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 and bank dependent industries. This credit contraction also caused wages to fall and consumer delinquencies to rise, contributing to subsequent declines in nontradable employment. *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, there are 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 house price shocks affect bank balance sheets, borrowers located in strong housing markets could still face a contraction in credit if their bank is exposed to losses elsewhere. This contrasts with other channels, where the effects of house price shocks are felt locally, rather than propagated through bank networks. I find that adverse shocks cause lending and employment to fall in other areas where banks operate, consistent with declining bank credit being an important mechanism by which housing shocks transmit to the economy.

The analysis proceeds in two steps: the first demonstrates that banks exposed to falling house prices contract credit, and the second demonstrates that this credit contraction adversely affects employment. Supporting the first point, banks that did more precrisis mortgage lending in counties where house prices declined have more nonperforming loans, greater declines in equity, and a higher probability of failure. Within county variation demonstrates that these losses affected the supply of credit. A 10% decline in house prices across a bank's markets is found to result in a 15% decline in small business lending and a 16% decline in retained mortgage originations relative to other banks in the same county. Lending predominantly responds to differences in the multimarket exposure of banks to house price declines, rather than local house price shocks, indicating that house price shocks affect the supply of bank credit.

The primary purpose of this paper is to analyze how this contraction in credit affected the real economy. If borrowers can frictionlessly switch to other 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 losses have the potential to explain some of the employment declines in distressed housing markets.

Counties whose banks are exposed to other weak housing markets are found to experience declines in employment. A one standard deviation greater bank exposure to house price declines, controlling for local house price appreciation, reduces local employment by 1.2% between 2007 and 2010. This estimate does not reflect spillovers from neighboring counties, as instrumenting for bank exposure using the exposure of local banks to declines in geographically distant counties results in the estimates rising slightly. Likewise, this result is not due to reverse causality (credit supply affecting house prices), as the estimate is little changed when instrumenting for bank exposure using the Saiz (2010) housing supply elasticity in banks' markets.

Finally, I investigate the mechanisms by which these shocks transmitted to local labor markets. The supply of bank credit can influence the economy in numerous ways, and studying which firms reduce employment is informative as to the mechanisms at play. Contractions in business credit would disproportionately affect firms that are more reliant on bank credit, while contractions in household credit would affect the consumption of households and thus employment in nontradable industries.

Bank shocks are found to disproportionately affect bank dependent firms. Wages and employment at young firms—which tend to be more reliant on banks— are estimated to be about two or three times more sensitive to banks shocks than wages and employment at mature firms. Likewise, employment growth in bank dependent industries is typically estimated to be at least twice as sensitive to bank shocks as employment growth in less bank dependent industries. This result is robust to numerous different ways of categorizing industries by bank dependence: external financial dependence as in Rajan and Zingales (1998), sensitivity to bank liquidity creation as in Berger and Sedunov (2017), and reliance on bank credit reported in the Survey of Business Owners as in Smolyansky (2019). Overall, these results indicate that a contraction in business credit resulted in a notable reduction in labor demand at bank dependent firms.

There is less evidence for bank shocks disproportionately affecting nontradable employment during the recession. Nontradable employment responds less to bank shocks than other types of employment, indicating that the employment losses are not predominantly driven by weaker demand. However, although banks shocks have only modest effects on nontradable employment initially, there are more prominent effects *after the recession ends*. Before these declines occur, counties with exposed banks experience a deterioration in wages, other types of employment, and household loan performance. This timing suggests that nontradable employment declines in counties with weak banks are a consequence of the broader labor market disruption, rather than a primary driver behind the declines. This interpretation is consistent with Kehoe et al. (2016); Huber (2018); Guerrieri et al. (2020), which all demonstrate that supply shocks can feed back into aggregate demand.

Taken together, these findings suggest that bank shocks affect labor demand by tightening financial constraints for bank dependent firms. Weaker job prospects in turn cause a deterioration in the financial standing of local households, eventually resulting in weaker demand and lower nontradable employment growth. These indirect effects of banks shocks on local demand affected employment well after the recession ended and thus contributed to the notable persistence of the employment losses in distressed areas (Yagan, 2019).

1.1 Related Literature

This paper fits into a large literature studying how banks use their internal capital markets to allocate funds across regions. Morgan et al. (2004) show that the integration of the U.S. banking system caused bank capital shocks to have cross-state effects, resulting in state business cycles becoming more alike. Huber (2020) finds that bank consolidation had little effect on capital flows, arguing that well-developed interbank markets functioned as a viable substitute for internal capital markets. I study the effects of bank shocks during a time that severe financial market stress exacerbated frictions in raising capital. Consistent with the conclusions of these papers, I find that bank losses during this period had significant effects on economic activity through-out the network of adversely affected banks.

In particular, this paper adds to work demonstrating that banks contract credit when exposed to weak real estate markets. This has been shown in the context of the 1990s real estate bust in Japan (Peek and Rosengren, 2000; Gan, 2007) and the 2000s housing bust in the US (Huang and Stephens, 2015; Bord et al., 2014; Berrospide et al., 2016).[1] This paper is particularly close to the second set of papers, which similarly document how the multimarket exposure of banks to distressed markets affects lending throughout their network.

The primary contribution is to identify the real effects of this housing induced credit contraction. Existing work provides mixed evidence regarding the channel emphasized in this paper. Supporting the credit supply story, Chodorow-Reich (2014); Cingano et al. (2016); Bentolila et al. (2018) demonstrate that firms with relationships to weak banks experienced significant employment declines during the financial crisis. Similarly, Mondragon (2014); Huber (2018) exploit geographic variation in exposure to large distressed banks and find significant effects of bank distress on local employment. However, Greenstone et al. (2020) find no evidence of shocks to small business credit affecting small businesses and Kahle and

[1] 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 (2019) studies the propagation of house price shocks through the internal networks of nonfinancial firms. Gilje et al. (2016) study the effects of shocks to bank deposits on mortgage lending in other counties.

Stulz (2013) find little evidence of financial constraints for publicly listed firms.

There is similarly a question as to whether falling house prices affected the economy through the bank credit channel. The aforementioned findings that (1) real estate shocks affect credit supply and (2) credit supply affects employment would suggest that differences in the health of banks can partially explain the employment losses in weak housing markets during the Great Recession. However, Mian and Sufi (2014) and Giroud and Mueller (2017) demonstrate that housing losses predominantly affected nontradable employment, suggesting a larger role for aggregate demand than bank credit.

I contribute to this literature in two ways. First, I distinguish employment losses through the bank credit channel from other channels through which falling house prices affect employment. Since the direct effects of falling house prices are determined by local house price movements, while the effects through banks are determined by house price declines throughout bank lending networks, the two effects can be separately identified. Second, I study which types of firms reduce employment in order to better understand the mechanisms at play. Financial constraints for businesses would cause employment declines in young (Siemer, 2019) or financially dependent firms (Rajan and Zingales, 1998; Duygan-Bump et al., 2015), while constraints for households would be more likely reflected in nontradable employment (Mian et al., 2020).

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 analyzes the roles of business credit and aggregate demand in the employment declines. Section 6 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 used to measure 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:

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

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 borrowers either strategically default or become unable to sell their property when facing difficulties making payments (Gerardi et al., 2017). Meanwhile, defaults become more costly as the collateral securing loans lose value. Falling land values can be also be particularly damaging to construction loans (Krainer, 2009), an important channel seeing as most failed banks had high concentrations in construction lending (Friend et al., 2013).

Since falling house prices are theorized to predominantly affect banks through losses on mortgages or construction loans, other indicators of the state of the housing market (e.g. mortgage delinquency or construction activity) might be more direct measures of how banks are affected by real estate shocks. For most of the paper, I study changes in house prices for the sake of consistency with other papers investigating how house price shocks affect employment, such as Mian and Sufi (2014) and Giroud and Mueller (2017). However, results are shown to be robust to using 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 bank holding company level. My measure of bank health is the average house price appreciation in the counties a bank lends in, weighting by 2002 mortgage lending. Since the spike in private label securitization and the subprime share of mortgage originations occurred between 2003 and 2004, 2002 lending volumes are unlikely to reflect an endogenous response to the housing boom.[2] The primary bank level explanatory variable is:

$$\Delta ln(HP)(\text{bank})_b = \sum_{c \in C} \frac{L_{b,c,02}}{\sum\limits_{c' \in C} L_{b,c',02}} \Delta ln(HP)_c$$

where $L_{b,c,02}$ is the value of bank b's 2002 home purchase mortgage lending in county c, and C is the sets of counties with house price data. This data comes from the Home Mortgage Disclosure Act (HMDA), which reports mortgage originations for financial institutions with at least \$32 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 that are not 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

[2] Results are modestly stronger when using 2006 lending volumes. Also, many papers alternatively 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 nonbank subsidiaries, which does not necessarily align with where banks have branches. Results using deposits to measure bank locations are presented as a robustness check.

variable is thus:

$$\Delta ln(HP)(\text{local banks})_c = \sum_{b\in B} \frac{L_{b,c,02}}{\sum\limits_{b'\in B} L_{b',c,02}} \Delta ln(HP)(\text{bank})_b$$
$$= \sum_{c'\in C} \omega_{c,c',02} \Delta ln(HP)_{c'}, \quad \omega_{c,c',02} = \sum_{b\in B} \frac{L_{b,c,02}}{L_{c,02}} \frac{L_{b,c',02}}{L_{b,02}} \tag{1}$$

where $L_{c,02}$ is the aggregate 2002 lending in county c, $L_{b,02}$ is the aggregate lending by bank b, and B is the set of HMDA reporting banks.

The second line shows that the exposure of a county's banks to real estate shocks is a weighted average of the shocks in US counties, with weights reflecting the share of loans that locally operating banks hold in that market. A county is considered to be exposed to adverse real estate shocks through the banking sector ("exposed" for short) if the banks that 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, my empirical strategy involves controlling for local house price appreciation or instrumenting using shocks in distant counties, thus estimates are identified off of variation in the exposure of locally operating banks to shocks in other counties.

2.2 Bank Outcomes

Two sources of data for bank-county loan originations are used to study the geography of lending declines. Small business lending data comes from the Community Reinvestment Act (CRA), which covers loan originations to firms with less than \$1 million in gross annual revenue, and is reported by banks with over \$1 billion in assets.[3] Mortgage lending data comes from the Home Mortgage Disclosure Act, which was described previously. When studying the effects of loan supply shocks, I focus on mortgages that are retained on banks' balance sheets (loans not reported as being sold in HMDA) since banks' losses should affect

[3]The asset threshold was \$1 billion in 2005, but steadily rose to \$1.1 billion by 2010.

their capacity to hold loans more so than originate them for sale. For both data sets, I aggregate lending to the bank-county level. The dependent variable of interest is the growth in the value of loans that banks originated during the crisis (2008-2010) relative to the precrisis period (2004-2006).

The analysis is also supplemented with balance sheet data from the Call Reports and bank failure data from the FDIC. While these data lack the geographic granularity needed to distinguish shocks to banks from shocks to local demand, they can be used to establish that real estate shocks have adverse effects on loan performance, equity growth, and failure rates.

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 specification comes from CBP, which provides mid-march employment at the county-industry level using data from the US Census Bureau's Business Register. Employment growth is measured between 2007 and 2010 to best correspond to the period of rising unemployment.[4]

In addition to studying employment growth across all industries, I also separately analyze growth by different industry segments in order to shed light on the mechanisms by which bank shocks affect employment. First, to investigate the role of declining business lending, I analyze growth by industry bank dependence using three separate classification schemes. Industries are classified as bank dependent if the firms in the industry frequently have capital expenditures exceed cash flows from operations (Rajan and Zingales, 1998), have employment that is highly sensitive to bank liquidity creation (Berger and Sedunov, 2017), or frequently use banks for startup or expansion capital (Smolyansky, 2019).[5] Second, to investigate the

[4]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.

[5]Industries are bank dependent by the Rajan and Zingales (1998) measure if the median firm in the 3-digit

role of changes in consumer demand, I use the Mian and Sufi (2014) classification of 4-digit industries as tradable or nontradable.[6] Total employment for a given category (e.g. nontradable or bank dependent) is calculated by aggregating the employment across the industries within a category.

I use QWI for data on employment or average earnings disaggregated by firm age. QWI matches worker unemployment insurance data with employer characteristics from the Business Dynamic Statistics. Employment and earnings growth are taken from 2007:Q1 to 2010:Q1 to maintain consistency with the March timing of the CBP. Growth is calculated separately for young firms (10 years old and younger) and mature firms (over 11). Earnings pertain to the average earnings of employees with stable jobs (i.e. that stayed with the same firm for a quarter). I also separately analyze changes in the average earnings of new hires since wages may stickier for existing employees than for new hires.

2.4 Summary Statistics

Table 1 presents summary statistics of the main variables of interest. On average, the banks in a county are exposed to a 12.7% decline in house prices between 2006 and 2009. This shock is larger in magnitude than the average county level decline in house prices (1.7%), with the difference due to the fact that mortgage lending disproportionately occurs in large, urban areas, which experienced more significant house price declines than the typical county.

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

industry had capital expenditures exceeding cash flows from operations, based on 1990s Comupstat data for U.S. firms. Thank you to Nick Coleman for sharing this data from Coleman and Feler (2014) with me. The Berger and Sedunov (2017) measure is based on a regression of state-industry-level GDP per capita on state-level liquidity creation per capita. 2-digit industries are classified as bank dependent by this measure if they are above the median elasticity (see Table 12 in their paper for the industry specific elasticities). Finally, 2-digit industries are bank dependent by the Smolyansky (2019) measure if the share of firms that report having used bank credit is above the median, based on data from the 2007 Survey of Business Owners Public Use Microdata Sample. A firm is considered to have used bank credit if they report using a bank loan, home equity loan, or credit card loan for either startup or expansion capital.

[6] Restaurant and retail industries are classified as nontradable, industries prominent in world trade data are classified as tradable.

20%, whereas employment in mature firms declined by only about 5%.

3 Effect of Real Estate Shocks on Bank Credit

This section documents that banks located in areas with falling house prices experience elevated loan losses resulting in a contraction in credit supply. Analysis exploiting within-county variation in loan growth demonstrates that lending declines are due credit supply shocks rather than weak demand in distressed markets.

3.1 Empirical Strategy

While demonstrating that banks in distressed real estate markets experienced elevated loan losses or declines in equity is straightforward, showing that these losses affected credit supply is more complicated. Falling house prices can affect the demand for loans by either hampering economic activity or by reducing the value of collateral available to secure loans. These developments can create a relationship between lending and house prices that is not driven by bank losses or banks' willingness to lend.

In order to overcome this difficulty, I follow Huang and Stephens (2015); Bord et al. (2014); Berrospide et al. (2016) and take advantage of geographically disaggregated lending data to be able to control for demand. Namely, I estimate:

$$\Delta ln(L)_{b,c} = \alpha_c + \beta \Delta ln(HP)(\text{bank})_b + \epsilon_{b,c} \quad (2)$$

where $\Delta ln(L)_{b,c}$ is the growth in mortgage or small business loans originated in county c by bank b during the crisis (2008-2010) relative to before the crisis (2004-2006). $\Delta ln(HP)(\text{bank})_b$ is the multimarket exposure of a bank to house price appreciation, and α_c is a county fixed-effect used to control for demand.[7] Standard errors are clustered by bank and, in most specifications, I restrict the sample to observations where the bank had a 2006 branch. I

[7] Some specifications control for local house price appreciation rather than including county fixed effects.

also drop counties where the bank acquired branches from another bank.

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 with the county fixed effect would remove 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 controls for demand do not meaningfully change the estimate of β, this would indicate that bias due to falling demand in weak real estate markets is minimal.

3.2 Graphical Analysis of Balance Sheet Trends

Before discussing the main findings regarding the effects of house price shocks on credit supply, Figure 1 plots how various balance sheet variables evolve over time based on the exposure of a bank to house price shocks between 2006 and 2009. The hypothesis of 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. Figure 1 shows that changes to bank balance sheets are broadly consistent with this narrative.

The top four charts show the results of quarterly regressions of bank performance on $\Delta ln(HP)$(bank), and plot how the coefficients evolves over time. The top charts confirm that banks in weaker housing markets indeed experienced a significant deterioration in loan performance. Before 2006, net charge-off rates and nonperforming loans rates were on fairly similar trends for banks in markets that would go on to experience house price declines and banks in healthier markets. However, once house prices start falling, banks in weaker housing markets start seeing net charge-offs and nonperforming loans rise. By the end of 2009, banks in markets where house prices fell by 10%, on average, experienced annualized net charge-off rates that were 44 basis points higher, and nonperforming loan rates that were 70 basis points higher, than banks where house prices remained flat.

These losses coincided with equity declines for banks in weak housing markets. Banks in markets where house prices declined during the crisis increased equity significantly during the early and mid-2000s, likely due to the housing boom encouraging bank expansion. However, this equity growth reverted sharply when house prices started to fall. Banks in markets where house prices fell by 10% are expected to have equity decline by 5.6% between 2006 and 2009 relative to banks where house prices were flat. The effects on equity do not level-off until 2012, at which point a 10% house price decline is found to bring about an 8% decline in equity. These declines eventually result in the disproportionate failure of banks in weak housing markets. A 10% house price decline increases the likelihood that a bank fails by the end of 2012 by 2.8 percentage points.

These loan losses and equity declines mean that banks in weak markets faced a reduction in their lending capacity. However, this reduced capacity need not affect credit availability; if firms want less credit in these markets, banks may continue to be able to fund creditworthy customers. To test whether credit supply was affected, the bottom two charts of Figure 1 estimate a yearly variant of equation (2). For each year, loan originations relative to 2007 are regressed on $\Delta ln(HP)$(bank) and county fixed effects. The charts show that banks experiencing a 10% decline in house prices across their markets reduce small business loan originations by 20% and retained mortgage originations by 16% between 2007 and 2009 relative to other banks in the same county that were not exposed to house price declines. Lending then remains depressed through 2013. These results show that bank shocks affect lending beyond the effects of local real estate shocks. Two banks in the same market, presumably experiencing similar demand conditions, are expected to have significantly different loan growth if one is more exposed to losses from outside markets than the other. This transmission of shocks through bank networks is consistent with real estate shocks affecting the supply of credit.

3.3 Effect on Bank-County Lending

Table 2 expands on the findings using geographically disaggregated lending data to distinguish the effects house price shocks have on credit supply and demand. Since loan originations are a flow variable, I aggregate mortgage lending across precrisis and crisis years when analyzing changes in lending rather than using the growth in originations between individual years as in the previous chart. The dependent variable is the growth in lending to businesses with less than $1 million in revenue in the first four columns, and the growth in mortgage originations that banks kept on balance sheet in the last four columns.

Column 1 presents the estimates from a regression of bank-county small business loan growth on bank exposure to house price appreciation. The coefficient of 1.3 on $\Delta ln(HP)$(bank) indicates that a 10% decline in house prices across a bank's markets results in a 13% reduction in lending to small firms between the precrisis period (2004-2006) and the crisis period (2008-2010). However, as this specification does not include controls for demand, the coefficient reflects the influence of house price shocks on both loan supply and demand.

In order to control for demand, specifications in Columns 2 and 3 additionally include a control for county house price appreciation and county fixed effects, respectively. The estimated effect *increases*, with a 10% house price shock to a bank reducing small business lending by 14% and 15% in these specifications. The coefficient on $\Delta ln(HP)$ is slightly negative, although statistically insignificant, meaning that banks might actually allocate more lending to counties with falling house prices (conditional on their overall exposure to declines).

The slightly negative coefficient on $\Delta ln(HP)$ may be surprising given that falling house prices can disrupt the local economy and reduce demand for loans. However, it is important to note that demand for loans at an individual bank reflects both demand from local borrowers and supply from competing banks. If loan demand does indeed fall in weak housing markets, these findings indicate that it is offset by a larger contraction in supply from other banks operating in that county. As a result, banks do not shift credit away from weaker housing markets.

The specification in Column 4 expands the sample for the county fixed effect regression to include counties where the bank did not have a 2006 branch. A 10% decline in house prices in a bank's markets is found to reduce small business lending by 21% when this non-local lending is included. Namely, the largest declines in small business lending are in the peripheral markets of banks that are exposed to adverse real estate shocks, similar to what was shown by Berrospide et al. (2016) for mortgage lending.

Bank exposure to weak housing markets has similar effects on mortgage lending. A 10% decline in house prices throughout a bank's network reduces the volume of retained mortgage originations by 20%. When controlling for county level house price appreciation or adding county fixed effects, the estimated effects falls to about 16%. Unlike for small business loans, local house price movements affect mortgage originations. This is likely a combination of several factors. First, higher home prices, given a particular LTV, will result in larger mortgages. Second, households without sufficient equity in their homes may be unable to refinance when rates fall (Beraja et al., 2018).[8]

As with small business lending, the most severe declines are found to come from the non-local lending of exposed banks, with a 10% house price shock reducing mortgage lending by 20% when counties without a branch are included.

In brief, banks that are exposed to real estate declines reduce mortgage and small business lending everywhere, not just in the counties experiencing declines. That exposed banks cut lending throughout their network, rather than just in areas where house prices fall, indicates that the relationship between bank exposure and loan growth reflects a contraction in the supply of credit.

While the finding that banks' exposure to distressed real estate markets affects credit supply is not new, these findings are important for motivating the analysis of real effects.

[8]Consistent with these explanations, local house price appreciation is found to not affect the number of home purchase originations, even though it affects the value of originations and the number of refinance originations. Results available upon request.

First, these results establish the first link in the chain where falling house prices affect bank lending and bank lending affects local economies. Second, these results support the use of local house price movements to control for the direct effects of falling house prices. If the exposure of local banks to house price declines in other counties was correlated with county level variables affecting economic performance, for example due to spillovers from nearby counties or endogenous bank location decisions, this would bias estimates of supply effects upward in the absence of county fixed effects. However, estimates are basically identical whether one controls for county house price appreciation or uses county fixed effects. This provides credibility to the analysis in the next section, where a control for county house price appreciation is used to account for the direct effects of falling house prices on labor market outcomes.

4 Effect of Bank Credit on Employment

Having now established that the exposure of banks to real estate shocks throughout their network affects the supply of credit, the remainder of the paper studies how this credit contraction affects local labor markets. This section shows that counties whose banks are exposed to shocks in different, and distant, markets experience declines in total employment. The following section analyzes which firms are responsible for the employment declines in order to determine the roles of business credit and local demand.

4.1 Empirical Strategy

4.1.1 OLS

I start with OLS, estimating how employment is affected by the contraction in credit with the following equation:

$$\Delta ln(Emp)_c = \beta \Delta ln(HP)(\text{local banks})_c + \gamma \Delta ln(HP)_c + \zeta' \mathbf{X}_c + \epsilon_c \qquad (3)$$

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.[9]

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 reflects the effect of housing shocks through the bank credit channel. $\beta > 0$ would mean that a county whose banks locate in stable housing markets outperform other counties with similar local house price appreciation but more exposed banks.

4.1.2 IV

Second, I estimate equation (3) instrumenting for $\Delta ln(HP)$(local banks) using the exposure of local banks to declines in distant counties. This approach addresses the concern that spillovers from nearby counties bias the results. For example, falling house prices in one county may reduce expenditures in neighboring counties. Since bank locations are spatially correlated, this could create a relationship between employment growth and bank exposure to house price shocks that isn't driven by changes in bank credit supply.

The exposure of banks to house price appreciation in distant markets may therefore be a more plausibly exogenous metric for the health of local banks. This instrument is constructed by excluding the set of counties within $d$km of county c, denoted $C_d(c)$, when calculating the average exposure of local banks to house price appreciation:[10]

[9] For example, a concentration of employment in manufacturing is associated with falling house prices and employment, with the employment declines likely not being a consequence of changes in credit supply or local house prices.

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

$$\Delta ln(HP)(> d\text{km})_c = \sum_{c' \in C \setminus C_d(c)} \frac{\omega_{c,c',02}}{\sum\limits_{c'' \in C \setminus C_d(c)} \omega_{c,c'',02}} \Delta ln(HP)_{c'}$$

$\omega_{c,c',02}$, which was defined in equation (1), reflects the average share of loans that banks in c originate in c'. I use $\Delta ln(HP)(> d\text{km})$ as an instrument for $\Delta ln(HP)$(local banks) to rule out spatial spillovers as driving the results. If bank exposure correlates to local employment growth due to spillovers from nearby counties, then only using variation coming from distant areas should diminish the predicted effects. Conversely, if the findings are due to the bank credit channel, then the ramifications of having local banks exposed to other distressed markets should not depend on proximity to the other markets, 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.

I also present results instrumenting for $\Delta ln(HP)$(local banks) using banks' exposures to MSAs with inelastic housing supply. Since the supply of credit affects house prices (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. To mitigate this concern about reverse causality, I follow Mian et al. (2013); Mian and Sufi (2014) and use the Saiz (2010) housing supply elasticity as a source of exogenous variation in house price appreciation. This work showed that MSAs whose topological characteristics restrict development had more extreme house price declines during the housing bust. If OLS estimates of the effects of bank exposure on labor market outcomes are biased due to the endogeneity of house price appreciation, instrumenting for bank exposure using the housing supply elasticity in banks' markets would dampen the predicted effects.

4.2 Graphical Analysis of Employment Trends

Before going into the main analysis, Figure 2 shows how various county level labor market variables evolve over time based on the exposure of local banks to house price shocks between

2006 and 2009. Each graph plots the OLS estimate of the coefficient on $\Delta ln(HP)$(local banks) from equation (3) for a particular year.

The first such chart plots changes in total employment over time. A 10% decline in house prices in the markets that local banks operate in, controlling for local house price appreciation, is found to reduce employment by 2.5% between 2007 and 2010. These employment declines prove to be persistent, with total employment showing little recovery between 2010 and 2013. In addition to weak employment growth, exposed counties experience declines in wages, with a 10% house price shock to banks reducing average earnings by 1.1% between 2007 and 2010.

These declines in employment are found to be most pronounced for bank dependent firms. The middle charts plot employment changes for industries with a high and low dependence on external finance, while the bottom charts plot employment changes for young and mature firms. A 10% shock reduces employment in financially dependent industries by 3.6% by 2010, but only reduces employment in other industries by less than 1%. Likewise, a 10% shock reduces employment in young firms by 3.2% by 2010, while employment in mature firms falls by 1.1% and is faster to recover after the recession.

There is little evidence of a pretrend in employment growth. Between 2000 and 2007, counties with banks that would go on to face real estate declines had similar employment trends as counties with banks that located in more stable housing markets.[11] Counties with exposed banks do not see employment growth deviate from that of other counties until house prices actually fall and loan performance starts to deteriorate, consistent with differences in $\Delta ln(HP)$(local banks) reflecting differences in the health of banks, rather than some other unobservable county level variable.

[11] There was an upward trend in average earnings in counties with less exposed banks, however the difference in earnings growth is statistically insignificant.

4.3 Bank Shocks and Employment Growth

Having documented the dynamics of various labor market outcomes, I will now present the main results demonstrating that the relationship between bank exposure to house price declines and subsequent employment declines is causal. In general, I find that the predicted effects of bank shocks are undiminished in IV specifications relative to OLS specifications. Additionally, I show that these results are robust to numerous changes in controls, specifications, and measures of bank exposure to real estate shocks.

Table 3 reports the main estimates of equation (3) pertaining to how total county level employment responds to the two real estate shocks. Columns 1 and 2 present OLS estimates for how county real estate shocks and bank exposure to real estate shocks affect employment growth between 2007 to 2010, with these variables of interest included separately. The elasticity of employment with respect to bank exposure to house price appreciation is estimated as 0.40, while the elasticity of employment with respect to local house price appreciation is estimated as 0.16. These elasticities imply that a one standard deviation decline in either variable reduces employment by slightly under 2%.

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 roughly a third when controlling for the other, however each remains significant. The coefficient of 0.25 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 2.5% decline in employment. The reduction in the coefficient on $\Delta ln(HP)$ from 0.16 to 0.10 when controlling for bank exposure suggests that the bank credit channel accounts for slightly more than a third of the relationship between employment growth and house price appreciation.

Columns 4 and 5 demonstrate that the predicted effects of bank exposure are not driven by spillovers from nearby counties. These columns present estimates when instrumenting for $\Delta ln(HP)$(local banks) with the exposure of banks to declines in counties more than

250km away. If the estimates were driven by spillovers from nearby counties with common banks, then identifying effects off of exposure to declines in distant markets would reduce the predicted effects. Instead, coefficients rise somewhat. When not controlling for local house price appreciation, the coefficient on $\Delta ln(HP)$(local banks) rises from 0.40 in the OLS specification to 0.42 in the IV specification, despite the fact that the OLS estimate partially reflects the effect of local house price declines on employment. When controlling for local house price appreciation, the estimate rises from 0.25 in the OLS specification to 0.33 in the IV specification.

These findings are not specific to distance used to construct the instrument. Figure 3 plots how the estimates differ when instrumenting for $\Delta ln(HP)$(local banks) with the exposure of banks to increasingly distant counties.[12] Instead of estimates falling when more nearby counties are excluded, coefficient estimates are about flat in specifications not controlling for local house price appreciation, and rising for specifications with the control. By around 400km, whether or not I control for local house price appreciation becomes mostly irrelevant, indicating that the instrument successfully removes the variation in the exposure measure coming from local housing shocks.

Some caution is required in interpreting these IV estimates. As the distance used to construct the instrument rises, identification increasing comes larger and more geographically dispersed banks. If these large banks are more sensitive to housing shocks, this would cause the local average treatment effect identified in the IV specification to be greater than the average treatment effect.[13]

Column 6 of Table 3 shows that the results are also robust to using the exposure of banks to markets with inelastic housing supply as an instrument. The estimated effect

[12]This figure does not include confidence intervals for the estimates in order to focus on how point estimates change with different distances. In Figure A1, I plot estimates for each specification separately and include confidence intervals. I also present results when restricting the sample to counties in an MSA.

[13]Direct evidence of differences across bank sizes is mixed. In unreported regressions, I find that larger banks respond more to adverse shocks in terms of mortgage and small business lending. However, Table A1 shows that the estimated effect of bank shocks on employment is slightly stronger when excluding large banks from the exposure measure, and slightly weaker when removing small banks, pointing towards somewhat greater effects of shocks to smaller banks.

of bank exposure on employment growth is slightly larger than in the corresponding OLS specification. That is, counties with banks located in regions more predisposed to booms and busts in house prices due to topological characteristics experience worse declines in employment. Thus the main results are not driven by reverse causality between house price shocks and credit supply.

Finally, the last two columns show that the main findings are robust to limiting the sample to counties within an MSA. Given that exposed banks were shown to disproportionately cut lending in peripheral markets, there might be a concern that the results are driven entirely by smaller, sparsely populated counties that compose a significant share of the sample, but a small share of national employment. However, estimates for the sample of urban counties are similar to those for the broader set of counties.

Three robustness checks are shown in the Appendix. First, in Table A2, I find that results are robust to including additional controls for changes in households' net worth, the share of borrowers with credit scores under 660, and the 2008 mortgage delinquency rate. Second, in Table A3, I find that results are robust moving to a panel specification where bank exposure to house price shocks over the previous year predict changes in employment in the next year. Third, in Table A4, I show that results are largely robust to using different measures of bank exposure to real estate shocks and different measures of bank market shares. Real estate shocks more closely related to mortgage performance (e.g. house price changes, mortgage delinquency, and changes in households' net worth due to house price changes) tend to matter more when bank market shares reflect mortgage lending, while variables more related to construction losses (e.g. changes in construction employment, changes in construction permit issuance and precrisis construction permit issuance) tend to matter more when bank market shares reflect where banks have branches, consistent with construction lending being a more branch-oriented activity than mortgage lending.

Summing up the results of the paper thus far, I have shown that (1) exposed banks cut mortgage and small business lending throughout their network, rather than just in counties experiencing house price shocks; (2) counties with more exposed banks, controlling for local house price movements, experience declines in employment; and (3) shocks in distant markets with common banks affect local employment at least as much as shocks in nearby markets. While this provides substantial evidence that shocks propagate through bank networks and affect local markets, there is still a question of how. This is the focus of the next section.

5 Mechanisms

This section analyzes which firms are affected by credit supply shocks in order to determine the mechanisms by which such shocks affect the economy. First, I show that employment declines are concentrated in bank dependent firms, indicating an important role for business credit in explaining the losses. Second, I demonstrate that though bank shocks result in notable nontradable employment declines, they mostly materialize after the recession. Before these declines occur, exposed counties experience falling wages and rising household loan delinquencies. This timing suggests weaker demand in exposed counties reflects deterioration in the financial standing of households more so than a reduction in household credit.

5.1 Business Lending

If the relationship between employment growth and bank exposure to real estate shocks reflects a contraction in the supply of credit to local businesses, then there should be disproportionately large employment declines for more bank dependent firms. I provide evidence this is the case using three different industry-based measures of bank dependence. I then show that bank shocks additionally have larger effects on employment at young firms.

Table 4 repeats the primary analysis in the paper, separately analyzing employment growth in high and low bank dependence industries. Each pair of columns presents the estimated effects of bank shocks on employment growth for these industries using one of the three industry classifications discussed in Section 2.3. Every specification controls for local house price appreciation and 2-digit industry shares.

On balance, the results are supportive of bank dependent firms being more sensitive to bank shocks. However, the results are somewhat noisy and sensitive to the particular bank dependence measure chosen. The first four columns present results for employment growth by dependence on external finance as in Rajan and Zingales (1998). In the OLS specification, I find an elasticity of 0.36 for financially dependent industries, compared to 0.09 for other industries, with the difference being significant at the 5% level. The difference is however muted and insignificant in the IV specification, with coefficients of 0.29 and 0.19 in high and low dependence industries, respectively.

Results are more robust when bank dependence reflects the Berger and Sedunov (2017) sensitivity to bank liquidity creation in Columns 5-8. With this measure, I find elasticities of 0.38 and 0.15 for high and low bank dependence firms in the OLS specification, and elasticities of 0.48 and 0.22 in the IV specification. The more prominent difference across industries may be a consequence of this bank dependence measure directly pertaining to the sensitivity of employment to banking conditions. However, this similarity may come at a cost; if factors besides business credit availability drive employment declines in counties with weak banks, similar factors could also affect the estimates of industry sensitivity to liquidity creation in Berger and Sedunov (2017).

Finally, Columns 9-12 present results when bank dependence reflects the share of firms that reported using bank credit in the Survey of Business Owners. By this measure of bank dependence, there is little difference between high and low dependence industries in the OLS specification. However, differences are much more pronounced in the IV specification, with elasticities of 0.48 and 0.09 for high and low dependence industries, respectively.

Overall, bank dependent industries are found to be over twice as sensitive to bank shocks in four of the six specifications, with the difference from low dependence industries being statistically significant in each of these specifications. In a fifth specification, high dependence industries are still about 50% more responsive to bank shocks, though the results are insignificant. These results hold despite using several rather disparate methods for categorizing industries as bank dependent or not. Thus the balance of evidence points towards employment losses being driven by firms in more bank dependent industries.

Another way to assess whether bank shocks disproportionately affect bank dependent firms is to test for differences in effects for young and mature firms. Young firms tends to be more dependent on banks due to their start up costs, opacity, and lack of capital market financing (Black and Strahan, 2002; Cetorelli and Strahan, 2006; Robb and Robinson, 2014). As such, they should experience larger employment declines when local banks contract credit.

The findings in Table 5 suggest that bank shocks disproportionately affect employment growth in younger firms. Similar to the analysis in Table 4, each pair of columns presents estimates of the effects of bank shocks on young (10 years old or younger) and mature (over 10 years old) firms. In the first pair of columns, young firm employment is found to have an elasticity of 0.32 with respect to banks shocks, compared to an elasticity of 0.11 for mature firms. Local house price shocks, in contrast, have employment effects that are similar across firm ages. Differences are smaller in the IV specification, where employment in young and mature firms are estimated to have elasticities of 0.36 and 0.22, respectively.

Overall, the findings by firm age are suggestive but not definitive. Compared to mature firms, young firms are estimated to be about three times more sensitive to bank shocks in the OLS specification, and 50% more sensitive in the the IV specification. However, the results are noisy and far from significant. This fact is due in large part to high standard errors for young firms, where employment growth is very volatile. Additionally, these results may be weakened because the measure of bank exposure discounts banks that focus more on lending to young firms. First, IV estimates reflect shocks to larger, geographically dispersed banks, which are disadvantaged in serving less established firms (Berger et al., 2005). Second, using 2002 market shares means discounting new entrants, which have a comparative advantage in lending to new borrowers (Marquez, 2002).[14]

[14]When a new bank enters a market, they face an adverse selection problem due to the information advantage of incumbent banks. This problem is mitigated with new borrowers.

The results in the last four columns indicate these factors may be contributing to the lack of significance. The estimated differences between young and mature firms are about twice as large when bank exposure to house price appreciation is measured using 2006 market shares. The specification likely best suited to capture the banks lending to young firms—when bank exposure reflects 2006 market shares and isn't restricted to geographically dispersed banks—produces elasticities of 0.51 and 0.08 for young and mature firms, with the difference significant at the 1% level.

In short, counties whose banks were exposed to real estate losses in other markets suffered large employment declines. These employment declines were most concentrated in bank dependent firms, suggesting that a contraction in business credit drove much of the decline.

5.2 Aggregate Demand

5.2.1 Effects on Nontadable Employment

In addition to affecting firms that are more reliant on bank finance, credit supply shocks may also have disproportionate effects on firms that are reliant on local demand. First, changes in the supply of consumer credit can affect the spending of local households (Haltenhof et al., 2014; Gropp et al., 2014). Second, credit supply shocks can affect demand due declining wages and employment at bank dependent firms feeding back into local consumption (Kehoe et al., 2016; Huber, 2018). To test for such effects, I follow Mian and Sufi (2014) and analyze the response of nontradable employment to bank shocks. Prior research has shown that falling house prices reduce the wealth of households, causing a drop in consumption (Mian et al., 2013; Kaplan et al., 2017) and declines in nontradable employment in worse hit areas (Mian and Sufi, 2014; Giroud and Mueller, 2017). I show that bank credit also plays a role in these dynamics.

Table 6 presents estimates of how local house price declines and bank exposure to house price declines affect nontradable employment. Overall, there is little evidence of bank shocks having a disproportionate effect on nontradable employment. The first two columns, where the variables of interest are included separately, show that bank shocks have smaller effects on nontradable employment than total employment, while local house price shocks have similar effects on the two employment groups. Most of the relationship between bank shocks and nontradable employment growth between 2007 and 2010 seems to be due to the effects of local house price shocks. Controlling for local house price appreciation causes the coefficient on $\Delta ln(HP)$(local banks) to fall from 0.31 to 0.13 and become insignificant. The predicted effects of bank shocks on nontradable employment are thus only about half of what was found for overall employment, where I found a coefficient of 0.25 when controlling for local house price appreciation. In Column 4, bank shocks are found to matter a bit more when instrumenting with shocks from distant counties, but effects are still insignificant and well below what was found for overall employment.

As might be expected given this weaker relationship, bank shocks account for a smaller portion of the relationship between house price shocks and nontradable employment growth than they did employment growth overall. Controlling for $\Delta ln(HP)$(local banks) causes the coefficient on $\Delta ln(HP)$ to decline from 0.154 to 0.126 or 0.118 in the OLS and IV specifications, respectively. Thus bank exposure is found to account for roughly a fifth of the relationship between between nontradable employment growth and house price shocks, compared to over a third for overall employment.

The last five columns present similar analysis, but with local real estate shocks accounted for with the change in households' net worth due to house price shocks as in Mian and Sufi (2014). This measure accounts for both the severity of house price declines and the leverage of local households and thus should better reflect the wealth effects of house price changes. The predicted effects of bank exposure are more robust in these specifications, with $\Delta ln(HP)$(local banks) remaining economically and statistically significant when controlling for local housing wealth shocks. However, this difference is attributable to the change in sample to counties where housing wealth shock data is available. The predicted effect of bank shocks on nontradable employment is still somewhat smaller than equivalent analysis with total employment.[15] Bank shocks are found to account for about a third of the relationship between housing net worth shocks and nontradable employment growth, which is still somewhat smaller than what is found for overall employment growth.

Overall, there is nothing to indicate that bank shocks had particularly large effects on local demand during the Great Recession. While nontradable employment declined in counties with weaker banks, this decline was smaller than for overall employment. This result is more consistent with nontradable firms reducing employment due to financial constraints than it is with them reducing employment because of tight consumer credit conditions weakening demand.

5.2.2 Dynamics

Although bank shocks did not disproportionately contribute to nontradable employment declines during the recession, Figure 4 shows that there were large effects after the recession ended. The figure plots how the effect of bank exposure to falling house prices varies over time for tradable and nontradable industries. Immediately after house prices start to fall, exposed counties experience declines in tradable employment that are larger than for nontradable employment. The largest effects of bank exposure on nontradable employment instead are found to occur between 2010 and 2012, during which time tradable employment starts recovering. Thus bank shocks do dramatically affect nontradable employment, but with more of a lag than direct house price shocks.

This timing influences how much estimated effects of house price shocks are biased when not controlling for bank shocks. Figure A2 plots the coefficient on $\Delta ln(HP)$ in specifications with and without controls for bank exposure over time. For growth up until 2009 or 2010, the bias is fairly modest, indicating that findings pertaining to nontradable employment growth during the recession, such as Mian and Sufi (2014), predominantly reflect the effects

[15] The specification controlling for housing net worth shocks (Column 8) is repeated with total employment growth as the dependent variable in Column 6 of Table A2. I find a coefficient of 0.53 on $\Delta ln(HP)$(local banks) when total employment growth is the dependent variable, compared to only 0.25 for nontradable employment growth.

of housing wealth shocks rather than bank losses. However, failure to control for bank exposure becomes more problematic later in the sample. Thus the adverse effects of bank shocks on local demand seem to contribute to the significant persistence of employment losses in weak housing markets (Yagan, 2019), even if they were not a primary contributer to the initial declines.

5.2.3 Effects on Wages and Delinquency

One possible explanation for the delayed timing with which bank shocks affect nontradable employment is that these effects are a consequence of the initial contraction in labor demand. Bank shocks have been shown to affect employment and earnings, which could affect the desired consumption of local households. If there is a delay with which these labor demand shocks filter through to aggregate demand, this would cause delayed effects on nontradable employment. For example, Ganong and Noel (2019) shows that the largest effects of unemployment on nondurable spending occur at the exhaustion of unemployment benefits. With the American Recovery and Reinvestment Act extending the duration of unemployment insurance benefits to up to 99 weeks, it is possible that much of the effects of unemployment shocks could be felt years after the rise in unemployment.

If the delayed effects of bank shocks are due to the general equilibrium effects of a credit supply shock, we should see a deterioration in households' financial conditions precede the decline in nontradable employment. Figure 2 already showed that employment and average earnings fell in counties with more exposed banks. In order to elaborate on how households were affected by the credit supply shock, Table 7 investigates how bank shocks and house price shocks affect various types of earnings, while Figure 5 plots how these variables affect the delinquency rate for credit cards and mortgages.

Table 7 shows that a 10% shock to banks results in about a 1.1% decline in average earnings between 2007 and 2010. Effects are over twice as large for new hires, meaning that even if wages are sticky for a particular job, wages will still respond to shocks through the formation of new jobs. While this reduction in the marginal cost of hiring additional workers may have facilitated new hiring for less adversely affected firms, this also means workers being rehired at lower wages and thus needing to reduce spending to accommodate. Earnings are similarly about twice as responsive for young firms as for mature firms, indicating that financial constraints for firms likely explain the wage declines. Effects are larger in IV specifications than in the corresponding OLS specifications, so the effects do not reflect spillovers from house price declines in nearby counties.

Figure 5 shows that bank shocks also affected the ability of households to repay loans. Households in counties with more exposed banks are more likely to fall behind on mortgage and credit card payments, with delinquency rates rising from 2007 and 2011. Similar to what was found for nontradable employment, these effects occur later than the effects of local house price shocks. While delinquency rates in weak housing markets started to retrace between 2009 and 2011, delinquency rates in counties with exposed banks continued to deteriorate through 2011.

To recap, nontradable employment responds quickly to changes in local house prices, while the largest effects of bank shocks are more delayed. Prior to the largest declines in nontradable employment, counties experience declines in wages and employment, resulting in rising delinquencies on household loans. Taken together, these findings indicate that bank shocks do affect demand, but this predominantly is a byproduct of the initial shock to the demand for labor at bank dependent firms.[16] This is consistent with Kehoe et al. (2016), which shows that a credit supply shock causes a reallocation from the nontradable sector as a decline in labor demand reduces demand for local goods, and Huber (2018) which finds that a bank credit supply shock has both a direct effect on firms borrowing from a bank, but also an indirect effect on nontradable firms in areas where the bank operates due to lower

[16] Note that this should not be taken to mean that consumer credit does not affect demand in general. For one, credit cards are disproportionately provided by large national banks, and thus credit may not be very sensitive to differences in the health of local banks. Additionally, the availability of mortgage credit may affect the economy through house prices, in which case controlling for local house price growth would cause me to understate the effects of bank shocks.

aggregate demand.[17]

6 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 and 2010. Banks that were exposed to falling house prices in different (and distant) counties reduced lending locally, resulting in falling employment. Employment declines in counties with exposed banks were concentrated in bank dependent firms, indicating the results were due to a contraction in business credit.

These findings are important for understanding geographic differences in the severity of 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.

These findings also have important implications for evaluating the policy responses to the crisis. Although some of the economic ramifications of house price shocks can be similar whether they act through consumer spending or bank balance sheets, the appropriate policy prescriptions can differ substantially. For example, a controversial provision in the Helping Families Save Their Homes Act of 2009 would have empowered bankruptcy judges to reduce the principle owed on a mortgage.[18] If household debt was suppressing demand but banks were unconstrained, enabling these "cram-downs" might have supported household spending and boosted the economy. However, the evidence that activity was constrained by the ability of banks to intermediate raises questions about the effectiveness of such a policy. Forced

[17]While the qualitative results are similar to Huber (2018), the estimated magnitude of the aggregate demand effect is smaller. In Huber (2018), nontradable employment was about 40% more sensitive to a lending contraction than employment overall. In contrast, this paper estimates that nontradable employment is at least 25% less sensitive to bank shocks than overall employment, with the relative difference in effects depending on the time elapsed since the shock.

[18]This provision was dropped in the Senate.

principal reductions could have exacerbated bank losses and caused a worse credit crunch. In general, that bank losses played an important role in explaining the employment losses in weak housing markets justifies the emphasis that policy makers put on providing capital and liquidity to the banking sector.

Finally, the large estimated effect of bank losses on employment provides a justification for many of the post-crisis reforms to the banking sector. House price changes need not affect the economy to the same extent that they did during the Great Recession. With better capitalized banks, or more conservatively unwritten loans, falling house prices would have less of an effect on banks' lending capacity and thus have smaller adverse effects on the economy.

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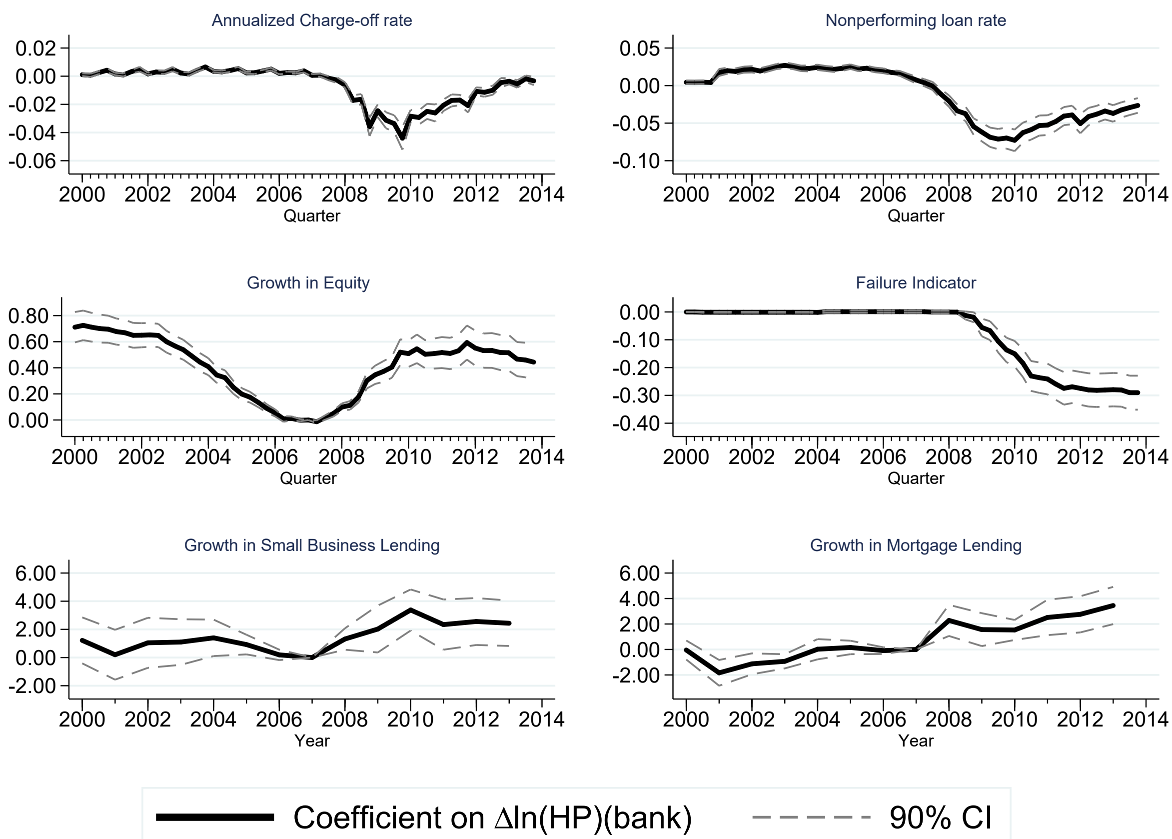

Figure 1: Real Estate Shocks and Bank Performance

Notes: This figure reports estimates of $\{\beta_t\}$ from one of the following specifications:

$$y_{b,t} = \alpha_t + \beta_t \Delta ln(HP)(\text{bank})_b + \epsilon_{b,t} \qquad \text{(Charts 1-4)}$$
$$y_{b,c,t} = \alpha_{c,t} + \beta_t \Delta ln(HP)(\text{bank})_b + \epsilon_{b,c,t} \qquad \text{(Charts 5 \& 6)}$$

In the first two rows, coefficients are estimated for each quarter from 2000:Q1 to 2013:Q4 for the following bank-quarter dependent variables: charge-off rate of loan portfolio (top-left), nonperforming loan rate of loan portfolio (top-right), equity relative to 2007:Q1 $\left(\frac{ln(\text{equity})_{b,t}}{ln(\text{equity})_{b,07:Q1}}\right)$ (middle-left), and an indicator for whether a bank failed by a given quarter (middle-right). In the bottom row, regressions are estimated each year for bank-county origination data and specifications include county fixed effects. The dependent variables are bank-county originations of loans to firms with less than \$1 million in revenue (bottom-left), and originations of mortgages that were held on balance sheet (bottom-right), both relative to 2007. Dashed lines report the 90% confidence intervals. Standard errors for the bottom charts are clustered by bank.

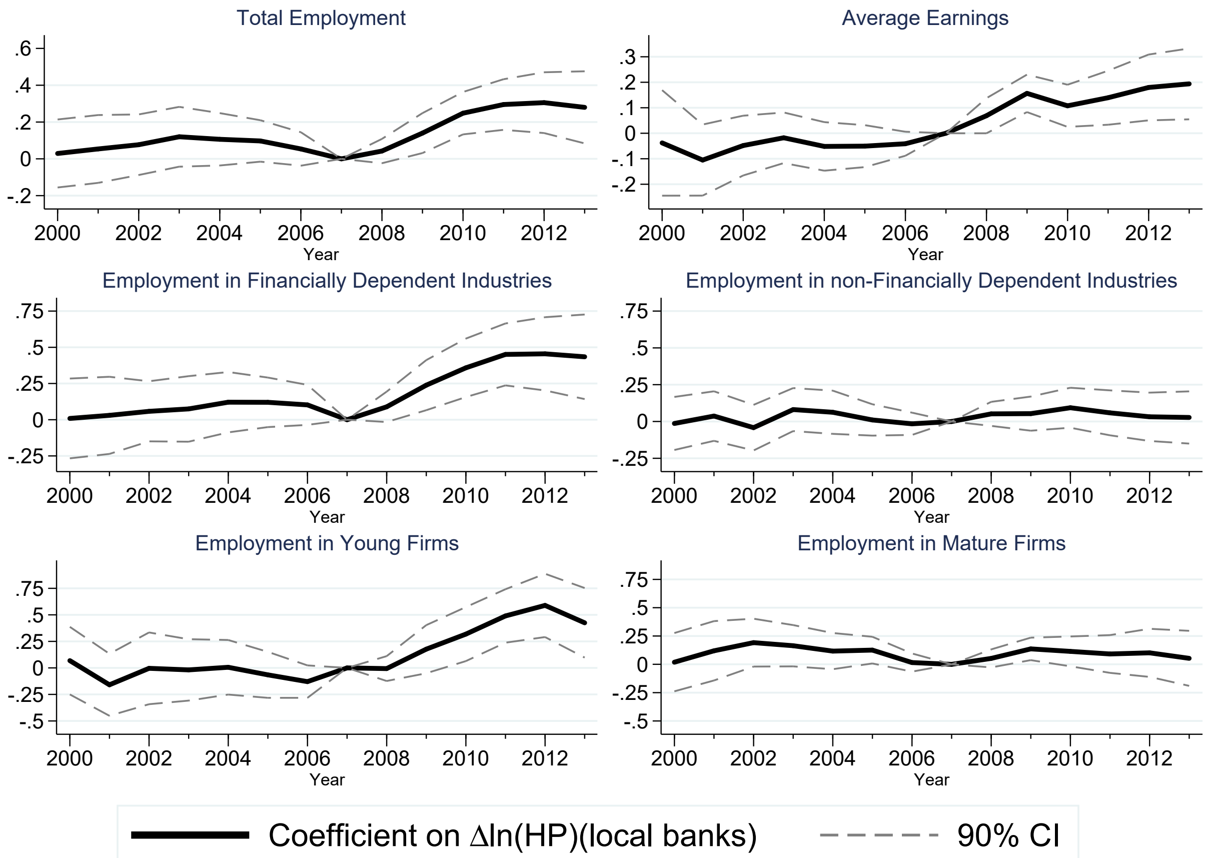

Figure 2: Bank Health and Employment Growth

Notes: This figure reports estimates of $\{\beta_t\}$ from the specification:

$$ln(\frac{y_{c,t}}{y_{c,07}}) = \beta_t \Delta ln(HP)(\text{local banks})_c + \gamma_t \Delta ln(HP)_c + \zeta_t' \mathbf{X_c} + \epsilon_{\mathbf{c},\mathbf{t}}.$$

Coefficients are estimated for each year from 2000 to 2013 for the following county level dependent variables: total employment (top-left), average earnings (top-right), employment in financially dependent industries (middle-left), employment in non-financially dependent industries (middle-right), employment in firms that are 10 years old or less (bottom-left), and employment in firms that are over 10 years old (bottom-right). $\mathbf{X_c}$ includes controls for the share of county employment in each 2-digit industry. Dashed lines report 90% confidence intervals, based on standard errors that are clustered by state.

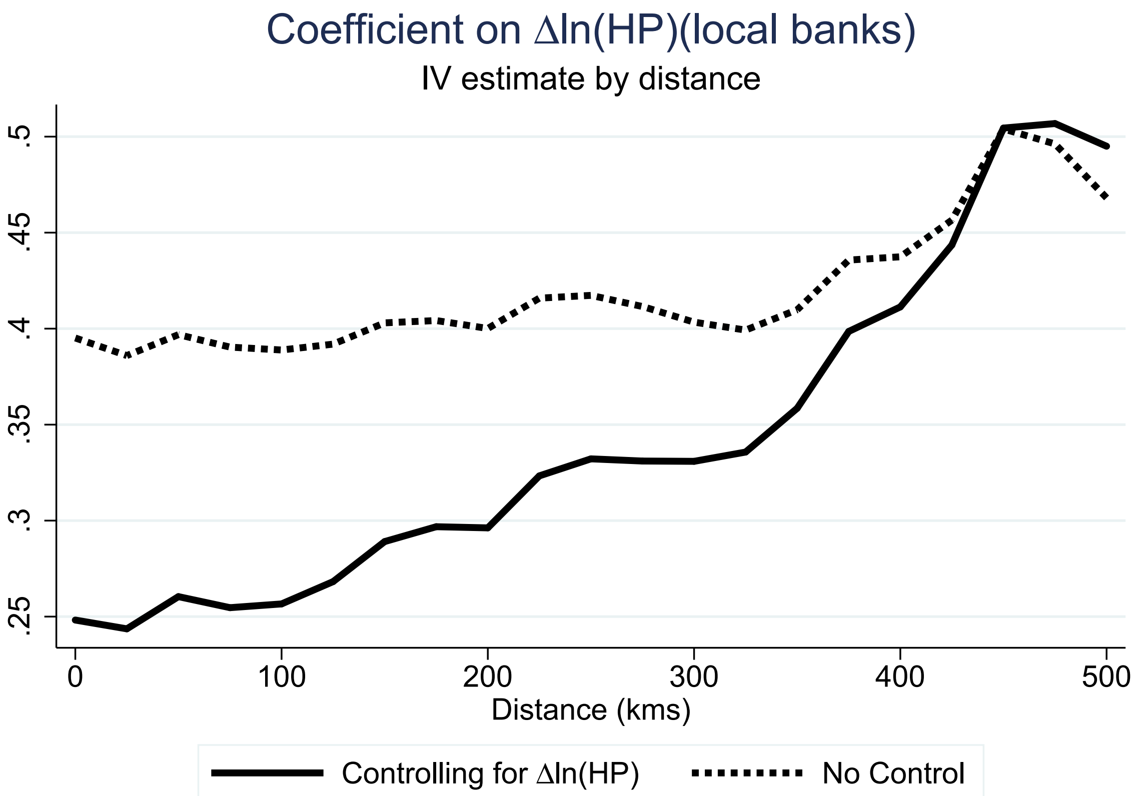

Figure 3: Effect of Bank Health: Distance Based Instruments

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 various 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 plotted on the y-axis, with $d = 0$ plotting the OLS estimate. The solid line plots the coefficient on $\Delta ln(HP)$(local banks) for the specification controlling for $\Delta ln(HP)$, while the dotted line plots the coefficient when omitting the control. Each specification additionally controls for the share of employment in 2-digit industries.

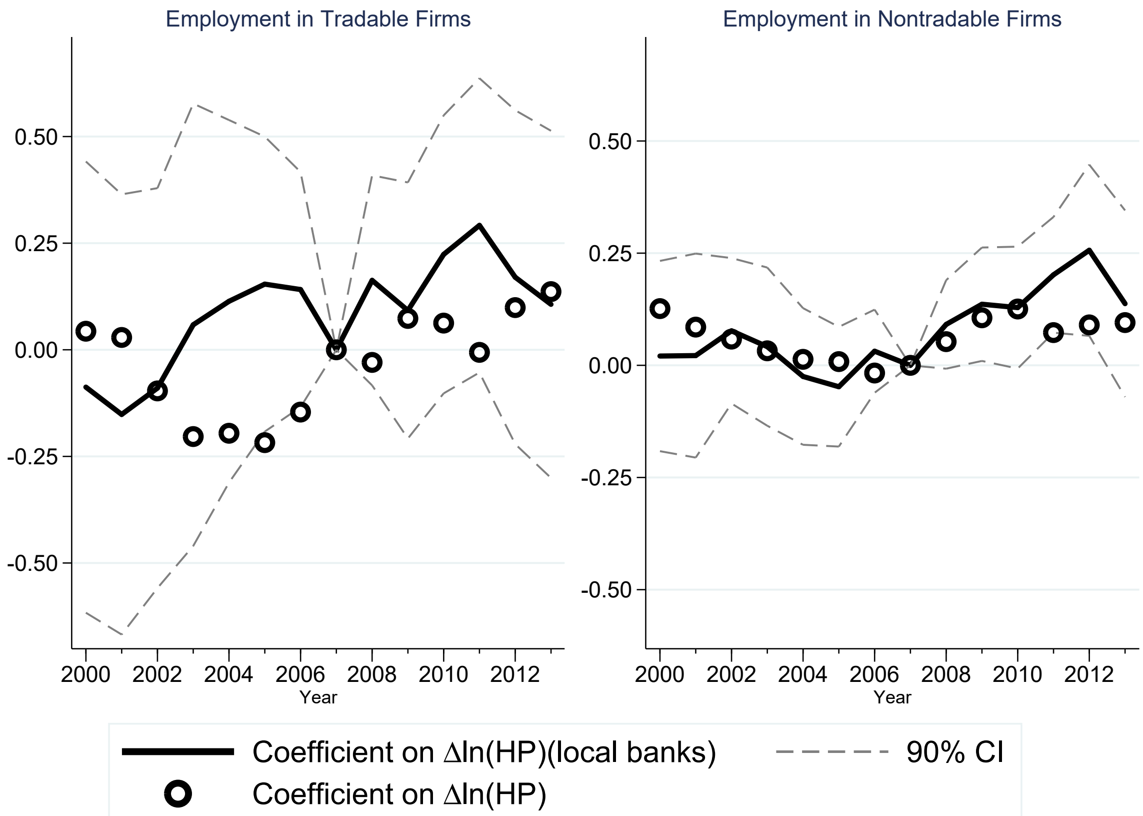

Figure 4: Bank Health and Employment, by Industry Tradability

Notes: This figure reports estimates of $\{\beta_t\}$ and $\{\gamma_t\}$ from the specification:

$$ln(\frac{y_{c,t}}{y_{c,07}}) = \beta_t \Delta ln(HP)(\text{local banks})_c + \gamma_t \Delta ln(HP)_c + \zeta_t' \mathbf{X_c} + \epsilon_{\mathbf{c},\mathbf{t}}.$$

Coefficients are estimated for each year from 2000 to 2013 for employment in tradable industries (left) and employment in nontradable industries (right). Dashed lines report 90% confidence intervals for $\{\hat{\beta}_t\}$, based on standard errors that are clustered by state. 4-digit NAICS industries are categorized as in Mian and Sufi (2014); retail and restaurant-related industries are categorized as nontradable while industries appearing in global trade data are tradable.

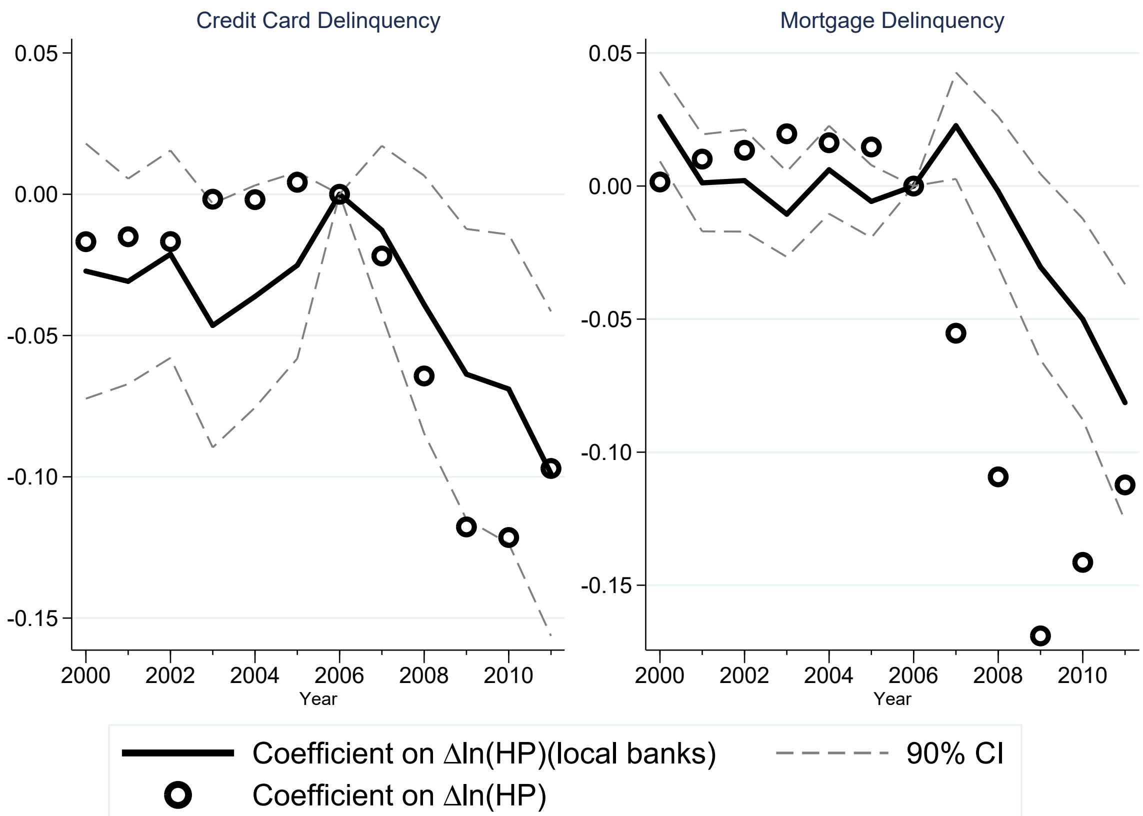

Figure 5: Bank Health and Household Loan Delinquencies

Notes: This figure reports estimates of $\{\beta_t\}$ and $\{\gamma_t\}$ from the specification:

$$y_{c,t} - y_{c,06} = \beta_t \Delta ln(HP)(\text{local banks})_c + \gamma_t \Delta ln(HP)_c + \zeta_t' \mathbf{X_c} + \epsilon_{\mathbf{c,t}}.$$

Coefficients are estimated for each year from 2000 to 2011, where $y_{c,t}$ is the delinquency rate for credit card loans (left) or mortgages (right) in the fourth quarter of county c in year t. $\mathbf{X_c}$ includes controls for the share of county employment in each 2-digit industry. Dashed lines report 90% confidence intervals for $\{\hat{\beta}_t\}$, based on standard errors that are clustered by state. Delinquency rates come from the NY Fed's Consumer Credit Panel.

Table 1: Summary Statistics

	Mean	Standard Deviation	Percentile 10th	50th	90th	Obs
Bank-County Origination Growth: 2004-2006 to 2008-2010						
Loans to Small Businesses	-0.420	0.804	-1.313	-0.370	0.405	7207
Retained Mortgages	-0.217	0.897	-1.243	-0.184	0.754	12787
County Real Estate Shocks: 2006 to 2009						
$\Delta ln(HP)$(local banks)	-0.127	0.047	-0.182	-0.128	-0.067	2402
$\Delta ln(HP)$	-0.017	0.121	-0.146	0.010	0.083	2402
ΔNetWorth	-0.065	0.085	-0.172	-0.039	0.003	942
County Employment Growth: 2007 to 2010						
Total	-0.078	0.087	-0.175	-0.074	0.019	2402
Young Firms	-0.205	0.188	-0.413	-0.197	-0.002	2382
Mature Firms	-0.049	0.111	-0.170	-0.046	0.064	2388
Financially Dependent	-0.083	0.142	-0.241	-0.083	0.074	2402
Non-Financially Dependent	-0.070	0.119	-0.205	-0.061	0.055	2402
Liquidity Sensitive	-0.156	0.166	-0.351	-0.142	0.014	2402
Non-Liquidity Sensitive	-0.020	0.087	-0.105	-0.020	0.070	2402
High Bank Use	-0.119	0.119	-0.257	-0.114	0.010	2402
Low Bank Use	-0.013	0.134	-0.132	-0.013	0.117	2402
Nontradable	-0.045	0.111	-0.160	-0.050	0.082	2402
Tradable	-0.176	0.329	-0.541	-0.148	0.123	2399

Notes: "Young firms" are firms that are 10 years old or younger. "Financially dependent" firms are those in 3-digit industries where capital expenditures exceed cash flows for the median Compustat firm (Rajan and Zingales, 1998). "Liquidity Sensitive" firms are those in 2-digit industries that are more sensitive to bank liquidity creation (Berger and Sedunov, 2017). "High Bank Use" industries are above the median 2-digit industry in the share of firms reporting using banks for startup or expansion capital (Smolyansky, 2019). "Nontradable" and "tradable" industries are defined using the 4-digit classification in Mian and Sufi (2014).

Table 2: Bank-County Loan Growth

Dep. Variable	Growth in Loans to Small Firms				Growth in Mortgage Originations			
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)	1.32**	1.37**	1.50**	2.13**	1.97**	1.57**	1.55**	2.03**
	(0.44)	(0.48)	(0.47)	(0.66)	(0.42)	(0.49)	(0.53)	(0.77)
$\Delta ln(HP)$		-0.11				0.67**		
		(0.15)				(0.22)		
R^2	0.035	0.035	0.324	0.113	0.070	0.076	0.264	0.097
Obs.	7059	7059	7059	22809	11542	11542	11542	52802
Industry Controls?	Yes	Yes			Yes	Yes		
County FE?			Yes	Yes			Yes	Yes

Notes: This table reports coefficients from regressions of bank-county loan origination growth on bank exposure to local house price appreciation. The dependent variable is the growth in lending to businesses with under $1 million in annual revenue (Columns 1-4), or the growth in retained mortgage originations (Columns 5-8). Growth is from the precrisis period (2004-2006) to crisis period (2008-2010). In addition to the bank level real estate shock in every specification, I include county house price appreciation (Columns 2 & 6), or county fixed effects (Columns 3, 4, 7 & 8) to control for demand. Specifications without county fixed effects additionally control for the share of county employment in each 2-digit industry. 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. Observations are dropped if a bank acquired branches in that county from another bank during the crisis. Standard errors, in parentheses, are clustered by bank. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 3: Effect of Bank Shocks on Employment Growth

Dep. Variable	Employment Growth: 2007-2010							
Sample	All Counties						MSA	
Specification	OLS			IV >250km		IV Saiz	OLS	IV >250km
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)$(local banks)	0.40**		0.25**	0.42**	0.33**	0.28**	0.30**	0.30$^+$
	(0.05)		(0.07)	(0.08)	(0.11)	(0.09)	(0.10)	(0.17)
$\Delta ln(HP)$		0.16**	0.10**		0.08*	0.09*	0.08$^+$	0.08
		(0.03)	(0.04)		(0.04)	(0.04)	(0.04)	(0.05)
R^2	0.172	0.173	0.184	0.172	0.182	0.183	0.255	0.255
Obs.	2402	2402	2402	2402	2402	2402	1093	1093
F				115	141	74		74
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. $\Delta ln(HP)$ 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. The first six columns use the full sample of counties with data on house price movements, while the last two restrict the sample to counties in an MSA. Bank exposure to house price appreciation is instrumented for using the exposure to house price appreciation in counties more than 250km away in Columns 4, 5 & 8, and with bank exposure to markets with an elastic housing supply in Column 6. Standard errors, in parentheses, are clustered by state. $^+$,*,** indicate significance at 10%, 5% and 1%.

Table 4: Effects by Bank Dependence

Dep. Variable	Employment Growth: 2007-2010											
Dependence Measure	Rajan & Zingales (1998)				Berger & Sedunov (2017)				Smolyansky (2019)			
Specification	OLS		IV		OLS		IV		OLS		IV	
Financial Dependence	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
$\Delta ln(HP)$(local banks)	0.36**	0.09	0.29$^+$	0.19	0.38**	0.15*	0.48**	0.22**	0.25**	0.22*	0.48**	0.09
	(0.12)	(0.08)	(0.17)	(0.13)	(0.10)	(0.06)	(0.16)	(0.08)	(0.07)	(0.10)	(0.14)	(0.13)
$\Delta ln(HP)$	0.15**	0.12*	0.16**	0.10$^+$	0.18**	0.08**	0.15**	0.07*	0.16**	0.06	0.11*	0.09*
	(0.03)	(0.05)	(0.04)	(0.05)	(0.06)	(0.03)	(0.06)	(0.03)	(0.05)	(0.04)	(0.06)	(0.04)
R^2	0.115	0.128	0.114	0.128	0.107	0.058	0.106	0.057	0.136	0.056	0.131	0.055
Obs.	2402	2402	2402	2402	2402	2402	2402	2402	2402	2402	2402	2402
Difference	.265*		.093		.23*		.26$^+$		.034		.39*	
	(.131)		(.172)		(.102)		(.156)		(.1)		(.195)	
Industry Controls?	Yes	Yes	Yes	Yes	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. Odd columns report results for industries with high bank dependence and even columns report results for industries with low bank dependence. Three different bank dependence measures are used: external financial dependence as in Rajan and Zingales (1998) (Columns 1-4), industry sensitivity to bank liquidity creation as in Berger and Sedunov (2017) (Columns 5-8), and industry reliance on banks for startup or expansion capital as in Smolyansky (2019) (Columns 9-12). Every specification controls for local house price appreciation and the share of employment in each 2-digit NAICS industry. IV specifications instrument for bank exposure using the exposure of banks to house price appreciation in counties more than 250km away. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 5: 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)	0.32*	0.11	0.36	0.22^{+}				
	(0.15)	(0.08)	(0.28)	(0.13)				
$\Delta ln(HP)$(2006 banks)					0.51**	0.08	0.53^{+}	0.26^{+}
					(0.15)	(0.09)	(0.29)	(0.15)
$\Delta ln(HP)$	0.11	0.12**	0.10	0.10*	0.08	0.13**	0.07	0.09*
	(0.08)	(0.03)	(0.09)	(0.04)	(0.08)	(0.04)	(0.09)	(0.04)
R^2	0.042	0.145	0.042	0.144	0.045	0.144	0.045	0.142
Obs.	2382	2388	2382	2388	2382	2388	2382	2388
Difference	.204		.135		.435**		.268	
	(.179)		(.316)		(.159)		(.36)	
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. 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. Bank exposure to house price appreciation reflects 2002 mortgage lending in the first four columns (as in the rest of the paper), and 2006 mortgage lending in the last four columns. IV specifications instrument for bank exposure using the exposure of banks to house price appreciation in counties more than 250km away. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table 6: Effect on Nontradable Employment

Dep. Variable	Employment Growth: 2007-2010								
Specification	OLS			IV	OLS				IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\Delta ln(HP)$(local banks)	0.31**		0.13	0.16	0.47**		0.23*	0.25**	0.30*
	(0.07)		(0.08)	(0.13)	(0.06)		(0.10)	(0.09)	(0.14)
$\Delta ln(HP)$		0.15**	0.13**	0.12**			0.11*		
		(0.02)	(0.04)	(0.04)			(0.04)		
ΔNetWorth						0.29**		0.20**	0.19*
						(0.05)		(0.06)	(0.07)
R^2	0.041	0.050	0.052	0.052	0.104	0.112	0.117	0.121	0.120
Obs.	2402	2402	2402	2402	942	942	942	942	942
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of nontradable (restaurant and retail) 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, while $\Delta NetWorth$ controls for the percentage change in households' net worth due to house price shocks. Every specification also controls for the share of employment in each 2-digit NAICS industry. Columns 5-9 restrict the sample to counties where data on $\Delta NetWorth$ is available. Bank exposure to house price appreciation is instrumented for using the exposure to house price appreciation in counties more than 250km away in Columns 4 & 9. The variable $\Delta NetWorth$, and the classification of nontradable industries, come from Mian and Sufi (2014). Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table 7: Effect on Average Earnings

Dep. Variable	Earnings Growth: 2007-2010							
Specification	OLS				IV			
Sample	All	New Hires	Young	Mature	All	New Hires	Young	Mature
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)$(local banks)	0.11*	0.24*	0.25**	0.12$^+$	0.27*	0.47**	0.36**	0.29*
	(0.05)	(0.09)	(0.07)	(0.06)	(0.11)	(0.15)	(0.13)	(0.13)
$\Delta ln(HP)$	0.07*	0.01	0.07*	0.06*	0.03	-0.04	0.05	0.03
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.05)	(0.04)	(0.03)
R^2	0.106	0.027	0.059	0.078	0.098	0.024	0.058	0.073
Obs.	2388	2388	2382	2388	2388	2388	2382	2388
Industry Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports coefficients from regressions of growth in average earnings from 2007 to 2010 on the exposure of local banks to house price appreciation. Every specification controls for local house price appreciation and the share of employment in each 2-digit NAICS industry. Earnings pertains to all stable (full quarter) jobs in Columns 1 & 5, new hires in Columns 2 & 6, jobs at young (10 years old or less) firms in Columns 3 & 7, and jobs at mature firms in Columns 4 & 8. Equations are estimated by OLS in the first four columns, 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%.

Appendix

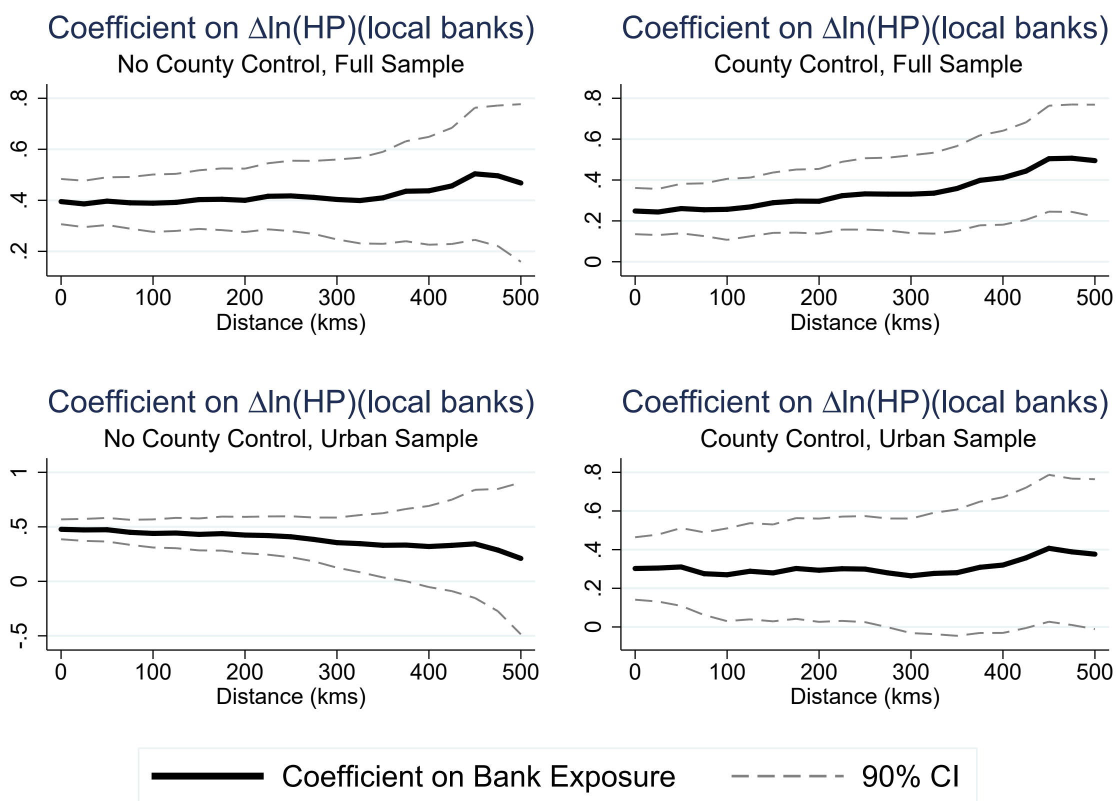

Figure A1: Effect of Bank Health: Distance Based Instruments

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 various 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 90% confidence interval is plotted on the y-axis, with $d = 0$ plotting the OLS estimate. The top two charts use the full sample of US counties, while the bottom two restrict the sample to counties in an MSA. The left charts do not control for local house price appreciation, while the right charts do. Each specification additionally controls for the share of employment in 2-digit industries. Standard errors are clustered by state.

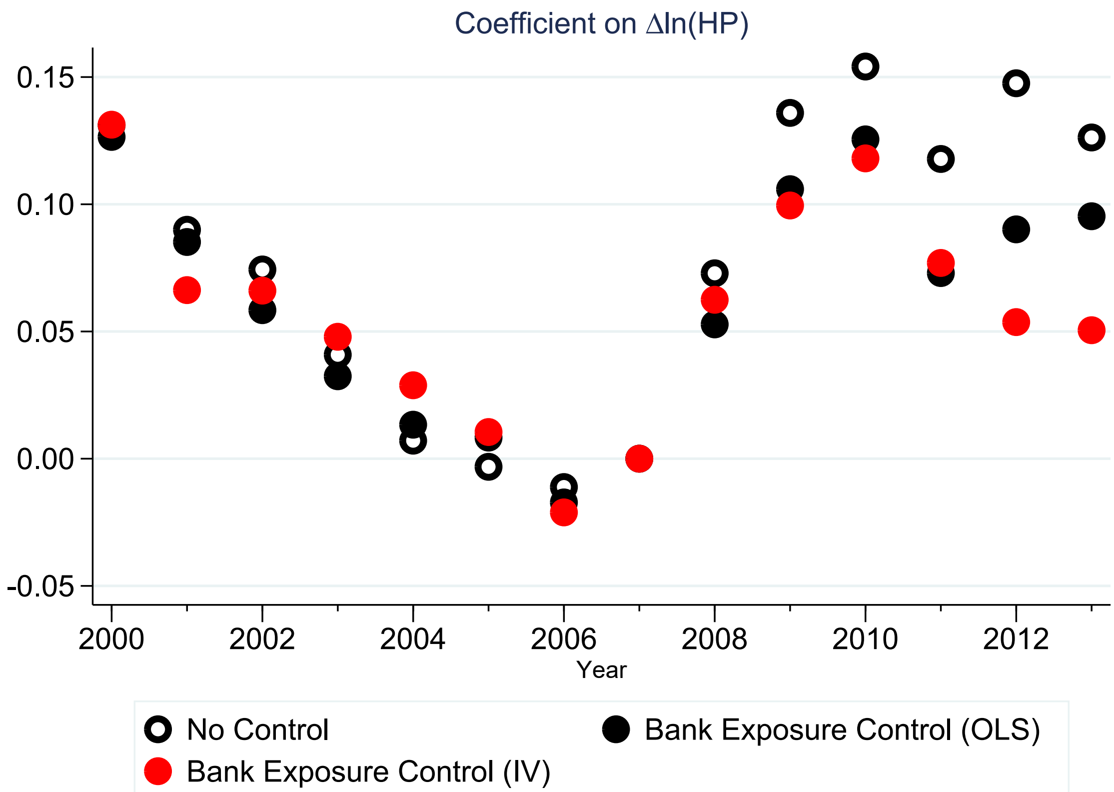

Figure A2: Effect of Controlling for Bank Exposure

Notes: This figure reports estimates of $\{\gamma_t\}$ from the specification:

$$ln(\frac{y_{c,t}}{y_{c,07}}) = \beta_t \Delta ln(HP)(\text{local banks})_c + \gamma_t \Delta ln(HP)_c + \zeta_t' \mathbf{X_c} + \epsilon_{\mathbf{c,t}}$$

where $y_{c,t}$ is nontradable employment in county c in year t. Empty dots show the coefficient on $\Delta ln(HP)$ for a given year in the specification omitting $\Delta ln(HP)$(local banks), while the solid black and red dots show the coefficient on $\Delta ln(HP)$ when estimating the above equation with OLS and IV, respectively. In the latter, bank exposure is instrumented for with the exposure of banks to house price appreciation in counties more than 250km away. Each specification additionally controls for the share of employment in 2-digit industries. Nontradable employment is defined by 4-digit NAICS industry codes as in Mian and Sufi (2014).

Table A1: Effect of Bank Shocks on Employment Growth, By Bank Size

Dep. Variable	Employment Growth: 2007-2010			
Bank Sample	All Banks	>\$50 million	<\$1 billion	\$50 million-\$1 billion
	(1)	(2)	(3)	(4)
$\Delta ln(HP)$(local banks)	0.25**	0.21**	0.26**	0.20**
	(0.07)	(0.08)	(0.04)	(0.05)
$\Delta ln(HP)$	0.10*	0.12**	0.06^{+}	0.10**
	(0.04)	(0.04)	(0.03)	(0.04)
R^2	0.183	0.179	0.189	0.183
Obs.	2401	2401	2401	2401
Industry Controls?	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. $\Delta ln(HP)$ 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. Each column uses a different sample of banks when computing the exposure of local lenders to house price appreciation: $\Delta ln(HP)$(local banks) is the average exposure to house price appreciation of all lender in Column 1, lenders with over \$50 million in 2002 home purchase originations in Column 2, lenders with under \$1 billion in 2002 home purchase originations in Column 3 and lenders with 2002 home purchase originations between \$50 million and \$1 billion in Column 4. Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table A2: Bank Shocks and Employment Growth, Additional Controls

Dep. Variable	Employment Growth: 2007-2010							
Specification	OLS				IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ln(HP)$(local banks)	0.25**	0.32**	0.26**	0.22**	0.33**	0.53**	0.35**	0.30**
	(0.07)	(0.08)	(0.07)	(0.07)	(0.11)	(0.18)	(0.11)	(0.11)
$\Delta ln(HP)$	0.10**		0.10*	0.12**	0.08*		0.08^{+}	0.10*
	(0.04)		(0.04)	(0.04)	(0.04)		(0.04)	(0.04)
ΔNetWorth		0.16*				0.09		
		(0.06)				(0.08)		
Subprime Share			-0.07				-0.08^{+}	
			(0.05)				(0.05)	
Mortgage Delinquency				0.05				0.05
				(0.10)				(0.10)
R^2	0.184	0.287	0.188	0.191	0.182	0.276	0.186	0.190
Obs.	2402	942	2402	2097	2402	942	2402	2097
F					141	95	146	125
β only $\Delta ln(HP)$ ctrl.	0.25	0.26	0.25	0.22	0.33	0.55	0.33	0.30
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 while adding in additional controls relative to the baseline specification in Table 3. Every specification controls for local house price shocks and the share of employment in each 2-digit NAICS industry. Additional controls considered are: the change in household net worth due to house price shocks from Mian and Sufi (2014), the 2006 share of households with a credit score under 660, and the 2008 mortgage delinquency rate. Equations are estimated by OLS in the first four columns, and IV in the remaining columns, instrumenting for bank exposure using the exposure to real estate shocks in counties more than 250km away. For reference, the second to last row reports the coefficient on bank exposure in an equivalent specification for the same sample, but only controlling for local house price appreciation and not the additional control. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.

Table A3: Robustness to Panel Specification

Dep. Variable	Annual Employment Growth (t to $t+1$)				
Specification	OLS			IV	
	(1)	(2)	(3)	(4)	(5)
$\Delta ln(HP)$(local banks)	0.34**		0.26**	0.36**	0.32**
	(0.05)		(0.07)	(0.09)	(0.11)
$\Delta ln(HP)$		0.10**	0.05^{+}		0.04
		(0.02)	(0.03)		(0.03)
R^2	0.174	0.171	0.175	0.174	0.174
Obs.	7206	7206	7206	7206	7206
F				144	174
Year FE	Yes	Yes	Yes	Yes	Yes
Industry Controls?	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 previous year. The dependent variable is the growth in 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 includes year fixed effects and controls for the share of 2006 employment in each 2-digit NAICS industry. The first three columns are estimated using OLS, while the last two 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. Standard errors, in parentheses, are clustered by state. $^{+},^{*},^{**}$ indicate significance at 10%, 5% and 1%.

Table A4: Robustness to Other Real Estate Shocks

Dep. Variable	$100 \times \Delta ln(Employment)_{07\text{-}10}$					
Shock:	$\Delta ln(HP)$	$\Delta NetWorth$	*Mortgage Delinquency*	$\Delta Const\ Emp / Emp_{06}$	$\Delta Permits / Units_{00}$	$Permits_{04\text{-}06} / Units_{00}$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel 1: 2002 Mortgage Lending Weighted						
Shock(local banks)[Z-score]	1.18**	1.03**	-1.60**	1.76**	1.20**	-0.78*
	(0.33)	(0.36)	(0.31)	(0.25)	(0.31)	(0.35)
Shock[Z-score]	1.22**	1.57*	-0.36	0.97**	0.42	-0.02
	(0.45)	(0.60)	(0.23)	(0.26)	(0.27)	(0.25)
Panel 2: 2006 Mortgage Lending Weighted						
Shock(local banks)[Z-score]	1.28**	1.35**	-1.80**	1.90**	1.19**	-0.75*
	(0.35)	(0.37)	(0.37)	(0.24)	(0.29)	(0.34)
Shock[Z-score]	1.15*	1.35*	-0.22	0.87**	0.47+	-0.06
	(0.46)	(0.58)	(0.23)	(0.25)	(0.27)	(0.25)
Panel 3: 2002 Deposit Weighted						
Shock(local banks)[Z-score]	0.34	0.91+	-1.09**	1.67**	1.09**	-0.91*
	(0.49)	(0.50)	(0.41)	(0.30)	(0.34)	(0.39)
Shock[Z-score]	1.64**	1.45+	-0.27	0.41	0.16	0.31
	(0.56)	(0.76)	(0.32)	(0.28)	(0.35)	(0.36)
Panel 4: 2002 Small Business Lending Weighted						
Shock(local banks)[Z-score]	0.62+	0.58	-1.28**	1.73**	1.17**	-0.91*
	(0.34)	(0.38)	(0.24)	(0.30)	(0.27)	(0.37)
Shock[Z-score]	1.44**	1.70**	-0.36	0.99**	0.36	0.10
	(0.44)	(0.62)	(0.22)	(0.22)	(0.31)	(0.27)
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 percentage change in household net worth due to house price declines, (3) the 2008 mortgage delinquency rate, (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 precrisis period (2004-2006) and the crisis period (2008-2010) as a fraction of the 2000 housing stock, and (6) precrisis construction permit issuance as a fraction of the 2000 housing stock. The four panels present results for different data sources to weight banks' exposures to the various real estate shocks: 2002 mortgage lending in Panel 1, 2006 mortgage lending in Panel 2, 2002 deposits in Panel 3, and 2002 small business lending in Panel 4. Real estate shocks and bank exposure measures are standardized to facilitate comparison across the different measures. Standard errors, in parentheses, are clustered by state. $^{+}$,*,** indicate significance at 10%, 5% and 1%.