if locally operating banks locate in distressed markets.

House prices come from the Federal Housing Finance Agency county level house price index, a weighted, repeat-sales index constructed from single-family mortgages purchased or guaranteed by Fannie Mae or Freddie Mac (Bogin et al., 2016).

Banks in areas with falling house prices suffer greater loan losses for several reasons. For one, falling house prices increase the likelihood of mortgage default, as underwater homeowners either strategically default or become unable to sell their house in the event of distress (Gerardi et al., 2017). Meanwhile, defaults become more costly as the collateral securing loans lose value. Additionally, falling land values significantly affect the performance of construction loans (Krainer, 2009). This was particularly important during this period, as the majority of bank failures occurred in banks with a high concentration in construction and land development lending (Friend et al., 2013).

Given that falling house prices are theorized to affect banks through mortgage delinquencies or losses on construction loans, other indicators of the state of the housing market, such as the delinquency rate on local mortgages or declines in construction activity might be more direct measures of how banks are affected by housing shocks. In the main part of the paper, I focus on changes in house prices for the sake of consistency with other papers investigating channels through which house price shocks affect employment, such as Mian and Sufi (2014) and Giroud and Mueller (2017a). However, in the end I show that the results are robust to, and often strengthened by, the use of real estate shocks more tightly connected to loan performance.

To test how exposure to housing shocks affects bank lending, I aggregate the county level house price shocks to the level of the bank holding company. My measure of bank health is the average house price appreciation in the counties a bank lends in, weighting by 2006 mortgage lending.[7] Thus the primary bank level explanatory variable is:

$$\Delta ln(HP)(bank)_b = \sum_{c \in C} \frac{L_{b,c,06}}{L_{b,06}} \Delta ln(HP)_c$$

$\frac{L_{b,c,06}}{L_{b,06}}$ is the share of bank b's 2006 home purchase mortgage lending in county c. This data comes from the Home Mortgage Disclosure Act (HMDA), which reports mortgage originations for financial institutions with at least $35 million in assets, and a branch in an MSA. "Bank" is meant broadly to include commercial banks, thrifts and credit unions. I aggregate the lending of financial institutions and subsidiaries to the level of the regulatory high holder using the concordance from Avery et al. (2009). For financial institutions which aren't part of a bank holding company, a "bank" is defined by the institution itself and any subsidiaries in the HMDA data.

In order to determine how the multimarket exposure of local banks affects local outcomes, I further aggregate this bank health measure to the county level. The health of the banks operating in a particular county is measured by the average of the bank level shocks, weighting by banks' mortgage lending in the county. The primary county level explanatory variable is thus:

$$\Delta ln(HP)(local\ banks)_c = \sum_{b \in B} \frac{L_{b,c,06}}{\sum_{b' \in B} L_{b',c,06}} \Delta ln(HP)(bank)_b \tag{1}$$

A county is considered to be exposed to adverse real estate shocks through the banking sector ("exposed" for short) if the banks which are originating mortgages in the area are lending in counties with falling house prices. This will reflect both the declines in the county itself, as well as declines in other counties where locally operating banks are also lending. However, the inclusion of controls for local house price appreciation or the utilization of

[7] Many papers identify the area of a bank's operations using branch deposits instead of mortgage lending. I focus on mortgage lending in order to capture wholesale lending or lending through non-bank subsidiaries, which doesn't necessarily line up well with where banks have branches. Results using deposits to measure bank locations are used as a robustness check.

instruments measuring the exposure to shocks in distant counties means that estimates are identified off of variation in the exposure of locally operating banks to shocks in other counties.

2.2 Bank Outcomes

To test how bank exposure to real estate shocks affects loan performance, equity, and lending, I use balance sheet data from the Call Reports. This data provides a quarterly snapshot of the balance sheets of commercial banks. Banks which are part of a multibank holding company are aggregated to the level of the regulatory high holder. The dependent variables of interest are the nonperforming loan rates for various loan categories, and the quarterly growth rate in either commercial and industrial lending or equity.[8]

Two sources of data for bank-county level lending are used to study the geography of the lending declines. For small business lending, data from the Community Reinvestment Act (CRA) are used. This data reports business loan originations which are either under $1 million in value or to firms with less than $1 million in revenue.[9] This is reported by banks with roughly over $1 billion in assets.[10] The variable of interest is growth in the value of loan originations during the crisis (2008-2010) relative to the pre-crisis period (2004-2006).

Data from the Home Mortgage Disclosure Act are used to study mortgage lending. Unlike the CRA data, which is aggregated to the bank-county level, HMDA is available at the loan level, and includes applications in addition to originations. The dependent variables using the HMDA data are the approval rate on mortgages applications, and the growth in the number of approved mortgage applications.[11]

[8] The nonperforming loan rate is the ratio of the value of loans which are 90 days past due or not accruing interest to total loans for a given lending category.

[9] Small business lending includes business lending which is either unsecured, or secured by non-farm non-residential properties.

[10] $1 billion was the asset threshold in 2005, the reporting threshold has steadily risen since then to $1.2 billion.

[11] The approval rate is $\frac{Approved_{b,c}}{Approved_{b,c}+Denied_{b,c}}$. Since applications which are withdrawn or closed for incompleteness may not reflect credit supply decisions, they aren't included in this ratio. Lending growth is: $ln(N_{10}+N_{09}+N_{08})-ln(N_{04}+N_{05}+N_{06})$. Where N_t is the number of mortgages the bank approves in year

2.3 Labor Market Outcomes

To test for real effects of the county level bank shocks, I use labor market data from the County Business Patterns (CBP) and the Quarterly Workforce Indicators (QWI). Employment growth in the baseline specifications comes from CBP, which provides mid-march employment at the county level using data from the US Census Bureau's Business Register. Growth is measured between 2007 and 2010 to best correspond to the period of rising unemployment.[12]

I use QWI for employment data disaggregated by firm age and wage data disaggregated by worker education. QWI matches worker unemployment insurance data with employer characteristics from the Business Dynamic Statistics. Employment growth is taken from quarter-end 2007:Q1 to quarter-end 2010:Q1 to maintain consistency with the mid-march timing in the CBP. Growth is calculated separately for young firms (10 years old and younger) and mature firms (over 11). For wages, I measure the quarterly wage for a particular type of worker (e.g. college educated workers) as the quarterly payroll divided by the average of beginning and end of quarter employment. Wage growth is calculated from 2007:Q1 to 2010:Q1, either in aggregate or for a particular education category.

2.4 Summary Statistics

Table 1 presents summary statistics of the main variables of interest. Part A shows the bank and bank-county level variables. On average, banks were exposed to a 6.3% decline in house prices. 8.4% of the banks in the sample failed during or after the crisis. Distress seems to have been disproportionately due to construction loans, which had a 6.4% nonperforming loan rate at the end of 2008, compared to only 1.7% for the rest of the portfolio.

Part B summarizes the county level data on labor market outcomes and real estate shocks.

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t. Counts instead of volumes are used due to the somewhat mechanical relationship between house prices and loan sizes.

[12] The unemployment rate rose from 4.4% in March 2007, to a peak of 10.0% in October 2009, and was still elevated at 9.9% by March 2010.

On average, the banks in a county are exposed to a decline in house prices of 12.6%. This shock is larger in magnitude than the average county level decline in house prices (1.8%). This difference is due to the inclusion in the sample of small counties which typically had relatively minor housing shocks but, by virtue of accounting for a small percentage of lending, had little influence the bank exposure measures. The baseline sample includes these small counties, but the findings are generally stronger in the specifications restricted to larger counties.

Employment dropped by 7.8% on average from March 2007 to March 2010. This contraction was particularly dramatic for young firms, for whom employment declined by over 20%, whereas employment in mature firms declined by less than 5%.

3 Bank Real Estate Shocks and the Supply of Credit

This section documents that banks in distressed markets experience elevated loan losses and declines in equity and lending. Within-county variation in small business and mortgage lending is then used to rule out low demand in distressed markets as the reason for the lending declines.

3.1 Bank Level

How does operating in distressed markets affect bank balance sheets? The hypothesis proposed in this paper is that banks exposed to distressed housing markets experience elevated loan losses, resulting in a deterioration in their capital position and a decline in lending. Here I show that the changes to bank balance sheets are consistent with this narrative.

Table 2 regresses various bank performance measures on bank exposure to house price appreciation. The first 3 columns present the coefficient from regressing 2008 year-end nonperforming loan rates on bank exposure to house price appreciation. In column 1, we see that a 10% decline in house prices increases the overall nonperforming loan rate by 0.69

percentage points, compared to a mean non-performing loan rate of 2.5%. In the next two columns, we see that the relationship between house price declines and loan performance is disproportionately driven by the performance of construction and land development (CLD) loans. A 10% decline in house prices increases the nonperforming rate on CLD loans by 2.0 percentage points, compared to 0.39 for all other loans.

Being exposed to falling house prices also increases the likelihood of failure, particularly for construction oriented banks. Columns 4 and 5 present estimates from a linear probability model for whether or not the bank ended up failing between 2007 and 2016. A 10% decline in house prices increases the likelihood of failure by 4.8 percentage points, compared to a mean of 8.4%. The specification in column 5 additionally interacts $\Delta ln(HP)(bank)$ with an indicator for whether the bank was above the mean ratio of CLD lending to capital in 2006. A 10% decline in house prices increases the likelihood of failure by 5.8 percentage points for construction oriented banks, compared to 2.8 for non-construction banks.

The last four columns demonstrate that these loan losses are also associated with lower growth in equity and commercial lending. I regress the quarterly growth in equity or lending on bank exposure to house price appreciation and quarter fixed effects for the period 2007:Q2 to 2010:Q1.[13] A 10% decline in house prices is associated with a 0.8% quarterly decline in equity, which would amount to a 9.7% decline over the 12 quarter sample period. The effect is largest in construction oriented banks, who are expected to experience a 12.0% decline in equity over 12 quarters in response to this shock, compared to 6.3% for other banks.

The difference between construction and non-construction oriented banks is even clearer with commercial and industrial loan growth. A 10% house price decline is expected to reduce commercial loans by 1.9% over the sample period. However, when the interaction term is added, we see that this decline is entirely driven by construction oriented banks, who reduced commercial loans by 2.6% between 2007 and 2010 in response to a 10% decline in house prices. In contrast, commercial lending in low construction banks had a negligible

[13] Standard errors are clustered by bank and observations surrounding bank mergers are dropped. The quarterly growth rates are winsorized at the 1st and 99th percentile.

response to falling house prices.

In sum, banks in distressed housing markets experienced a significant deterioration in loan performance and declines in equity and commercial lending. The contraction in commercial lending was largely driven by the construction oriented banks which experienced the worst loan losses and capital declines.

3.2 Bank-County Lending

While the bank level results show that banks exposed to housing shocks have lower lending, they alone don't prove that there was decline in the availability of credit. One explanation for the results is that falling house prices adversely affect the local economy, causing a reduction in the demand for loans. This section explores the geography of the lending declines and shows that exposed banks cut lending throughout their markets, not just in distressed counties. This behavior is consistent with a shock to the supply of credit.

3.2.1 Empirical Strategy

To understand how demand shocks would bias the previous estimate of how real estate shocks affect the supply of credit, consider a framework along the lines of Khwaja and Mian (2008) and Jiménez et al. (2014). Suppose that lending growth for a particular bank in a county, $\Delta ln(L)_{b,c}$, depends on a bank level supply shock due to real estate losses, $\Delta ln(HP)_b$, with an elasticity β, a county specific demand component, η_c, and an idiosyncratic error. This means that lending growth will be:

$$\Delta ln(L)_{b,c} = \alpha + \beta \Delta ln(HP)_b + \eta_c + \epsilon_{b,c} \tag{2}$$

Aggregating over counties, and defining $\overline{x}_b \equiv \sum\limits_{c \in C} \frac{L_{b,c}}{\sum\limits_{c' \in C} L_{b,c'}} x_{b,c}$ as the loan weighted average of $x \in \{\Delta ln(L)_{b,c}, \eta_c, \epsilon_{b,c}\}$, we have the aggregate lending growth for the bank is:

$$\overline{\Delta ln(L)}_b = \alpha + \beta \Delta ln(HP)_b + \overline{\eta}_b + \overline{\epsilon}_b$$

The object of interest is β, representing the causal effect of the bank shock on the supply of credit. However, regressions of bank level lending on the shock variable as run earlier in the section will produce the coefficient: $\hat{\beta} = \beta + \frac{cov(\overline{\eta}, \Delta ln(HP)_b)}{var(\Delta ln(HP)_b)}$. Given that the bank shock is an average of the county level real estate shocks, a relationship between local demand and local housing shocks will bias my findings.

I address this bias with geographically disaggregated lending data in the spirit of Huang and Stephens (2015); Bord et al. (2014); Berrospide et al. (2016). Namely, I estimate bank-county lending as in equation 2, using the multimarket exposure of a bank to house price appreciation to measure $\Delta ln(HP)_b$, and either county level house price appreciation or county fixed effects to control for η_c. The primary dependent variables are the growth in small business lending or mortgage originations in county c by bank b during the crisis (2008-2010) relative to before the crisis (2004-2006). I cluster by bank and, in most specifications, restrict the sample to observations where the bank had a 2006 branch.[14]

Intuitively, this approach tests whether banks cut lending in distressed markets, or whether banks that are more exposed to distressed markets cut lending throughout their network. If exposed banks cut lending due to falling demand in weak housing markets, then the contraction in lending should predominantly occur in those weak housing markets. In this case, controlling for demand should eliminate the relationship between bank shocks and lending. Alternatively, if exposed banks cut lending because they take losses on their loan portfolio and need to deleverage, they should cut lending throughout their network, regardless of local real estate conditions. If the controls for demand don't meaningfully change the estimate of β, this would indicate that the bias due to falling demand in weak real estate markets is minimal.

[14] I drop counties where the bank acquired branches from another bank.

3.2.2 Small Business Lending Findings

Table 3 shows that bank losses adversely affected the supply of small business credit. Column 1 presents the estimated coefficients from a regression of bank-county small business loan growth on bank exposure to house price appreciation. The coefficient of 1.64 on $\Delta ln(HP)(bank)$ indicates that a 10% decline in house prices across a bank's markets results in a 16% reduction in lending to firms with less than $1 million in revenue between the pre-crisis period (2004-2006) and the crisis period (2008-2010). However, as this specification doesn't include the controls for demand, the coefficient reflects the influence of house price shocks on both loan supply and demand, similar to the potential bias in the previous section.

In order to control for demand, the specifications in columns 2 and 3 additionally include a control for county house price appreciation and county fixed effects respectively. When controls for demand are included the estimated effect *increases* slightly, with a 10% house price shock to a bank reducing small business lending by 18%. If real estate shocks predominantly affect the demand for loans, then the reduction in lending would be concentrated in the counties experiencing the adverse shock. The fact that exposed banks cut lending throughout their branch network, with minimal regard to local house price appreciation, indicates that real estate shocks predominantly affect the supply of credit.

The specification in column 4 expands the sample for the fixed effect regression to include counties where the bank didn't have a 2006 branch. A 10% decline in house prices in a bank's markets is found to reduce small business lending by 25% when this non-local lending is included. Namely, the largest declines in small business lending are in the peripheral markets of banks which are exposed to adverse real estate shocks, similar to what was shown previously by Berrospide et al. (2016) for mortgage lending.

Similar results are found in columns 5-8, where small business loans are defined as loans under $1 million in size instead of loans to firms with less than $1 million in revenue. Here, a 10% decline in house prices across a bank's markets is predicted to result in a 12% reduction in lending when excluding the controls for demand, and a 13% or 14% reduction when the county control or fixed effects are included. Effects are again larger when the sample includes counties without a branch. $\Delta ln(HP)(bank)_b$ is significant at the 1% level in every specification.

The lack of a relationship between loan growth and county level house price appreciation may be surprising given that falling house prices can disrupt the local economy and reduce the demand for loans. It is important to note that this discussion is of demand at the individual bank level, which reflects both the demand from local borrowers, as well as supply from competing banks. If falling house prices affect the balance sheets of local banks and result in a contraction in credit, this would register as an increase in demand for a given bank. Thus if it is assumed that loan demand falls overall in weak housing markets, that banks are not found to shift lending away from these markets indicates that the reduced demand is offset by a contraction the supply of credit from competing banks.

3.2.3 Mortgage Lending Findings

Table 4 presents similar findings, except for mortgage lending instead of small business lending. In the first four columns, I test how bank exposure to weak real estate markets affects the growth in the number of approved loans between the pre-crisis period (2004-2006) and the crisis period (2008-2010). In the last four, I test how these shocks affect the percentage of applications which are approved during the crisis period.

Banks which are exposed to falling house prices approve fewer mortgage applications. A 10% decline in house prices throughout a bank's network is found to reduce the number of approved mortgages by 11%. When controlling for county level house price declines or adding county fixed effects, the estimated effects fall to 8% or 9%. As with small business loan growth, the elasticity roughly doubles when the sample expands to include counties where the bank didn't have a branch in 2006.

In the last four columns, the dependent variable is the approval rate on mortgages instead of the growth in approvals. The estimated effects are generally consistent with the growth regressions. A 10% shock to house prices for a bank reduces the approval rate by 4 percentage points, with the county house price control and county fixed effects having minimal influence on the estimate. Again, effects are amplified when the sample includes non-local lenders, with the 10% shock reducing the acceptance rate by 6 percentage points.

In brief, banks which are exposed to real estate declines reduce small business and mortgage loan originations throughout their network, not just in the counties experiencing declines. County controls or fixed effects have little influence on the estimated elasticity between lending and bank exposure, indicating that real estate shocks predominantly affected the supply of bank credit.

4 Effect of Bank Credit on Employment

Having now established that the exposure of a bank to real estate shocks throughout their network affects the supply of credit (conditional on local conditions), the remainder of this paper is devoted to determining effect of this credit contraction on local labor markets.

4.1 OLS, with county level controls

The simplest approach to identifying how employment is affected by the contraction in credit is to estimate the equation:

$$\Delta ln(Emp)_c = \beta_1 \Delta ln(HP)(local\ banks)_c + \beta_2 \Delta ln(HP)_c + \beta_x' \mathbf{X}_c + \epsilon_c \tag{3}$$

Where $\Delta ln(Emp)_c$ is employment growth between 2007 and 2010 and the independent variables of interest are county level house price appreciation and the average exposure of locally operating banks to house price appreciation. Following Mian and Sufi (2014), $\mathbf{X}_c$ is a set of controls for the share of 2006 employment in each 2-digit NAICS industry. These controls are included to mitigate the potential bias from industry-wide problems affecting local employment and house prices. For example, a concentration of employment in manufacturing is likely to be associated with both falling house prices and employment, with the employment declines not being a consequence of either credit supply or local house price movements.

The assumption underlying this approach is that the control for local housing conditions adequately accounts for the direct effects of house price appreciation on labor demand so that β_1 reflects the effect through the bank credit channel. $\beta_1 > 0$ would mean that a county whose banks locate in stable housing markets would outperform other counties with similar local house price appreciation, but more exposed banks.

Table 5 reports the estimated relationship between employment growth and the two real estate shock variables. The specifications in columns 1 and 2 include the variables of interest separately. The elasticity of employment with respect to bank exposure to house price appreciation is estimated as 0.45, while the elasticity of employment with respect to local house prices is estimated as 0.15. These elasticities imply that a one standard deviation decline in either variable reduces employment by about the same amount: 1.9%.

The specification in column 3 includes both variables together and thus attempts to distinguish employment loses due to the bank credit channel from those attributable to the direct effects of local house price declines. The coefficients on $\Delta ln(HP)(local\ banks)$ and $\Delta ln(HP)$ each fall by about a third when controlling for the other, however each remains significant. The coefficient of 0.29 on $\Delta ln(HP)(local\ banks)$ indicates that a 10% decline in house prices across the markets of locally operating banks results in about a 2.9% decline in employment. The reduction in the coefficient on $\Delta ln(HP)$ from 0.15 to 0.09 when controlling for bank exposure suggests that the bank credit channel accounts for about a third of the relationship between employment growth and house price appreciation.

This methodology might be invalid if counties with exposed banks differ from other counties in ways not captured by the control for local house price appreciation. For example, these counties could be disproportionately served by banks which were targeting subprime borrowers, and thus would have worse delinquency rates or more levered households. Columns 4-7 add additional county level controls to alleviate these concerns.[15] Additionally controlling for the 2008 county level mortgage delinquency rate in column 4 doesn't materially change the results. Controlling for the percentage of 2009 home sales that are categorized as distressed causes the coefficient on $\Delta ln(HP)(local\ banks)$ to increase from 0.29 to 0.40. However, this greater estimate is entirely due to the change in the sample, as the number of observations decreases from 2402 to 909 counties.

If local house price declines matter due to declines in housing wealth, then the change in house prices might not be the appropriate measure for the local housing shock. The specification in column 6 controls for the percentage change in household net worth due to falling house prices from Mian and Sufi (2014) instead of local house price appreciation. This incorporates both the house price decline in the county, as well as how levered local households are with respect to housing. The coefficient on $\Delta ln(HP)(local\ banks)$ remains elevated at 0.45, again due to the smaller sample.

The specification in the last column includes a number of additional controls pertaining to the pre-recession county demographics.[16] The coefficients on both $\Delta ln(HP)(local\ banks)$ and $\Delta ln(HP)$ increase somewhat relative to the baseline specification in column 3, but the findings are mostly unchanged.

4.2 Instrumental Variable Approaches

There are several reasons one might worry that the relationship between employment growth and bank exposure reflects something besides the effect of a shock to bank balance sheets. For example, the results could be attributable to spillovers from neighboring counties, the endogeneity of bank market shares or the endogeneity house price growth. I use three instrumental variable approaches to address these concerns.

[15]The controls for delinquency and distressed sales in columns 4 and 5 are from the NY Fed's Consumer Credit Panel. The controls for housing wealth shocks and county demographics in columns 6 and 7 come from Mian and Sufi (2014) and are available from the replication files on Economtrica's website.

[16]I follow Mian and Sufi (2014) and include: percentage white, median household income, percentage owner-occupied, percentage with less than a high school diploma, percentage with only a high school diploma, unemployment rate, poverty rate, and percentage urban.

Note that, by rearranging equation 1, the multimarket exposure of banks to real estate declines can be written as:

$$\Delta ln(HP)(local\ banks)_c = \sum_{c' \in C} \omega_{c,c',06} \Delta ln(HP)_{c'}, \quad \omega_{c,c',06} = \sum_{b \in B} \frac{L_{b,c,06}}{L_{c,06}} \frac{L_{b,c',06}}{L_{b,06}} \tag{4}$$

Namely, the exposure of a county's banks to a real estate shock is a weighted average of the shock in US counties, with the weight reflecting the share of loans that locally operating banks hold in that market.[17]

Each instrument comes from changing either $\omega_{c,c',06}$ or $\Delta ln(HP)_{c'}$ to remove a source of variation considered to be problematic. First, to address the issue of spillovers, I create an instrument measuring the average exposure of local banks to declines in distant counties. Second, to address the concern that market shares are the result of an endogenous response to the subprime boom, I replace the 2006 market shares with the 2002 market shares. Finally, to address the endogeneity of house price declines, I replace $\Delta ln(HP)_{c'}$ with the housing supply elasticity from Saiz (2010).

4.2.1 Shocks from Distant Markets

Bank locations are spatially correlated, thus other markets that local banks operate in aren't going to be a random subset of US counties. Instead, the bank exposure in one county is likely to be correlated with conditions in areas near enough to the county to directly influence it. For example, falling house prices in Cambridge, MA may reduce the desired expenditure of local home owners. As some of this expenditure would have occurred over the county border in nearby Boston, it might impact non-tradable employment in Boston. To the extent that these areas have banks in common, this could bias the coefficient on $\Delta ln(HP)(local\ banks)$.

The exposure of banks to declines in distant markets may thus be a more plausibly exogenous metric for the health of local banks. This instrument is computed by excluding

[17] Specifically, $\omega_{c,c',06}$ is the average share of loans that banks in county c hold in c', weighted by their market share in c.

the set of counties within $d$km of county c, denoted $B(c,d)$, when calculating the average exposure of local banks to house price appreciation.[18]

$$\Delta ln(HP)(> dkm)_c = \sum_{c' \in C \setminus B(c,d)} \frac{\omega_{c,c',06}}{\sum_{c'' \in C \setminus B(c,d)} \omega_{c,c'',06}} \Delta ln(HP)_{c'}$$

$\omega_{c,c',06}$, which was defined in equation 4, reflects the average share of loans that banks in c originate in c'. Equation 3 can then be estimated using $\Delta ln(HP)(> dkm)$ as an instrument for $\Delta ln(HP)(local\ banks)$. If bank exposure correlates to local employment growth due to spillovers from neighboring counties, then only using variation coming from distant areas should diminish the predicted effects. Conversely, if the findings are due to the bank balance sheet channel, then the ramifications of having a local bank exposed to other distressed markets shouldn't be dependent on how close the county is to that market, as the effect on bank capital would be the same. In this situation, we should see similar coefficients in the OLS and the IV approach.

Table 6 shows that the primary findings are robust to instrumenting for bank exposure with distant shocks. The first two columns present the reduced form results from regressing employment growth on the bank exposure to real estate shocks in counties more than 250km away and industry controls. The coefficients are somewhat higher than in the corresponding OLS specifications. The estimated coefficient on $\Delta ln(HP)(> 250km)$ is 0.58 when excluding the control for local house price appreciation and 0.39 when including the control. Previously, when the measure of bank exposure reflected both conditions near and far from the county, the estimated coefficients were only 0.45 and 0.29 (table 5, columns 1 & 3). Simply put, distant shocks are found to matter at least as much as nearby shocks, indicating that the findings are not driven by spillovers from neighboring counties.

The next two columns present results using the exposure to distant shocks as an instrument for $\Delta ln(HP)(local\ banks)$. The coefficient estimates are similar to those in the reduced

[18] Distance is calculated between county centroids using Vincenty's formula. County locations come from the U.S. Census Bureau's Gazetteer Files.

form specification, declining slightly to 0.57 in the specification without the local control and increasing to 0.49 in the specification with it.

Some caution is required in interpreting the magnitude of these estimates. First, the variation in $\Delta ln(HP)(>250km)$ comes from larger and more geographically dispersed banks. These banks may have been more sensitive to housing shocks than banks operating predominantly in one market. This would cause the local average treatment effect identified in the IV specification to be greater than the average treatment effect.[19] Second, the sample includes numerous small counties which would likely be more sensitive to these distant shocks. Exposed banks were shown to disproportionately cut lending in peripheral markets. Since banks' core markets are likely to be large and urban, small counties are likely to be more sensitive to shocks occurring in geographically dispersed banks.

To address this second point, the last four columns restrict the sample to counties within an MSA. Focusing on these urban counties diminishes the effect somewhat, however results are reasonably similar to those in the full sample. The predicted elasticity of employment with respect to bank exposure to house price appreciation, controlling for local house price appreciation, is about 0.34 in the reduced form specification and 0.39 in the IV specification.

Perhaps more interesting is how these findings vary by the distance parameter. Again, if the bank balance sheet channel drives the results, the effects of bank exposure should be invariant to the distance, possibly increasing somewhat if larger banks are more sensitive to real estate shocks.

Figures 1 and 2 plot how estimates differ by distance parameter. For distances up to either 500km or where the first stage F-statistic falls under 10, I calculate the bank exposure to house price appreciation coming from counties more than that distance from the county in question, and plot the coefficient from the IV specification for that distance parameter.

[19] Larger banks do more lending through mortgage company subsidiaries, which make riskier loans (Demyanyk and Loutskina, 2016). Similarly, large banks may have been more active in the originate-to-distribute market, and not thoroughly screening borrowers. These large banks would thus take greater losses when the private label securitization market shut down and banks were forced to hold these loans on their balance sheet (Purnanandam, 2011).

The OLS coefficient is plotted for a distance of 0. Figure 1 plots the estimated coefficient on $\Delta ln(HP)(local\ banks)$ for each of the four specifications ($\{$No Control, Control for $\Delta ln(HP)\}\times\{$Full Sample, Counties in an MSA$\}$) for different distances. Figure 2 presents the same findings, only with the results plotted separately and including 95% confidence intervals.

Two broad patterns are noticeable. First, the estimates in the specifications with and without the controls converge as the distance parameter increases (i.e. when the effect is identified off exposure from more distant counties). Controlling for local house price appreciation generally reduces the predicted coefficient on bank exposure. However, by about 400km, whether or not I control for local house price appreciation becomes mostly irrelevant. This indicates that the instrument successfully removes the variation in the exposure measure coming from local housing shocks.

Second, urban markets are more sensitive to bank shocks in general, while other counties seem to be more sensitive to shocks from distant markets. In the OLS specification and for low distance parameters, the coefficient estimates are larger in the urban sample. However, the estimated coefficients in full sample rise as the distance parameter increases, suggesting that shocks to large geographically dispersed banks are particularly harmful to counties outside an MSA. For urban counties, the OLS and IV estimates tend to be fairly similar, even for higher distance parameters. If large exposed banks retrench by pulling out of smaller peripheral markets, this could explain the pattern.

4.2.2 2002 Market Shares

Another concern regarding non-random bank market shares is that banks may have chosen to lend in certain counties based on unobserved characteristics related to subsequent employment declines. For example, a bank may have a high exposure to real estate declines not because of historical accident, but because it specifically chose to enter markets to cater to subprime borrowers. To address this concern, I compute the exposure of banks based on 2002 mortgage lending volume instead of 2006.[20] As the spike in private label securitization and the subprime share of mortgage originations occurred between 2003 and 2004, 2002 lending volumes are less likely to be an endogenous response to the housing boom.

Table 7 demonstrates that previous results aren't driven by banks sorting into counties during the subprime boom. The first two columns present the reduced form results from regressing employment growth on bank exposure to real estate shocks based on 2002 mortgage lending and industry controls. I find a coefficient of 0.39 on $\Delta ln(HP)(2002\ locations)$ when I exclude the control, and a coefficient of 0.25 when I control for local house price appreciation. These estimates are slightly smaller than in the baseline specification where bank exposure is computed based 2006 market shares, however they remain significant at the 1% level.

In columns 3 and 4, I use the exposure based on 2002 mortgage lending as an instrument for the 2006 exposure to house price appreciation. This results in a greater predicted affect of bank exposure to house price declines than in the corresponding OLS specifications. This may reflect the fact that banks which have been in the county longer have had more time to build relationships and obtain knowledge about local borrowers. Consequently, any contraction in credit from these banks would be more costly to their customers, as it would be more difficult to substitute to another lender.

If the lenders with a consistent presence in the county are disproportionately local or regional lenders, this could rekindle potential concerns about spillovers from neighboring counties. In the last four columns, I combine the previous two instruments and instrument for bank exposure to house price appreciation with the 2002 mortgage exposure of local banks to appreciation in counties more than 250km away. Similar to the last section, there is, if anything, a greater sensitivity to real estate declines occurring in distant markets, alleviating concerns about local spillovers biasing the results.

[20] Specifically, the instrument is: $\Delta ln(HP)(2002\ locations)_c = \sum_{c' \in C} \omega_{c,c',02} \Delta ln(HP)_{c'}, \quad \omega_{c,c',02} = \sum_{b \in B} \frac{L_{b,c,02}}{L_{c,02}} \frac{L_{b,c',02}}{L_{b,02}}$.

4.2.3 Housing Supply Elasticity

The endogeneity of the county level house prices may be a concern as well. Since the supply of credit affects house prices and construction activity (Peek and Rosengren, 2000; Loutskina and Strahan, 2015; Favara and Imbs, 2015), a bank may be systematically located in weak real estate markets because it is responsible for them. For example, banks which depended more on wholesale funding may have cut lending, resulting in falling house prices and employment across their markets even though losses on real estate loans didn't cause the supply shock.

To address this issue, I instrument for bank exposure to real estate shocks using the exposure to MSAs with an inelastic supply of housing. Saiz (2010) shows that topological characteristics in the 50km surrounding a city center influence the capacity to develop land. MSAs with a large percentage of nearby land unavailable due to hilly terrain or bodies of water have an inelastic supply of housing. The difficulty in adding new units in inelastic regions facilitated a greater boom and bust in house prices (Mian et al., 2013; Mian and Sufi, 2014). As a result, a bank which is exposed to house price declines because it located in inelastic regions is more plausibly facing an exogenous deterioration in loan performance.

Table 8 presents the findings for three different instruments relating to bank exposure to MSAs with an elastic housing supply. In the first two columns, the instrument is the average exposure of local banks to the Saiz (2010) elasticity based on 2006 mortgage lending. In columns 3 & 4, the instrument is the exposure of banks to elastic markets more than 250km from the county, and in 5 & 6 the instrument is the exposure to elastic markets based on 2002 mortgage lending.

As with the other instrumental variable approaches, the IV estimates are similar to the OLS estimates. Recall that a regression of employment growth on house price appreciation, bank exposure to house price appreciation and industry controls produces a coefficient of 0.29 on $\Delta ln(HP)(local\ banks)$. When I estimate this equation instrumenting for $\Delta ln(HP)(local\ banks)$ with the exposure to elastic regions, exposure to distant elastic regions, and 2002 exposure to elastic regions, I find coefficients of 0.35, 0.55, and 0.40. OLS and IV estimates are also similar when omitting the control for local house price appreciation. Thus, reverse causality between bank lending and house prices doesn't seem to drive the results.

4.3 Extensions/Robustness

This paper concludes with two extensions and two robustness checks. The first extension shows that younger, and thus presumably more bank dependent, firms disproportionately account for the employment declines in exposed counties. The second extension shows that wages decline in exposed counties. Finally, I show that the results are robust to the use of other measures of real estate shocks, and the use of a panel specification which takes into account the timing of the house price and employment declines.

4.3.1 Effects by Firm Age

If the relationship between employment growth and bank exposure to real estate shocks indeed reflects a contraction in the supply of bank credit, employment in young firms should be affected more. First, young firms have had little time to accumulate and retain earnings, making them more dependent on external finance in general. Second, their small scale means that bond market access is likely to be infeasible, making them more dependent on bank finance in particular. Finally, the opacity of young firms exacerbates the adverse selection problem in switching banks, as incumbent banks have superior information regarding credit quality. Thus while mature firms may be able to function off of retained earnings or alternative sources of finance, young firms should be most dramatically affected by changes in the supply of credit from local banks.[21]

[21] There is substantial evidence in favor of these claims in the literature. Black and Strahan (2002); Cetorelli and Strahan (2006); Robb and Robinson (2014) discuss the importance of bank lending in facilitating entrepreneurship. Becker and Ivashina (2014); Adrian et al. (2012) document the substitution to bond finance during the financial crisis. Sharpe (1990); Detragiache et al. (2000); Marquez (2002) discuss the adverse selection problem in switching banks.

Table 9 shows that adverse bank shocks disproportionately affect employment growth in younger firms. Each specification repeats the previous analysis using the growth in employment in young firms (10 years old or younger) and mature firms (over 10 years old) as the dependent variables, instead of aggregate employment growth. In the first two columns, I find a coefficient of 0.73 when regressing young firm employment growth on $\Delta ln(HP)(local\ banks)$, compared to 0.26 for mature firms, with the difference being significant at the 1% level. The specifications in columns 3 and 4 instrument for $\Delta ln(HP)(local\ banks)$ using the exposure of local banks to house price appreciation in counties more than 250kms away. The elasticity for young firm employment is little changed, while the elasticity for mature firms increases to 0.41, making the difference insignificant.[22]

The greater sensitivity of young firms to bank exposure isn't due to young firms being more affected by local house price shocks. In the final four columns, I control for county house price appreciation and get broadly similar results. When controlling for local house price appreciation, I find a coefficient of 0.64 on $\Delta ln(HP)(local\ banks)$ for young firms and 0.05 for mature firms. Namely, only young firms respond to the bank losses, with mature firms predominantly responding to local house price shocks. The difference is again dampened in the IV specification.

In short, counties whose banks were exposed to real estate losses in other markets suffered large employment declines. That these employment declines were most concentrated in bank dependent firms increases confidence that the channel of influence is indeed a contraction in the supply of bank credit.

4.3.2 Effect on wages

How did bank exposure to real estate declines affect wages? In addition to providing a more complete picture of how bank lending affects local labor markets, identifying the extent of

[22] Larger firms disproportionately borrow from larger banks (Berger et al., 2005), potentially explaining why established firms are more sensitive to the conditions for large geographically dispersed banks than the smaller local banks.

wage adjustment is also important for understanding sectoral differences in the response to housing shocks. Mian and Sufi (2014) show that housing wealth shocks affect non-tradable, but not tradable employment, consistent with falling house prices predominantly affecting consumption. However, Kehoe et al. (2016) show that a tightening of firm debt constraints will cause a reallocation to the tradable goods sector due to a "relative demand effect" whereby a shock to labor demand feeds back into demand for non-tradable goods. Evidence of this mechanism is shown by Huber (2018), who finds that a bank credit supply shock has both a direct effect on firms borrowing from a bank, but also an indirect effect on non-tradable firms in areas where the bank operates due to lower aggregate demand. Thus with moderately flexible wages, a credit shock might have a negligible impact on tradable employment. This makes it important to understand if wages respond to local shocks as argued by Beraja et al. (2016), or if they are largely non-responsive as in Mian and Sufi (2014).

As with Mian and Sufi (2014), I test how the growth in payroll per employee responds to real estate shocks. However, instead of using County Business Patterns data, I use Quarterly Workforce Indicators data since it can be disaggregated by education category. This can mitigate a potential composition bias in the more aggregate measure. If temporary or low skilled workers have lower search or training costs, they could be more readily laid-off during a downturn. Wage declines could then be masked by a change in the composition of the workforce to include a higher percentage of high wage individuals.[23]

Table 10 shows that counties with exposed banks experience wage declines, especially for young or low education workers. Each column reports the coefficients from a regression of payroll per worker growth on bank exposure to house price appreciation, controlling for local house price appreciation and 2006 industry employment shares. Column 1 shows that average payroll aggregated across all education categories is weakly affected by bank house

[23] This bias is well documented in the literature analyzing wage cyclicality. Workers who enter unemployment disproportionately come from the low end of the wage distribution, causing researchers to understate the true pro-cyclicality of real wages. See for example Bils (1985); Solon et al. (1994); Daly et al. (2012).

price shocks. A 10% shock is found to reduce wages 1.5% between 2007:Q1 to 2010:Q1, with the effect only being marginally significant. However, columns 2-6 show that the drop in wages was more severe for most education categories. A 10% shock to local banks is found to reduce the wage of young workers (under 25 years) by 3.4%, workers without a high school diploma by 2.5%, and high school educated workers by 1.9%. All of these effects are significant at the 1% level. Declines are less severe at the high end of the education spectrum, with college educated workers experiencing an insignificant 0.8% decline in wages in response to a 10% shock.

4.3.3 Panel Specification

Most of this paper relies on cross sectional data, studying how real estate shocks between 2006 and 2009 affect employment between 2007 and 2010. This approach has the advantage of being relatively agnostic as to the timing with which shocks to banks impact the economy. However, it may invite concerns about the direction of causality as the coefficient on the independent variables can reflect a relationship between employment growth and subsequent house price appreciation.

Table 11 presents estimates from regressing county employment growth between years t and $t+1$ on county level house price appreciation and bank exposure to appreciation between $t-1$ and t (still using 2006 mortgage originations to measure a bank's exposure to a county). All specifications include the controls for 2006 2-digit industry employment shares, with standard errors clustered by state as in the previous sections. Additionally, year fixed effects are included, so the identification still fundamentally comes from cross sectional variation. The panel runs from 2007 to 2009, so that the coefficient on the real estate shock variables are interpretable as the predicted effect of the 2006-2009 housing shock on 2007-2010 employment as before.[24]

[24] If β is the elasticity between $ln(\frac{y_{t+1}}{y_t})$ and $ln(\frac{x_t}{x_{t-1}})$, then the cumulative effect of changes to x over the sample will be: $\sum_{t=2007}^{2009} ln(\frac{y_{t+1}}{y_t}) = \sum_{t=2007}^{2009} \beta ln(\frac{x_t}{x_{t-1}})$, making β the elasticity between $ln(\frac{y_{2010}}{y_{2007}})$ and $ln(\frac{x_{2009}}{x_{2006}})$ as before.

The main findings of the paper are robust to using a panel specification. When omitting the control for local house price appreciation in column 1, I find a coefficient of 0.39 on $\Delta ln(HP)(local\ banks)_{t-1,t}$, meaning that a 10% decline in house prices in the markets of local banks over 2006-2009 would result in a 3.9% cumulative employment decline between 2007 and 2010. This elasticity is little changed from the coefficient of 0.45 in the cross sectional specification shown in table 5.

The specification in column 2 uses local house price appreciation over the previous year as the independent variable instead of bank exposure and finds a weaker role for falling house prices than before, with a coefficient of 0.10 on $\Delta ln(HP)_{t-1,t}$ compared to 0.15 in the cross sectional approach. As the earlier specifications neglected the timing of the house price appreciation, the estimates reflected the reverse causality of falling employment impacting house price appreciation in addition to the causal effects of house price declines.

When including both local house price appreciation and the exposure of local banks to house price appreciation in column 3, I find that only bank exposure predicts future employment declines. The coefficient of 0.31 on $\Delta ln(HP)(local\ banks)_{t-1,t}$ is nearly identical to the coefficient of 0.29 in the cross sectional regression with the control for local house price appreciation. The coefficient on local house price appreciation falls to 0.04 and becomes insignificant. In unreported regressions, contemporaneous house price appreciation is found to correlate with employment growth even though lagged appreciation does not. The fact that bank exposure to house price shocks in the last year relates to future employment growth should increase confidence that the findings aren't due to reverse causality.

In the last four columns, I instrument for bank exposure to falling house prices with the exposure coming from distant markets (columns 4 & 5) or 2002 mortgage lending (columns 6 & 7), and get similar results to to earlier findings. When instrumenting with exposure to house price declines in counties more than 250kms away, I find a coefficient of 0.52 whether or not I control for local house price appreciation. This is similar to the cross sectional findings instrumenting with distant shocks in table 6.

When instrumenting with exposure based on 2002 mortgage originations, I again get broadly similar findings. The coefficients on $\Delta ln(HP)(local\ banks)_{t-1,t}$ are 0.40 and 0.45 in the specifications with and without the control for local appreciation. These estimates are broadly similar to those in table 7 instrumenting for bank exposure with the exposure based on 2002 market shares and controlling for local house price appreciation.

4.3.4 Alternative Bank Exposure Measures

How robust are the findings to using alternative measures of bank exposure to real estate shocks? Real estate shocks other than house price declines will relate to bank losses, and market shares besides those for mortgages will reflect the geographic spread of different bank operations. Regarding the appropriate real estate shock, mortgage delinquency may better relate to mortgage losses than falling house prices, while declines in construction activity may better reflect losses on construction loans. Regarding the appropriate measure of a bank's geographic scope, where banks have branches may be more important for some types of lending than where they originate mortgages.

Table 12 shows that the primary findings are robust to, and often strengthened by, the use of alternative real estate shocks. Each specification follows equation (3) replacing $\Delta ln(HP)_c$ with an alternative county level real estate shock, and replacing $\Delta ln(HP)(local\ banks)_c$ with the multimarket exposure of local banks to the alternative shock.

$$\Delta ln(Emp)_c \times 100 = \beta_1 Shock(local\ banks)_c + \beta_2 Shock_c + \beta_x' \mathbf{X}_c + \epsilon_c \tag{5}$$

This equation is estimated for six different county level real estate shocks. All local real estate shocks and bank exposure measures are standardized to facilitate comparison across the different measures. β_1 is thus the predicted percentage point change in employment coming from a one standard deviation increase in the exposure of local banks to a given real estate shock. The housing shocks considered are: (1) house price appreciation, as before,

(2) the 2008 mortgage delinquency rate from the NY Fed's Consumer Credit Panel, (3) the percentage change in household net worth due to house price declines from Mian and Sufi (2014), (4) the change in construction employment between 2006 and 2009 as a fraction of 2006 employment from the County Business Patterns, (5) the change in the number of construction permits issued between the pre-crisis period (2004-2006) and the post-crisis period (2008-2010) as a fraction of the 2000 housing stock from the US Census Bureau, and (6) pre-crisis construction permit issuance as a fraction of the 2000 housing stock.

The two panels in table 12 present results using two different ways of measuring bank market shares when constructing the bank shocks. The top panel weights by 2006 mortgage lending, as in the rest of the paper, while the bottom panel weights by 2006 branch deposits in a county, using data from the FDIC's Summary of Deposits. While mortgage lending may capture mortgage exposure well, deposits are more likely to correlate with other types of lending which predominantly occur through branches, such as construction lending.

Across the 12 specifications, the coefficient is fairly stable. A one standard deviation increase in mortgage delinquency or the level of pre-crisis construction permit issuance, or a one standard deviation decrease in house prices, housing net worth, construction employment, or construction permits, is found to reduce employment by between 0.7% and 1.9%. In over half of the specifications, the predicted effect is between 1.1% and 1.4%.

While the differences in the magnitude of the estimates are modest, they are informative. Two broad patterns stick out. First, the house price or mortgage specific real estate shocks have a larger predicted effect when weighting by mortgage lending, while the real estate shocks more pertinent to construction activity tend to have larger predicted effects when weighting by deposits. This pattern is expected as banks tend to originate construction loans where they have branches, whereas mortgage lending is more spread out due to lending through brokers or non-bank subsidiaries. Second, the predicted effects of changes in mortgage delinquency and changes in household net worth are larger than the predicted effects of changes in house prices. This also makes sense; if households in a county are less leveraged with respect to housing, a decline in house prices will have a smaller effect on their net worth, will be less likely to result in the mortgage being underwater, and thus will be less likely to induce default or losses to the bank.

While this paper has focused on house prices for the sake of consistency with other work, it is not necessarily falling house prices per se that drive the results. Instead, house prices moved with other factors related to the performance of bank loans. This indicates that future declines in house prices could be less damaging, as tighter mortgage standards or more muted construction activity would likely limit the pass-through of house price shocks to bank health.

5 Conclusion

Using geographic data on bank mortgage originations, I demonstrate that losses to the banking system contributed to the decline in lending and employment between 2007 to 2010. Banks which were exposed to falling house prices in other counties reduced lending locally, resulting in falling employment, especially for young firms. Various instrumental variable approaches confirm that this pattern is not driven by spillovers from neighboring counties, endogenous bank location decisions during the housing boom, or reverse causality.

This finding is important for understanding the geographic heterogeneity in employment losses during the Great Recession. While the stark relationship between house price declines and employment losses is well documented, the mechanisms behind this relationship are still debated. Bank losses are found to account for about a third of the relationship between house price shocks and employment declines. The health of local banks may thus be an important omitted variable in other studies examining how real estate shocks impact the local economy.

A back of the envelope calculation suggests that bank housing losses also had a large effect on employment in aggregate. The OLS regression controlling for local house price appreciation produced a coefficient of 0.29 on $\Delta ln(HP)(local\ banks)$. Given the average bank exposure to house price appreciation of -12.6%, this implies a partial equilibrium effect of 3.7%. In the model of Beraja et al. (2016), regional elasticities to a discount rate shock are 2.3 times that of an aggregate shock. This would imply that falling house prices resulted in a 1.6% decline in aggregate employment due to the bank balance sheet channel, or roughly a fifth of the total employment losses over the period.

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6 Appendix

6.1 Figures

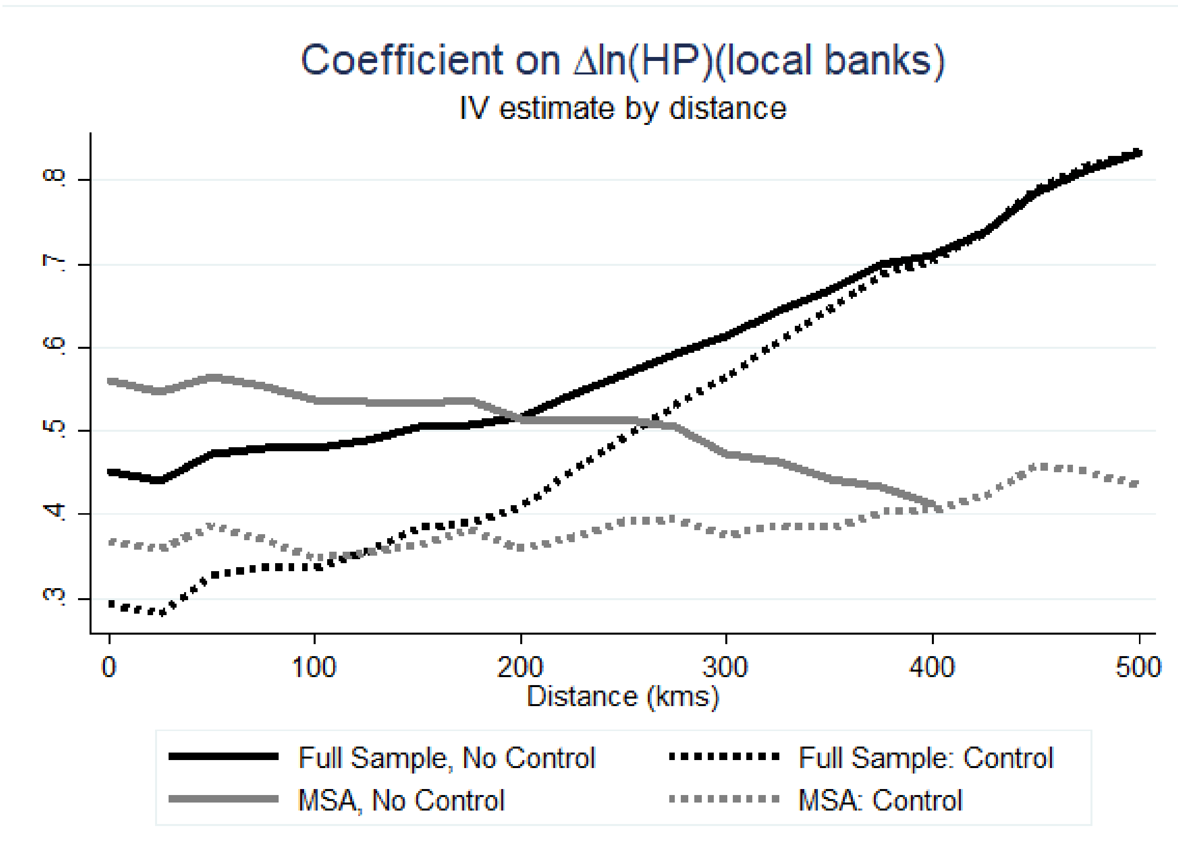

Figure 1: Effect of Bank Health: Distance Based Instruments

Notes: This figure reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation, instrumenting for bank exposure with appreciation coming from different distances away. For each distance parameter d on the x-axis, the instrument for bank exposure is the average bank exposure to house price appreciation in counties more than $d$km away. The coefficient on bank exposure is then plotted on the y-axis, with $d = 0$ plotting the OLS estimate. For each distance, results from 4 specifications are plotted: The solid (dotted) black line presents the coefficient using the full sample of US counties, excluding (including) the control for county house price appreciation. The solid (dotted) grey line presents the results for counties in an MSA, excluding (including) the county level control. Each specification additionally controls for the share of employment in 2-digit industries. Coefficients from specifications with a first stage F-statistic under 10 are suppressed.

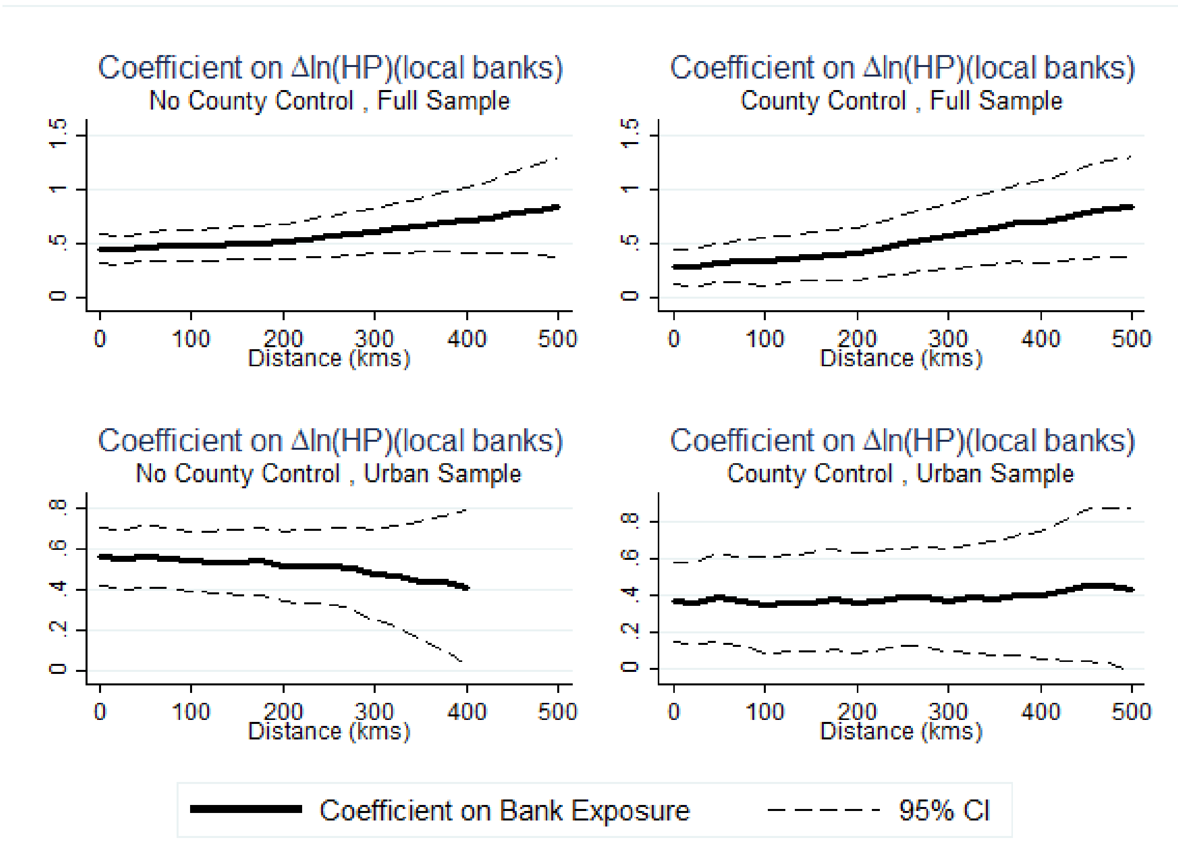

Figure 2: Effect of Bank Health: Distance Based Instruments

Notes: This figure reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation, instrumenting for exposure with shocks coming from different distances away. For each distance parameter d on the x-axis, the instrument for bank exposure is the average bank exposure to house price appreciation in counties more than $d$km away. The coefficient on $\Delta ln(HP)(local\ banks)$ and the 95% confidence interval is then plotted on the y-axis, with $d = 0$ plotting the OLS estimate. The top two panels use the full sample of US counties, while the bottom two restrict the sample to counties in an MSA. The left panels do not control for local house price appreciation, while the right panels do. Each specification additionally controls for the share of employment in 2-digit industries. Standard errors are clustered by state and coefficients from specifications with a first stage F-statistic under 10 are suppressed.

6.2 Tables

Table 1a: Summary Statistics

	Mean	Standard Deviation	Percentile 10th	50th	90th	Obs
			Bank Level Variables			
Bank Exposure and Survival						
$\Delta ln(HP)(bank)$	-0.063	0.132	-0.195	-0.025	0.051	3275
Failure Indicator	0.084	0.277	0.000	0.000	0.000	3275
Non-Performing Loan Rate (2008:Q4)						
Total	0.025	0.035	0.002	0.015	0.057	3029
Construction	0.064	0.105	0.000	0.019	0.189	2960
Non-Construction	0.017	0.023	0.001	0.011	0.037	3029
Quarterly Growth Rates						
Equity	0.004	0.070	-0.046	0.012	0.053	33009
Commercial Loans	-0.001	0.118	-0.116	-0.002	0.121	32518
			Bank-County Level Variables			
Business Lending Growth						
To Small Firms	-0.375	0.847	-1.277	-0.343	0.471	7888
$Small\ Loans(\leq \$1mil)$	-0.242	0.769	-0.988	-0.246	0.489	7970
Mortgage Lending						
Growth in Approvals	-0.078	0.690	-0.847	-0.072	0.674	12940
Approval Rate(08-10)	0.794	0.136	0.611	0.816	0.950	13779

Table 1b: Summary Statistics

	Mean	Standard Deviation	Percentile 10th	50th	90th	Obs
			County Level Variables			
Employment Growth						
$Total\ (CBP)$	-0.078	0.087	-0.177	-0.074	0.019	2404
$Young\ (QWI)$	-0.201	0.203	-0.419	-0.194	0.011	2386
$Mature\ (QWI)$	-0.047	0.121	-0.175	-0.043	0.075	2390
County Real Estate Shocks						
$\Delta ln(HP)$	-0.017	0.121	-0.146	0.009	0.084	2404
$Mortgage\ Delinquency$	0.031	0.022	0.011	0.026	0.054	2103
$\Delta NetWorth$	-0.065	0.085	-0.172	-0.039	0.003	943
$\Delta Const/Emp$	-0.010	0.024	-0.032	-0.008	0.009	2404
$\Delta Permits/Units$	-0.025	0.035	-0.064	-0.014	-0.001	2381
$Permits/Units$	0.040	0.045	0.004	0.026	0.092	2381
$Distressed\ Sales$	0.137	0.179	0.000	0.001	0.407	909
Bank Mortgage Exposure to Shocks						
$\Delta ln(HP)(local\ banks)$	-0.126	0.043	-0.179	-0.127	-0.072	2404
$\Delta ln(HP)(> 250km)$	-0.167	0.024	-0.192	-0.170	-0.137	2404
$\Delta ln(HP)(2002\ locations)$	-0.127	0.047	-0.182	-0.128	-0.067	2403
$Mortgage\ Delinquency(local\ banks)$	0.046	0.007	0.037	0.046	0.054	2404
$\Delta NetWorth(local\ banks)$	-0.098	0.019	-0.119	-0.099	-0.073	2404
$\Delta Const/Emp(local\ banks)$	-0.015	0.004	-0.019	-0.015	-0.010	2404
$\Delta Permits/Units(local\ banks)$	-0.038	0.007	-0.047	-0.038	-0.029	2404
$Permits/Units(local\ banks)$	0.054	0.009	0.044	0.054	0.066	2404
Wage Growth						
$Total$	0.007	0.083	-0.070	0.005	0.092	2390
$Under\ 25\ yrs$	-0.040	0.104	-0.153	-0.043	0.077	2390
$< High\ School$	0.006	0.079	-0.075	0.002	0.086	2390
$High\ School$	-0.001	0.071	-0.074	-0.004	0.076	2390
$Some\ College$	-0.003	0.074	-0.077	-0.005	0.078	2390
$College$	-0.017	0.119	-0.130	-0.016	0.090	2390

Table 2: Real Estate Shocks and Losses on Construction Loans

Dep. Variable	Non-Performing Loans			Failure		Quarterly Growth			
	Total	CLD	Non-CLD			Equity		C&I Lending	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta ln(HP)(bank)$	-0.069**	-0.201**	-0.039**	-0.483**	-0.293**	0.080**	0.052**	0.016**	0.002
	(0.005)	(0.014)	(0.003)	(0.036)	(0.049)	(0.006)	(0.007)	(0.006)	(0.008)
$\Delta ln(HP)(bank) \times High\ CLD$					-0.283**		0.047**		0.021^{+}
					(0.070)		(0.012)		(0.011)
$High\ CLD$					0.093**		-0.010**		-0.006**
					(0.011)		(0.001)		(0.002)
R^2	0.068	0.062	0.052	0.053	0.095	0.077	0.087	0.020	0.021
Obs.	3029	2960	3029	3275	3275	33009	33009	32518	32518

Notes: This table reports coefficients from regressions of different measures of bank performance on bank exposure to house price appreciation. The dependent variables in columns 1-3 are the 2008 year end non-performing loan rate for (1) the bank's entire loan portfolio, (2) construction and land development (CLD) loans and (3) loans besides CLD loans. In columns 4 and 5, the dependent variable is an indicator for whether the bank failed between 2007 and 2016. The remaining columns estimate the quarterly growth rate in (6 & 7) equity and (8 & 9) commercial and industrial loans. These regressions span 2007:Q2 to 2010:Q1, include quarterly fixed effects, and cluster by bank. Quarterly growth rates are winsorized at the 1st and 99th percentile and quarters surrounding a merger/acquisition are dropped. Columns 5, 7 & 9 additionally interact the real estate shock with the indicator for whether the bank was above the mean in construction loans as a fraction of bank equity in 2006. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 3: Growth in Small Business Lending

Dep. Variable	Growth in Loans to Small Firms				Growth in Business Loans ($\leq$\$1mil)			
Sample	Counties with a 2006 branch			Full	Counties with a 2006 branch			Full
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)(bank)$	1.64**	1.77**	1.84**	2.52**	1.16**	1.34**	1.36**	2.04**
	(0.46)	(0.52)	(0.52)	(0.79)	(0.36)	(0.40)	(0.42)	(0.63)
$\Delta ln(HP)$		-0.21				-0.28^{+}		
		(0.18)				(0.15)		
R^2	0.041	0.043	0.312	0.097	0.033	0.035	0.316	0.082
Obs.	7262	7262	7262	28889	7328	7328	7328	35822
County FE?			Yes	Yes			Yes	Yes

Notes: This table reports coefficients from regressions of bank-county growth in small business loan originations on bank exposure to local house price appreciation. The dependent variable is the growth in the value of lending for businesses with under \$1 million in annual revenue (columns 1-4), or the growth in business loans under \$1 million in size (columns 5-8). Growth is measured as the total originations from 2008-2010 relative to originations between 2004-2006. In addition to the bank level real estate shock in every specification, I include county house price appreciation (2 & 6), or county fixed effects (3, 4, 7 & 8) to control for demand. Most specifications limit the sample to counties where the bank had a branch in 2006, except columns 4 and 8 which report the results for the full sample. Standard errors, in parentheses, are clustered by bank. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 4: Growth in Mortgage Lending

Dep. Variable	Growth in Approvals				Approval Rate(08-10)			
Sample	Counties with a 2006 branch			Full	Counties with a 2006 branch			Full
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)(bank)$	1.12**	0.82*	0.93*	2.00*	0.40**	0.41**	0.40**	0.58**
	(0.29)	(0.34)	(0.45)	(0.78)	(0.06)	(0.08)	(0.08)	(0.11)
$\Delta ln(HP)$		0.43**				-0.02		
		(0.14)				(0.03)		
R^2	0.038	0.042	0.216	0.084	0.115	0.116	0.334	0.128
Obs.	12145	12145	12145	64844	12916	12916	12916	97340
County FE?			Yes	Yes			Yes	Yes

Notes: This table reports coefficients from regressions of bank-county measures of the supply of mortgage credit on bank exposure to local house price appreciation. The dependent variable is the growth in the number of mortgage approvals during the crisis (2008-2010) relative to before it (2004-2006) in columns 1-4, and the approval rate of mortgages during the crisis in columns 5-8. In addition to the bank level real estate shock in every specification, I include county house price appreciation (2 & 6), or county fixed effects (3, 4, 7 & 8) to control for demand. Most specifications limit the sample to counties where the bank had a branch in 2006, except columns 4 and 8 which report the results for the full sample. Standard errors, in parentheses, are clustered by bank. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 5: Impact of Bank Shocks on Employment Growth

Dep. Variable	Employment Growth: 2007-2010						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta ln(HP)(local\ banks)$	0.45**		0.29**	0.27**	0.40**	0.45**	0.36**
	(0.07)		(0.08)	(0.08)	(0.12)	(0.10)	(0.08)
$\Delta ln(HP)$		0.15**	0.09*	0.12**	0.06$^+$		0.11**
		(0.03)	(0.04)	(0.04)	(0.04)		(0.04)
$Mortgage\ Delinquency$				0.08			
				(0.10)			
$Distressed\ Sales$					-0.05*		
					(0.02)		
$\Delta NetWorth$						0.13*	
						(0.06)	
R^2	.176	.174	.185	.19	.317	.294	.211
Obs.	2404	2404	2404	2103	909	943	2401
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls?							Yes

Notes: This table reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation. $\Delta ln(HP)$ controls for county level house price appreciation between 2006 and 2009. Every specification also controls for the share of employment in each 2 digit NAICS industry. Columns 4-7 add the following county level controls: the 2008:Q4 mortgage delinquency rate, the percentage of 2009 house sales characterized as distressed sales, the percentage change in household net worth due to falling house prices, and additional demographic controls which are listed in the text. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 6: Instrumenting with Shocks From Other Markets

Dep. Variable	Employment Growth: 2007-2010							
Sample	Full Sample				Counties in an MSA			
Specification	Reduced Form		IV		Reduced Form		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)(> 250km)$	0.58**	0.39**			0.60**	0.34**		
	(0.11)	(0.11)			(0.15)	(0.13)		
$\Delta ln(HP)$		0.13**		0.05		0.13**		0.07^{+}
		(0.03)		(0.05)		(0.03)		(0.04)
$\Delta ln(HP)(local\ banks)$			0.57**	0.49**			0.51**	0.39**
			(0.09)	(0.14)			(0.09)	(0.14)
R^2	.159	.184	.173	.18	.189	.244	.244	.256
Obs.	2404	2404	2404	2404	1094	1094	1094	1094
F			130	123			73.2	89.6
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation, instrumenting for bank shocks with the exposure of local banks to house price appreciation in counties more than 250km away. Columns 1, 2, 5, & 6 present the reduced form relationship between employment growth and the outside exposure of local banks, while the other columns present the IV estimates using the outside exposure as an instrument for bank exposure to real estate declines. The first four columns present the results for the full sample, while the last four restrict the sample to counties in an MSA. Even numbered columns additionally control for county house price appreciation, while every specification controls for the share of employment in each 2 digit NAICS industry. Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table 7: Instrumenting with Historical Bank Lending

Dep. Variable	Employment Growth: 2007-2010							
Instrument	Bank exposure from 2002 locations				Bank exposure from 2002 locations, counties more than 250km away			
Specification	Reduced Form		IV		Reduced Form		IV	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Instrument	0.39**	0.25**			0.39**	0.25**		
	(0.05)	(0.07)			(0.09)	(0.08)		
$\Delta ln(HP)$		0.10*		0.07		0.14**		0.03
		(0.04)		(0.04)		(0.03)		(0.05)
$\Delta ln(HP)(local\ banks)$			0.56**	0.42**			0.64**	0.58**
			(0.07)	(0.11)			(0.13)	(0.19)
R^2	.175	.186	.175	.184	.151	.18	.17	.175
Obs.	2403	2403	2403	2403	2403	2403	2403	2403
F			702	683			48.6	54.6
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation, instrumenting for bank shocks with the exposure of local banks to house price appreciation based on 2002 mortgage lending. Columns 1, 2, 5, & 6 present the reduced form relationship between employment growth and 2002 appreciation exposure, while the other columns present the IV estimates using the 2002 exposure as an instrument for the baseline measure using 2006 lending. In the first four columns the instrument is the multimarket exposure of locally operating banks to house price appreciation weighting by 2002 mortgage lending. In the last four columns, the instrument is the multimarket exposure of locally operating banks to appreciation in counties more than 250km away, weighing by 2002 mortgage lending. Even numbered columns additionally control for county house price appreciation, while every specification controls for the share of employment in each 2 digit NAICS industry. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 8: Instrumenting with Housing Supply Elasticity

Dep. Variable	Employment Growth: 2007-2010					
Instrument	Saiz Instrument		Saiz Instrument >250km		Saiz Instrument 2002 Locations	
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta ln(HP)(local\ banks)$	0.44**	0.35**	0.60**	0.55*	0.50**	0.40**
	(0.08)	(0.11)	(0.16)	(0.23)	(0.10)	(0.13)
$\Delta ln(HP)$		0.08*		0.04		0.07^{+}
		(0.04)		(0.06)		(0.04)
R^2	.176	.185	.172	.177	.177	.184
Obs.	2404	2404	2404	2404	2403	2403
F	72.5	84.7	51	53.2	52.3	63.7
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price growth, instrumenting for bank shocks with the exposure of local banks to MSAs with geographic constraints on housing supply. In the first two columns, I instrument for bank exposure to real estate shocks using the average exposure of local banks to the Saiz (2010) elasticity based on 2006 mortgage lending. In the middle two columns, the instrument is the bank exposure to this elasticity in counties more than 250km away. In the last two columns, the instrument is the average exposure to this elasticity based on 2002 mortgage lending. Even numbered columns additionally control for county price appreciation, while every specification controls for the share of employment in each 2 digit NAICS industry. Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table 9: Effects by Firm Age

Dep. Variable	Employment Growth: 2007-2010							
Specification	OLS		IV		OLS		IV	
Sample	Young	Old	Young	Old	Young	Old	Young	Old
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)(local\ banks)$	0.73**	0.26**	0.76**	0.41**	0.64**	0.05	0.70*	0.31^{+}
	(0.16)	(0.07)	(0.26)	(0.12)	(0.16)	(0.10)	(0.33)	(0.16)
$\Delta ln(HP)$					0.06	0.12**	0.04	0.07^{+}
					(0.08)	(0.03)	(0.10)	(0.04)
R^2	.041	.104	.0409	.102	.0416	.113	.0415	.108
Obs.	2386	2386	2386	2386	2386	2386	2386	2386
Difference	.471**		.349		.587**		.388	
	(.175)		(.281)		(.188)		(.364)	

Notes: This table reports coefficients from regressions of county level employment growth from 2007 to 2010 on the exposure of local banks to house price appreciation. Odd columns report results for employment growth in firms that are 10 years old or younger, while even columns report results for employment growth in firms that are over 10 years old. Every specification controls for the share of employment in each 2 digit NAICS industry, while the final four columns additionally control for county house price appreciation. These equations are estimated by OLS in columns 1, 2, 5 & 6, and IV in the remaining columns, instrumenting for bank exposure using the exposure to real estate shocks in counties more than 250km away. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 10: Evidence of Wage Adjustment

Dep. Variable	Wage Growth: 2007:Q1-2010:Q1					
	ALL	Under 25 yrs	Less Than High School	High School	Some College	College
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta ln(HP)(local\ banks)$	0.15^{+}	0.34**	0.25**	0.19**	0.16*	0.08
	(0.09)	(0.09)	(0.08)	(0.06)	(0.07)	(0.13)
$\Delta ln(HP)$	0.06^{+}	0.11**	0.07*	0.07*	0.06*	0.04
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
R^2	.0749	.162	.126	.124	.101	.026
Obs.	2390	2390	2390	2390	2390	2390
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of county level wage growth from 2007 to 2010 on the exposure of local banks to house price appreciation. Every specification controls county house price appreciation and for the share of employment in each 2 digit NAICS industry. Each column presents results for a different education category. Column 1 includes all workers, while the proceeding columns run the analysis for the wages of workers under 25 (column 2), workers with less than a high school education (column 3), workers who finished high school (column 4), workers with some college (column 5), and workers with a college education (column 6). Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 11: Robustness to Panel Specification

Dep. Variable	Annual Employment Growth (t to $t+1$)						
Specification	OLS			IV			
Instrument				$> 250km$		2002 Locations	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta ln(HP)(local\ banks)$	0.39**		0.31**	0.52**	0.52**	0.45**	0.40**
	(0.06)		(0.08)	(0.08)	(0.12)	(0.06)	(0.11)
$\Delta ln(HP)$		0.10**	0.04		0.00		0.02
		(0.02)	(0.03)		(0.03)		(0.03)
R^2	.172	.169	.173	.171	.171	.172	.173
Obs.	7212	7212	7212	7212	7212	7209	7209
F				152	156	999	1072
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of annual county level employment growth on the exposure of local banks to house price appreciation during the prior year. The dependent variable is the growth in mid-march employment between the year t and $t+1$ for years from 2007 to 2009. $\Delta ln(HP)$ controls for the county level house price appreciation between years $t-1$ and t. Every specification also controls for the share of 2006 employment in each 2 digit NAICS industry. The first three columns are estimated using OLS, while the last four are estimated using IV, instrumenting for bank exposure to appreciation using the exposure of local banks to appreciation over the previous year in counties more than 250 km away (columns 4 & 5) or the exposure of local banks to appreciation over the previous year based on 2002 mortgage market shares (columns 6 & 7). Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table 12: Robustness to Other Real Estate Shocks

Dep. Variable	$100 \times \Delta ln(Employment)_{07\text{-}10}$					
Shock:	$\Delta ln(HP)$	*Mortgage Delinquency*	$\Delta Housing$ *Net Worth*	$\Delta Const\ Emp$ $/Emp_{06}$	$\Delta Permits$ $/Units_{00}$	$Permits_{04\text{-}06}$ $/Units_{00}$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: Bank Shocks Weighted by 2006 Mortgage Lending						
Shock(*local banks*)[Z-score]	1.26**	-1.76**	1.33**	1.91**	1.23**	-0.78*
	(0.36)	(0.37)	(0.37)	(0.23)	(0.27)	(0.32)
Shock[Z-score]	1.13*	-0.23	1.37*	0.88**	0.44	-0.04
	(0.46)	(0.23)	(0.58)	(0.24)	(0.27)	(0.25)
R^2	.185	.17	.281	.197	.158	.142
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Panel 2: Bank Shocks Weighted by 2006 Deposits						
Shock(*local banks*)[Z-score]	0.69^{+}	-1.39**	1.09*	1.83**	1.31**	-1.11**
	(0.38)	(0.35)	(0.50)	(0.34)	(0.32)	(0.35)
Shock[Z-score]	1.34**	-0.07	1.33^{+}	0.31	0.02	0.43
	(0.48)	(0.31)	(0.71)	(0.31)	(0.31)	(0.33)
R^2	.176	.154	.27	.179	.152	.142
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table demonstrates the robustness of the primary county level findings to using alternative real estate shocks. Each column presents the result of regressing 2007 to 2010 employment growth on the average exposure of local banks to a particular real estate shock controlling for the county level real estate shock and the share of 2006 employment in each 2 digit NAICS industry. The real estate shocks considered are: (1) house price appreciation, (2) the 2008 mortgage delinquency rate, (3) the percentage change in household net worth due to house price declines, (4) the change in construction employment between 2006 and 2009 as a fraction of 2006 employment, (5) the change in the number of construction permits issued between the pre-crisis period (2004-2006) and the post-crisis period (2008-2010) as a fraction of the 2000 housing stock, and (6) pre-crisis construction permit issuance as a fraction of the 2000 housing stock. The top panel weights bank exposure to local shocks based on 2006 mortgage lending, while the bottom weights by 2006 branch deposits. Real estate shocks and bank exposure measures are standardized. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.