The Persistent Employment Effects of the 2006-09 U.S. Housing Wealth Collapse*

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Abstract

We show that the housing wealth collapse of 2006-09 had a persistent impact on employment across counties in the US. In particular, localities that had a larger loss in housing net-worth during that period had more depressed employment as late as 2016, without a commensurate population response. The use IV's and controls to identify the causal impact of the wealth shock amplifies those results, leading to an estimate that a 10 percent change in housing net-worth between 2006 and 2009 causes a 4.5 percent decline in local employment by 2016, as compared with a 2006 baseline. We do not find a long-term causal impact of the shock on wages. Sectoral results indicate, however, that the results are unlikely to be purely a result of persistently low demand, since, contrary to the short-run effects, the effect over the longer horizon is less concentrated in the non-tradables sectors and is instead more prominent in the high-skilled services sector.

JEL classification: G01; R23; E24

Keywords: U.S. housing collapse; Housing Net-Worth; Housing wealth; Persistent employment effects; Regional analysis; Local labor markets; Financial crises; Sectoral effects

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1 Introduction

We use regional variation in employment and housing net-worth across U.S. counties and document that U.S. regions where households suffered the largest losses in housing wealth between 2006 and 2009 are also ones in which employment remained most depressed (relative to its prior trend) as late as 2016.[1] By isolating exogenous variation in housing net-worth, we argue that this relationship reflects a long-lasting causal effect of housing wealth on employment at the county level. Our findings contrast with the standard view in macroeconomics that, while household demand shocks could account for short-run fluctuations, long-run movements are better explained by changes in technology or other slow-moving institutional factors.[2] They are more in line with recent work by Coibion et al. (2017) that find large and persistent aggregate U.S. output effects of the financial crisis.

In order to establish the line of causality from regional housing wealth to regional employment changes, we build on the seminal contribution of Mian and Sufi (2014), and use local housing price elasticities as an instrument for 2006-09 change in housing wealth. We find that the causal regional employment effect of the housing collapse of 2006-09 thus measured has not reverted over the subsequent decade. Specifically, we first estimate that a 10 percent change in housing net-worth between 2006 and 2009 reduces total employment by more than 3 percent in 2009, as compared with a 2006 baseline. Importantly, we next find that the same shock implied a relative decline in employment of close to 4.5 percent by 2016, as compared with a 2006 baseline.[3]

We also evaluate the impact of the housing wealth shock on local wages. We find that, while housing net-worth losses predicts wage declines (as in Beraja et al. (2016)), the relationship disappears when we instrument for local housing supply elasticity. This implies that, even if wages are flexible on average, wage movements did not operate as a stabilizing influence for declines in local employment demand. Strikingly, this stickiness in wages occurs in spite of the fact that out-migration occurs very slowly, with changes in working-age population at the level of local labor markets (Core Based Statistical Area) that occur slowly and that even at the long horizon are smaller than the employment effects.

Next, we do an extended analysis along two important dimensions that allows us to assess the heterogeneous effects of the collapse in housing net-worth across U.S. counties. First, we examine the differential impact of the housing net-worth shock in different sectors. We reproduce Mian and Sufi (2014)'s finding that the housing net-worth shock has a significant short-term impact on retail and food service employment, but additionally, we find that this relationship disappears somewhat quickly, after 2010. Moreover, distinctly, where we find the strongest long-lasting effect is in the

[1] This is in line from evidence from countries that were affected by large drops in housing wealth (Reinhardt and Rogoff (2009), Jordà et al. (2015, 2016)).

[2] Such a view would explain the persistent drop in employment after the Great Recession through changes in demographic characteristics of the population as well as generational differences in the timing of incorporation into the labor market (Fernald et al. (2017)).

[3] Two other papers that have analyzed the aftermath of the Great Recession using state level data are Jones et al. (2018) and Gertler and Gilchrist (2018). Furthermore, Davis and Haltiwanger (2019) have also revisited the regional impact of the 2006-09 housing wealth shock with a focus on business dynamism.

employment of a "skill-intensive" sector, encompassing health services, education, and professional and business services.[4]

Second, motivated by Glaeser and Gyourko (2005)'s findings that fast-growing cities have larger employment responses to demand shocks compared with slow-growing cities, we examine the differential impact of the housing net-worth shock across ex-ante differentially growing counties. For this exercise, we separate counties by their average employment growth rate from 1990-2003. We find that the housing net-worth shock indeed had its largest impact dynamically on ex-ante fast-growing counties.

Our results imply that shocks to household wealth can have very persistent negative effects. What is a potential theoretical mechanism? As explained in a major contribution recently, by Berger et al. (2017), wealth losses can affect consumption in an incomplete markets model, if housing serves as a collateral for household debt. In their framework, a reduction in housing net-worth reduces households' ability to smooth income shocks, leading to greater precautionary savings. This interpretation based on the theoretical framework in Berger et al. (2017) is in line with existing empirical evidence for short-run/contemporaneous impact of wealth shocks on consumption (Mian et al. (2013), Kaplan et al. (2016)). Such consumption effects can in turn have an impact on labor demand. If wages fail to adjust downward, this will have an impact on employment.

While such a demand channel can explain the short-run dynamics, the sectoral incidence of the shock implies a more complicated and potentially more interesting story at longer horizons. The relative decline of the high-skilled sector suggests that the demand shock likely makes the affected localities less amenable to the production of those goods.

In addition to the work we discuss above, our paper is related to several other contributions in the literature. There is ample evidence that changes in trade tariffs in local labor markets can have very persistent effects (Dix-Carneiro and Kovak (2017)). Moreover, recent work by Yagan (2017) finds evidence that regional employment losses around the 2007-09 ("Great") recession are predictive of regional employment differences as late as 2015. Yagan (2017), however, does not trace those effects explicitly to losses in housing net-worth. At the same time, county-level analysis by Mian and Sufi (2014) suggests that the loss in household wealth around the Great Recession can account for a large portion of the initial drop in employment between 2007 and 2009, especially among non-tradable sectors.

Together, the existing evidence suggests the presence of a causal mechanism that operates from the housing wealth losses in the Great Recession to long-term regional distribution of employment conditions. Our contribution is to provide evidence for the full causality chain running from the housing collapse to the differential employment losses over a long period of time. In addition to influential work by Reinhardt and Rogoff (2009) that shows that recoveries following financial crises driven recessions are quite slow, our results are also in line with Jordà et al. (2016), who, using data going back to the 1870s, find that recessions following large financial expansions are likely to

[4] As one might more naturally expect, we also find persistent effects on construction employment and smaller, but also persistent, effects on a residual sectoral group.

be long lasting, and that real estate credit has become an increasingly reliable indicator of financial fragility.

2 Data and motivating evidence

We now describe in detail the data we use in the paper as well as present some stylized facts that serve as motivating evidence for our econometric analysis.

2.1 Data

The main dataset used for our estimations is from the Quarterly Census of Employment and Wages (QCEW), made available by the Bureau of Labor and Statistics (BLS). It draws on employment and wages of establishments reporting to Unemployment Insurance programs, and covers more than 95% of jobs in the United States. It is the dataset of choice for the Bureau of Economic Analysis (BEA) for the production of national accounting estimates and for the BLS as a frame for the Current Employment Statistics.[5] The dataset includes total employment and wage bill by industry and county. In an extended analysis, we also use American Community Survey (ACS) data to complement the wage regression results by constructing an adjusted nominal wage index.

In order to investigate migration patterns, we also use population data from the County Resident Population Estimates from the U.S. Census Bureau after 2000 and the U.S. Intercensal County Population data before that. Finally, we obtain debt-to-income (DTI) ratios for different counties using data on household debt from the Equifax/Federal Reserve Bank of New York Consumer Credit Panel (CCP) made available as part of the extended Financial Accounts of the United States on the Federal Reserve Board website.

For more details on data sources and construction, see Appendix B.

2.2 Stylized facts

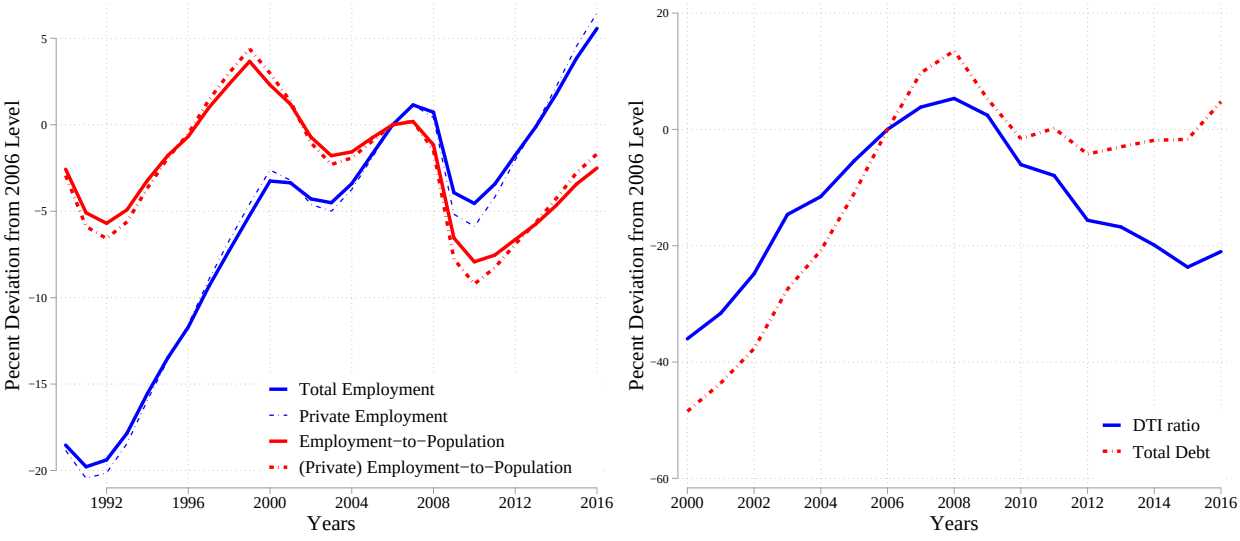
Figure 1 shows the recent evolution of employment and household debt in levels, and normalized by population and household income, respectively. There is a clear boom-bust cycle starting around 2003, with an increase in the employment-to-population ratio and an acceleration in the growth of household debt-to-income ratio.[6] The onset of the 2007-09 recession stands out as a prominent peak in all series. Strikingly, as debt-to-income ratio returns to its pre-boom levels, employment-to-population ratio remains depressed.

We are interested in understanding how changes to household net worth affected local employment. We follow Mian and Sufi (2014) in defining the change in household net worth in a given region n between 2006 and 2009 by

[5] As compared with the County Business Patterns it is more encompassing, since it includes government employees and a few other industries.

[6] Justiniano et al. (2017) associate that acceleration in household indebtedness with a sharp reduction in the relative cost of private label mortgages issuances in the second half of 2003.

Figure 1: Employment and Debt Trends



Source: Quarterly Census of Employment and Wages, Census Bureau

Source: FRBNY Consumer Credit Panel/Equifax, Bureau of Labor Statistics

$$\Delta_{06-09}\text{Net Worth}_n = \Delta_{06-09}\text{House Price Index}_n \times \frac{\text{Housing Wealth}_{n,2006}}{\text{Housing Wealth}_{n,2006} + \text{Financial Wealth}_{n,2006} - \text{Debt}_{n,2006}}$$

That is, the change in household net worth due to housing is given by the change in the house price index multiplied by a leverage term calculated using initial asset positions. In what follows we show results using the change in net worth made available in Mian and Sufi (2014)'s replication files.

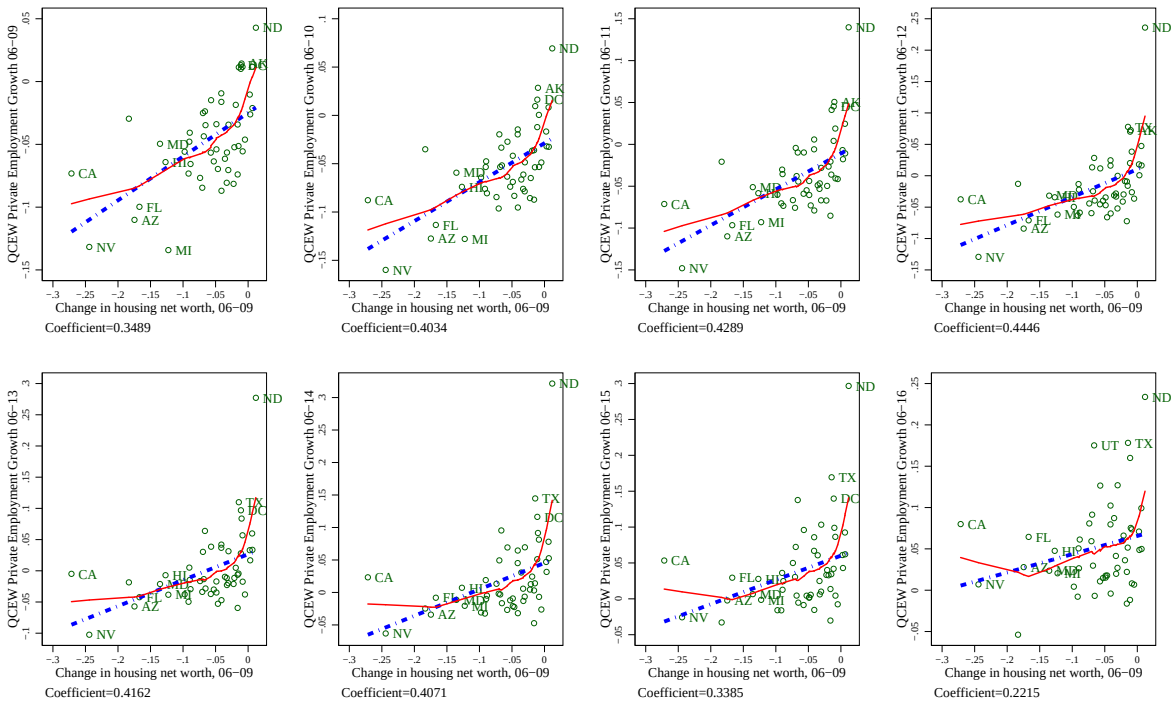
The panels in Figure 2 show in the vertical axis the change in employment in different states starting at 2006 and finishing at different horizons using data from the QCEW. The horizontal axis is the same for all panels and shows the change in housing net-worth between 2006 and 2009.[7] It clearly shows that the high net worth shock regions were also ones that suffered a more pronounced boom-bust cycle in employment.

Those comparisons do not account for differences in underlying trends across states. For example, California was a fast-growing state before the housing boom-bust cycle, so one would expect its employment to catch up with other states for that reason. In order to control for that, Figure 3 shows scatter plots for the difference between employment in each state and what one would have projected it to be in 2002 based on 1998-2002 growth rates. By choosing 2002 as our basis year, we also discount any differential gain from the credit boom years between 2003 and 2006. When trends are removed in this way, the relationship between the change in housing net-worth and changes in private employment becomes very stable and much more clearly linear. Except perhaps for 2016, there is very little, if any, sign of convergence between states.

The upper left panel of Figure 4 shows the same fact, but with a different grouping. Rather

[7] State-level changes in housing net-worth are calculated by taking a weighted average of county-level changes from the Mian and Sufi (2014) replication file. See Appendix A.1 for CBSA and county-level figures.

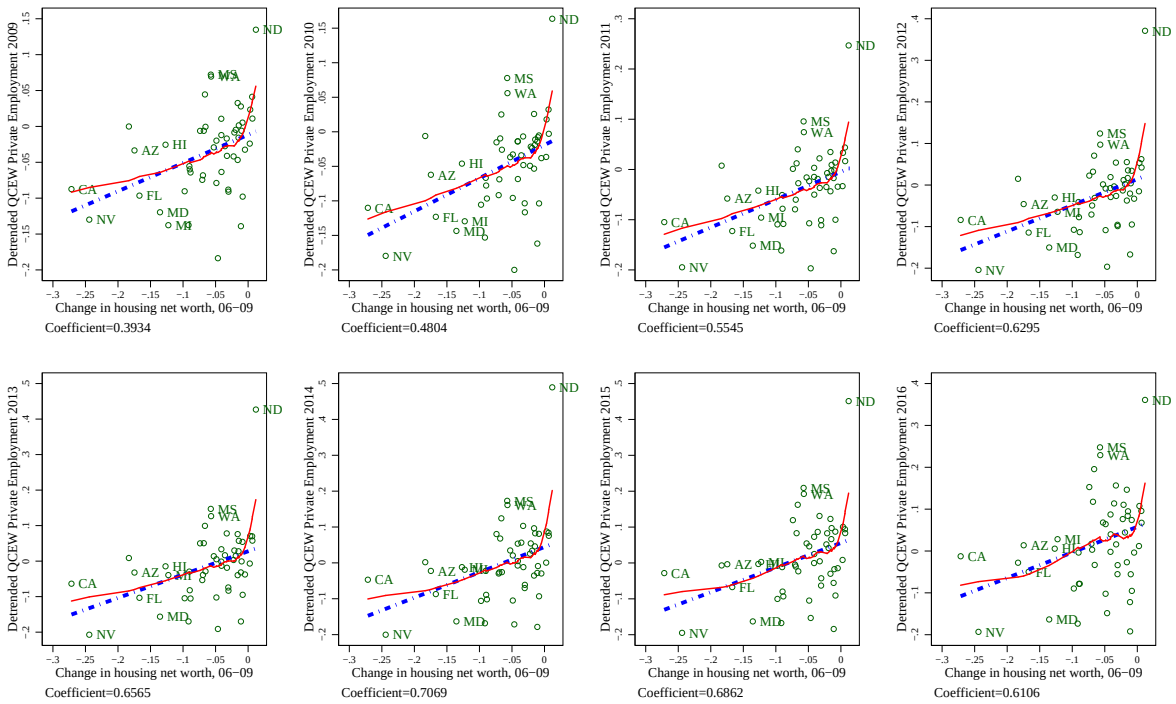
Figure 2: Change in Housing Net-Worth and Change in Employment (by State)



than showing the differences between states, we show the differences between counties, grouped by quantiles in terms of the size of the change in housing net-worth between 2006 and 2009. The lines refer to progressively lower quantiles in terms of the impact. The upper left panel shows the differences in private employment, taking 2006 as a common baseline. The lower left panel normalizes local employment by population. While there is little convergence in employment, the employment to population ratios do tend to converge relatively more, indicating that much of the adjustment has happened as households have moved away from depressed regions.

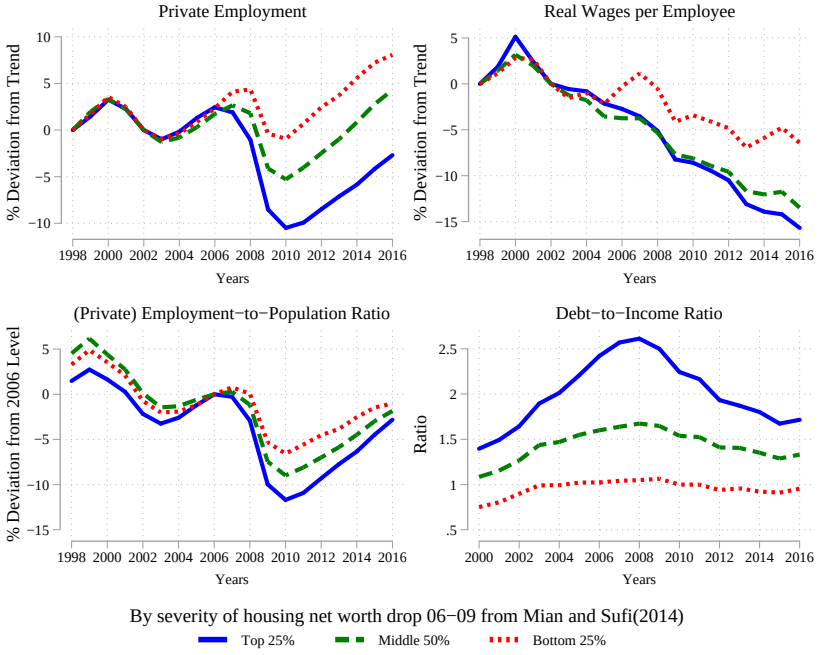
The right panels of Figure 4 present some information on the underlying mechanisms. The upper right panel plots the paths for real wages per employee. It shows a general declining trend in detrended real wages, consistent with historically low wage growth in the aftermath of the Great Recession. It also shows that wages remained relatively higher in the least affected counties, consistent with Beraja et al. (2016). However, the effect appears to be highly nonlinear, with virtually no wage differences between the top 25% and middle 50% most affected counties. Lastly, the bottom right panel shows the difference in the debt-income ratio. The counties that experienced the largest housing net-worth shocks were also the ones with the highest debt-to-income ratio around 2008. Those regions then experienced the greatest degree of deleveraging. As with aggregate data (Figure 1), debt-to-income ratios had mostly converged to pre-boom levels by 2016, even as employment differentials have remained fairly constant at their largest level.

Figure 3: Change in Housing Net-Worth and Change in Employment (Detrended, by State)



Notes: Employment trend is calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

Figure 4: Changes in Variables by Housing Net-Worth Quantiles (Detrended, by county)



Notes: Employment and wage trends are calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

3 Disentangling the employment effect of the housing wealth shock

In order to claim a causal effect of the change in housing net-worth on employment and other variables, one needs to rule out other omitted factors that may have driven both variables at the same time. For instance, first, any region specific shock affecting employment persistently in a given region would also affect house prices in that region immediately. For that reason, a naive causal interpretation of the relationships showed in the previous section may lead one to *overestimate* the impact of the housing wealth shock on employment. Second, for a given change in house prices, net worth shocks increase with leverage, and regions where households were more levered at the onset of the recession may distinguish themselves from other regions in several ways, such as income level, age composition, structure of the financial system, and regulatory environment. This would imply different exposures to various kinds of shocks that may be correlated with leverage, leading to either under or overestimation of the coefficient. Third, households may have borrowed more aggressively if they believed that they would be better able to cope with a high debt burden, or regions with deep financial systems allow households with large debt overhangs to refinance their debt at better terms. Those considerations would imply that one would tend to *underestimate* the long-run impact of the initial housing wealth shock.

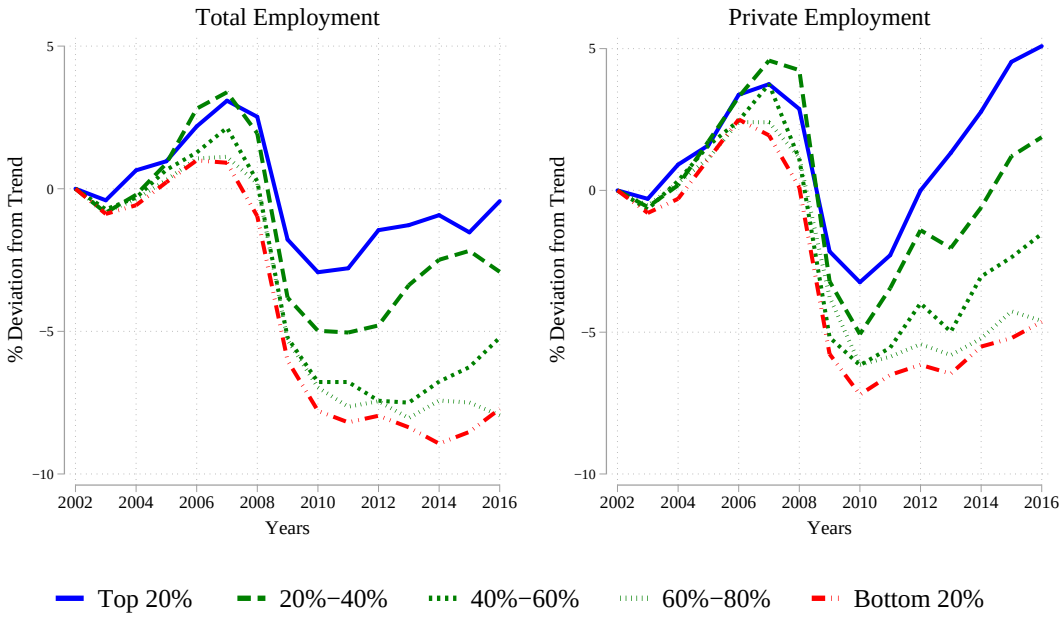
3.1 An IV framework

In order to disentangle the effect of the housing net-worth shock on employment we follow Mian and Sufi (2014) in comparing regions that had a more or less "elastic" housing supply as measured by the availability of land building restrictions given by geographical or regulatory constraints (Saiz (2010)). Their idea is that in regions with less land available, housing prices would have increased more quickly in the run-up years between 2002 and 2006, allowing households to raise more debt in comparison to their incomes. The key assumption for housing supply elasticity to be a valid instrument is that it is uncorrelated to the exposure of different localities to various shocks and to differences in their ability to recover from those shocks. Figure 5 shows median deviations of employment from their 1998-2002 trends by quantile of Saiz's housing supply elasticity measure. At the bottom of the recession, regions with lower housing supply elasticity had lost more employment, consistent with Mian and Sufi's (2014) original results. As time progresses, there is no sign of convergence between counties in different bins.

Figure 5 suggests that, especially in later periods, the strongest variation comes from comparing extreme quantiles of housing supply elasticity. This is consistent with Gao et al. (2016), who note that the relationship between supply elasticity and housing is nonmonotonic and provide a causal model consistent with that observation. Accordingly, we use a discretized version of the Saiz elasticity as our instrument. For parsimony, we use two dummies, picking up different terciles of the housing price elasticity.

Overall, in order to assess the causal dynamic effects of the initial (2006-09) housing net-worth shock while controlling for observable characteristics, we estimate a sequence of regression equations

Figure 5: Changes in Variables by Housing Supply Elasticity Quantiles (Detrended, by county)



Notes: Employment and wage trends are calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

of the form

$$\Delta_{06-yy} \log(\text{Employment}_n) = \beta_{yy} \Delta_{06-09} \text{Net Worth}_n + \gamma_{yy} X_n + \epsilon_{n,yy} \quad (1)$$

where n denotes a region (county or CBSA), Δ_{06-yy} denotes the change in the variable between 06 and $yy \in \{09, 10, ..., 16\}$, and X_n is a vector of regions specific controls. As in Mian and Sufi's (2014) work, we include as controls the share of 23 industries in our baseline regressions, as well as various socioeconomic characteristics of the population of the region (race, income, homeownership, education, unemployment rates, poverty and urbanization) in extended specifications. We add to those the share of government employment, which we can calculate using the QCEW data. Since we are interested in longer run effects of the housing collapse, we include controls for prior trends (growth rate in employment between 1998 and 2002 and between 2003 and 2006) in even our baseline regressions. We report the OLS estimates of β_{yy} for comparison in several instances. We then use a discretized version of the Saiz elasticity as an instrument for Δ_{06-09}Net Worth$_n$, so that we can provide a causal interpretation of β_{yy}.

3.2 Long-run causal employment effects

Table 1 shows regression results from estimating (1) under different specifications for the 2006-09 period considered by Mian and Sufi (2014). Panels A and B essentially provide replications of their

findings using the QCEW employment data including, respectively, all employees and only private employees. Column 1 presents the OLS estimate without controls and Column 2 presents the OLS estimate with control for pre-trends. Even at this short horizon, controlling for pre-trends implies a stronger effect. Column 3 adds controls for industry shares, and Column 4 corresponds to Mian and Sufi's baseline specification, with housing supply elasticity as the instrument and controls for industry shares.

In Column 5 we add various controls for observables such as socio-economic characteristics of the population of the region (race, income, home ownership, education, unemployment rates, poverty and urbanization), with little change in in the estimate. Finally, Column 6 performs a placebo test taking the change in employment between 1998 and 2002 as the left-hand-side variable with changes in employment between 1994 and 1998 and 1990 and 1994 taken as controls for pre-trends. The placebo test confirms that the specification adequately removes any differences in underlying trends between counties with different housing supply elasticities.

Table 1: Changes in Employment and Housing Net-Worth Shock (2006-2009)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Dependent variable: Change in total employment 2006-2016 (QCEW)						
Changes in Housing Net-Worth(06-09)	0.191***	0.226***	0.229***	0.347***	0.319***	-0.047
	(0.061)	(0.069)	(0.063)	(0.075)	(0.089)	(0.081)
R-squared	0.147	0.201	0.409	0.404	0.537	0.575
1st stage F-stat				17.95	10.34	19.08
Panel B: Dependent variable: Change in private employment 2006-2016 (QCEW)						
Changes in Housing Net-Worth(06-09)	0.221***	0.244***	0.245***	0.329***	0.317***	-0.008
	(0.062)	(0.071)	(0.064)	(0.081)	(0.101)	(0.095)
R-squared	0.164	0.192	0.409	0.423	0.529	0.525
1st stage F-stat				18.04	10.62	19.04
Observations	944	943	943	539	537	539
Specification	OLS	OLS	OLS	IV	IV	IV
Pre-trends		Yes	Yes	Yes	Yes	Yes
Industry controls			Yes	Yes	Yes	Yes
Other controls					Yes	
Placebo effects(98-02 changes)						Yes

Robust standard errors (clustered by state-level) are reported in parentheses.
Sample weights (by number of households) are applied to all specifications.
***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table 2 repeats the exercise but at the 2006-2016 horizon. As one might expect, at this longer horizon the introduction of controls for pre-trends and industrial composition have a larger effect on the coefficient. The increase in the point estimate in the IV specification relative to OLS is also noteworthy. This implies that leverage may have increased more ex-ante in counties where residents had better means to deal with large fluctuations in their net worth. [8]

[8]This interpretation is enhanced by the further increase in the coefficient once one controls for 2002 debt-to-income

Table 2: Changes in Employment and Housing Net-Worth Shock (2006-2016)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Dependent variable: Change in total employment 2006-2016 (QCEW)						
Changes in	0.0491	0.163*	0.197**	0.456**	0.426**	-0.047
Housing Net-Worth(06-09)	(0.080)	(0.089)	(0.082)	(0.196)	(0.190)	(0.081)
R-squared	0.003	0.149	0.358	0.406	0.532	0.575
1st stage F-stat				17.95	10.34	19.08
Panel B: Dependent variable: Change in private employment 2006-2016 (QCEW)						
Changes in	0.066	0.166*	0.194**	0.451**	0.440**	-0.008
Housing Net-Worth(06-09)	(0.084)	(0.094)	(0.086)	(0.210)	(0.216)	(0.095)
R-squared	0.005	0.142	0.315	0.353	0.482	0.525
1st stage F-stat				18.04	10.62	19.04
Observations	944	943	943	539	537	539
Specification	OLS	OLS	OLS	IV	IV	IV
Pre-trends		Yes	Yes	Yes	Yes	Yes
Industry controls			Yes	Yes	Yes	Yes
Other controls					Yes	
Placebo effects(98-02 changes)						Yes

Robust standard errors (clustered by state-level) are reported in parentheses.
Sample weights (by number of households) are applied to all specifications.
***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Thus overall, in terms of magnitudes, given the baseline estimates in column 4 (the same specification as in Mian and Sufi (2014)) of Tables 1 and 2, we can conclude the following in terms of short-run and long-run effects. In the short-run, a 10 percent change in housing net-worth between 2006 and 2009 reduces total employment by more than 3 percent in 2009, as compared with a 2006 baseline. In the long-run, the same shock implied a relative decline in employment close to 4.5 percent by 2016, as compared with a 2006 baseline. The causal effects of the housing net-worth shock thus do not revert over the course of a decade.

To obtain an overview of the over time evolution of the cumulative employment effects of the housing net-worth shock around the Great Recession, Table 3 shows the estimated coefficient of the effect at different time horizons, as given by estimating (1), using the baseline specification (see Appendix for table with specification with full controls). The coefficient increases gradually, peaking in 2015, six years after the trough of the recession as defined by the NBER. This result then summarizes our main empirical finding: the collapse in U.S. housing net-worth in 2006-09 had highly persistent local employment effects over the subsequent decade.

ratio, as we show later.

Table 3: Changes in Employment and Housing Net-Worth Shock by Year

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in Housing Net-Worth(06-09)	0.347***	0.411***	0.435***	0.417***	0.410***	0.444***	0.464**	0.456**
	(0.075)	(0.090)	(0.102)	(0.120)	(0.136)	(0.157)	(0.180)	(0.196)
1st stage F-stat	17.95	17.95	17.95	17.95	17.95	17.95	17.95	17.95
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in Housing Net-Worth(06-09)	0.329***	0.376***	0.392***	0.381***	0.381**	0.423**	0.464**	0.451**
	(0.081)	(0.095)	(0.111)	(0.133)	(0.154)	(0.177)	(0.194)	(0.210)
1st stage F-stat	18.04	18.04	18.04	18.04	18.04	18.04	18.04	18.04
Observations	539	539	539	539	539	539	539	539
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

4 Extended analysis

We now extend our analysis in several dimensions as well as conduct a series of robustness exercises.

4.1 Controlling for quality of life

While the Saiz (2010) instrument is plausibly orthogonal to idiosyncratic regional shocks that occurred around the time of the Great Recession, one may wonder whether they would be correlated with location-specific characteristics that may make some locations more sensitive than others to national shocks unrelated to housing wealth, or that could imply heterogeneity in the sensitivity to the housing wealth shock. This would occur because, as emphasized by Davidoff (2013), the same presence of large bodies of water and uneven terrain that affects local housing supply elasticities are themselves attractive, leading to higher demand for housing, a more highly skilled population, and greater economic development. In order to allow for that possibility, we now introduce controls for local quality of life.

Table 4 shows how allowing for these considerations change the estimates. Panel A repeats our baseline result. In Panel B, we include the measure of quality of life constructed by Albouy (2008) as a control. In order to construct it, Albouy (2008) uses after-tax real wages in each location, using the result that, in a spatial equilibrium, differences in real wages between cities for a worker with the same attributes should reflect a compensating differential in local amenities. Those real wages should capture any impact of the geographical features captured by the Saiz (2010) instrument on the demand for living in those places. We find that including such a control actually increases the size of the coefficient, implying that the effect of higher amenities on the local economy and population composition attenuates the effect of the housing wealth shock.

Table 4: Changes in Employment and Housing Net-Worth Shock (Controlling for Quality of Life)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW) - Baseline								
Changes in	0.347***	0.411***	0.435***	0.417***	0.410***	0.444***	0.464**	0.456**
Housing Net-Worth(06-09)	(0.075)	(0.090)	(0.102)	(0.120)	(0.136)	(0.157)	(0.180)	(0.196)
Observations	539	539	539	539	539	539	539	539
1st stage F-stat	17.95	17.95	17.95	17.95	17.95	17.95	17.95	17.95
Panel B: Dependent variable: Change in total employment(QCEW) - Quality of Life Index Control								
Changes in	0.444***	0.502***	0.514***	0.515***	0.549***	0.625***	0.714***	0.736***
Housing Net-Worth(06-09)	(0.086)	(0.105)	(0.118)	(0.133)	(0.151)	(0.169)	(0.192)	(0.215)
Observations	525	525	525	525	525	525	525	525
1st stage F-stat	9.45	9.45	9.45	9.45	9.45	9.45	9.45	9.45
Panel C: Dependent variable: Change in total employment(QCEW) - Amenities Index Control								
Changes in	0.430***	0.485***	0.500***	0.507***	0.540***	0.625***	0.722***	0.753***
Housing Net-Worth(06-09)	(0.094)	(0.118)	(0.138)	(0.153)	(0.171)	(0.192)	(0.208)	(0.227)
Observations	538	538	538	538	538	538	538	538
1st stage F-stat	10.98	10.98	10.98	10.98	10.98	10.98	10.98	10.98
Panel D: Dependent variable: Change in total employment(QCEW) - DTI in 2002 Control								
Changes in	0.391***	0.459***	0.485***	0.476***	0.488***	0.533***	0.584***	0.585***
Housing Net-Worth(06-09)	(0.084)	(0.101)	(0.112)	(0.130)	(0.145)	(0.164)	(0.185)	(0.200)
Observations	539	539	539	539	539	539	539	539
1st stage F-stat	17.14	17.14	17.14	17.14	17.14	17.14	17.14	17.14
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Panel C repeats the exercise substituting the Albouy (2008) measure for an index of local geographic amenities that is constructed by combining six measures of climate, topography, and water area that reflect preferred environmental qualities (warm winter, winter sun, temperate summer, low summer humidity, topographic variation, and water area). This is a natural amenities scale at the county level constructed by the U.S. Department of Agriculture. There is again an increase in the estimated coefficient on the effect of the housing net-worth shock on employment. Finally, Panel D incorporates directly the possibility that the development of local financial markets may vary systematically with the geographical attributes of the city, which could lead to a bias as one may expect to see larger and more volatile household indebtedness in more financially developed regions without a commensurate impact on consumption and employment. We allow for that possibility by introducing debt-to-income ratio in 2002 as a control. Again, this leads to a strengthening of the coefficient of interest.

Table 5: Changes in Employment and Housing Net-Worth Shock by Year (CBSA Level)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment (QCEW)								
Changes in	0.298***	0.355***	0.380***	0.398***	0.408***	0.436***	0.466***	0.480***
Housing Net-Worth(06-09)	(0.065)	(0.079)	(0.087)	(0.102)	(0.111)	(0.124)	(0.134)	(0.147)
1st stage F-stat	10.36	10.36	10.36	10.36	10.36	10.36	10.36	10.36
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.287***	0.324***	0.333***	0.354***	0.361***	0.381***	0.425***	0.415***
Housing Net-Worth(06-09)	(0.068)	(0.080)	(0.090)	(0.107)	(0.118)	(0.133)	(0.147)	(0.157)
1st stage F-stat	10.62	10.62	10.62	10.62	10.62	10.62	10.62	10.62
Panel C: Dependent variable: Change in total population								
Changes in	0.123***	0.159***	0.182***	0.209***	0.239***	0.268***	0.290***	0.302***
Housing Net-Worth(06-09)	(0.036)	(0.043)	(0.054)	(0.064)	(0.074)	(0.085)	(0.098)	(0.114)
1st stage F-stat	14.03	14.03	14.03	14.03	14.03	14.03	14.03	14.03
Panel D: Dependent variable: Change in working age population								
Changes in	0.069**	0.095**	0.108**	0.126**	0.150**	0.172**	0.186**	0.185*
Housing Net-Worth(06-09)	(0.033)	(0.041)	(0.050)	(0.055)	(0.062)	(0.071)	(0.085)	(0.101)
1st stage F-stat	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39
Observations	156	156	156	156	156	156	156	156
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

4.2 Local labor markets

One source of difficulty in interpreting the employment estimates we have presented so far is that, at the county level, the effect of the shock can spill over to neighboring counties. Many individuals may live in one county and work or shop in another, so that loss of employment in a locality need not be borne by local population in the same way as in completely self-contained regions. To deal with these issues, Table 5 reproduces the results for Core Based Statistical Areas (CBSA's), which are collections of counties linked by commuting.[9] As shown in Panels A and B, when running the regressions in those samples, we find that the employment impact of the housing net-worth shock is unchanged. At the CBSA level, we can crucially also investigate the impact of the housing net-worth shock on population. We find a progressively increasing impact over time, as individuals move out of more affected regions. However, even by 2016, the population movements between CBSA's were not enough to completely offset the employment losses. These results hold either for total population or working-age population (25-55 years) measures, as Panels C and D illustrate. For instance, while a 10% change in housing net-worth leads to about a 4.8% reduction in CBSA-level employment, it only leads to a 3% reduction in local total population, and even less in working-age population, a reduction of less than 2%.

[9]CBSA's are groups of counties tied to a "core" center with 10,000 people or more through commuting patterns.

Table 6: Changes in Nominal Wages and Housing Net-Worth Shock by Year

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in nominal wages per employees (QCEW) - County level								
Changes in	0.016	0.009	0.025	0.032	0.042	0.038	0.018	0.008
Housing Net-Worth(06-09)	(0.040)	(0.040)	(0.055)	(0.060)	(0.070)	(0.082)	(0.088)	(0.092)
1st stage F-stat	19.58	19.58	19.58	19.58	19.58	19.58	19.58	19.58
Observations	539	539	539	539	539	539	539	539
Panel B: Dependent variable: Change in (adjusted) nominal hourly wages (ACS) - PUMA level								
Changes in	-0.120**	-0.150*	0.081	-0.162*	-0.317***	-0.071	-0.027	-0.117
Housing Net-Worth(06-09)	(0.057)	(0.088)	(0.110)	(0.085)	(0.117)	(0.095)	(0.112)	(0.134)
1st stage F-stat	39.81	39.81	39.81	39.81	39.81	39.81	39.81	39.81
Observations	772	772	772	772	772	772	772	772
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

4.3 Effects on wages

Table 6 shows the impact of the net worth shock on wages. Strikingly, there is no significant impact. Wages in counties do not appear to adjust in spite of slow population movements that we documented above at the local labor market level.

We evaluate whether the result might be driven by changes in the composition of the local labor force with use of American Community Survey (ACS) data. With those data, we can follow Katz and Murphy (1992) to calculate the wage for different educational and age groups within each geographic unit and estimate an adjusted wage index by averaging over those wages with fixed weights. We describe the adjustment method in more detail in the Appendix.

Panel B of Table 6 shows the corresponding result using the adjusted ACS data, estimated at the level of Public Use Microdata Areas (PUMAs). We do not find evidence for downward adjustment in wages. Our results are in contrast with those in Beraja et al. (2016), who find a clear positive correlation between wage changes and employment changes after the Great Recession. In the Appendix, we show that we can recover their findings when running OLS, with regions where housing net-worth fell by more experiencing statistically significant higher wage reductions. We conclude that, while wages may react to some shocks, they do not seem to react to the large (exogenous) negative net worth shock suffered by many localities in the recession.

4.4 Differential effects across sectors

Next, we investigate the impact of the housing net-worth shock on employment within sub-sectors. We split the sample into five sub-sectors: tradable (mainly manufacturing), non-tradable (retail and restaurants), construction, high-skilled services (professional and business services, educational services, and health services) and others (including, among others, wholesalers and transportation

Table 7: Changes in Employment and Housing Net-Worth Shock by Sector (County Level)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in employment (QCEW) : Tradable								
Change in	-0.102	-0.330	-0.265	0.0712	0.352	0.533	0.545	0.810
Housing Net-Worth(06-09)	(0.327)	(0.352)	(0.409)	(0.374)	(0.402)	(0.419)	(0.440)	(0.500)
1st stage F-stat	16.72	16.75	16.76	16.92	16.94	16.77	16.77	16.77
Panel B: Dependent variable: Change in employment (QCEW) : Non-Tradable								
Change in	0.207*	0.192	-0.448**	-0.445*	-0.399	-0.382	-0.325	-0.272
Housing Net-Worth(06-09)	(0.112)	(0.118)	(0.206)	(0.244)	(0.252)	(0.275)	(0.293)	(0.296)
1st stage F-stat	19.32	19.32	19.32	19.32	19.32	19.32	19.32	19.32
Panel C: Dependent variable: Change in employment (QCEW) : Construction								
Change in	0.825***	0.964***	0.912***	0.851**	0.726*	0.727*	0.782**	0.808**
Housing Net-Worth(06-09)	(0.255)	(0.320)	(0.335)	(0.366)	(0.386)	(0.394)	(0.395)	(0.381)
1st stage F-stat	16.77	16.77	16.77	16.77	16.77	16.77	16.77	16.77
Panel D: Dependent variable: Change in employment (QCEW) : High-skilled services								
Change in	0.490***	0.530***	0.698***	0.761***	0.700***	0.685***	0.768***	0.754***
Housing Net-Worth(06-09)	(0.121)	(0.099)	(0.147)	(0.173)	(0.190)	(0.210)	(0231)	(0.261)
1st stage F-stat	18.05	18.05	18.05	18.05	18.05	18.05	18.05	18.05
Panel E: Dependent variable: Change in employment (QCEW) : Others								
Change in	0.369***	0.419***	0.426***	0.422**	0.534**	0.566**	0.600**	0.546*
Housing Net-Worth(06-09)	(0.115)	(0.142)	(0.163)	(0.202)	(0.233)	(0.282)	(0.301)	(0.307)
1st stage F-stat	18.82	18.82	18.82	18.82	18.82	18.82	18.82	18.82
Observations	539	539	539	539	539	539	539	539
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

services). In these sectoral splits, we follow Mian and Sufi (2014) directly, except that we further split the "others" sector from their decomposition into two: a high-skilled and the rest. We describe the details of these splits in Appendix B.

These sectoral-level results are presented in Table 7. As in Mian and Sufi (2014) we find that over the first years of the recession, losses in Housing Net Worth have sizable effects on non-tradable employment and construction. We also find a sizable effect on high-skilled services. The effect on non-tradable employment turns out to be relatively short-lived and flips sign over medium-term horizons. In terms of long-term effects, the effects on construction are very persistent, and the effect over high-skilled services is similarly large and increasing over the first few years, peaking in 2013. Employment in other services, which includes heavily linked sectors such as transportation and wholesale, is also persistently affected. In the Appendix, we use ACS data to confirm that the housing shock had its largest impact on high-skilled labor.

4.5 Differential effects across ex-ante growth trends

Lastly, we investigate how the effect of the net worth shock depends on local growth trends. Glaeser and Gyourko (2005) have emphasized that fast-growing cities present larger employment responses to demand shocks than slow-growing cities. We examine whether we can find a similar differences for the effects of the housing wealth shock. We separate counties based on their employment growth rate from 1990-2003 in three groups: high-growth counties are those with growth rates above the 66 percentile; middle-growth counties are those with growth rates between the 33 and 66 percentiles; and the low-growth counties are those with growth rate below the 33 percentile. Table 8 shows the relevant results. We find a positive answer, with the effect on ex-ante high growing counties about 50% larger than the effect on ex-ante middle growth counties and the effect on ex-ante slow-growing counties not statistically significant from zero.

Table 8: Changes in Employment and Housing Net-Worth Shock by Local Growth Trend

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in private employment (QCEW) : High-growth counties								
Change in	0.576***	0.671***	0.744***	0.811***	0.907***	1.025***	1.116***	1.144***
Housing Net-Worth(06-09)	(0.098)	(0.122)	(0.146)	(0.174)	(0.200)	(0.225)	(0.261)	(0.285)
1st stage F-stat	18.79	18.79	18.79	18.79	18.79	18.79	18.79	18.79
Observations	185	185	185	185	185	185	185	185
Panel B: Dependent variable: Change in private employment (QCEW) : Middle-growth counties								
Change in	0.509***	0.614***	0.642***	0.571***	0.565***	0.646***	0.729***	0.753***
Housing Net-Worth(06-09)	(0.134)	(0.138)	(0.151)	(0.178)	(0.204)	(0.214)	(0.229)	(0.249)
1st stage F-stat	13.49	13.49	13.49	13.49	13.49	13.49	13.49	13.49
Observations	160	160	160	160	160	160	160	160
Panel C: Dependent variable: Change in private employment (QCEW) : Low-growth counties								
Change in	0.050	0.022	-0.010	-0.053	-0.115	-0.129	-0.148	-0.229
Housing Net-Worth(06-09)	(0.079)	(0.095)	(0.106)	(0.119)	(0.132)	(0.162)	(0.179)	(0.200)
1st stage F-stat	22.75	22.75	22.75	22.75	22.75	22.75	22.75	22.75
Observations	176	176	176	176	176	176	176	176
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

4.6 Robustness and sensitivity analyses

We report in Appendix A.2 results from several robustness and sensitivity exercises. In particular, we investigate in greater detail how the impact of the the housing wealth shock on employment and wages change if we adopt an OLS estimator, if we allow for different sets of controls, if we exclude observations from "sand states," and if we use CBSA-level observations. We find that results are

robust to those modifications, with IV estimates generally implying larger employment and smaller wage effects than OLS estimates.

5 Conclusion

We show that the housing net-worth collapse of 2006-09 had an extraordinarily persistent impact on employment across US counties. In particular, we document that counties that had a larger loss in housing net-worth in that period had more depressed employment as late as 2016. Building on Mian and Sufi (2014), we use an IV strategy to establish causality for the dynamic and long-run effect of the initial (2006-09) housing net-worth shock on future employment. We show that the negative employment effect of the housing net-worth shock has reverted little over the subsequent decade.

Moreover, compared with the short-run effect of the shock, the long horizon effect is less concentrated in the non-tradables sectors and is instead more prominent in the high-skilled service and construction sectors. We also find that the housing net-worth shock had its largest impact dynamically on ex-ante fast-growing counties. An analysis at the local labor markets level shows that while there is also some negative effect on population over time, it is not enough to offset the long-run decline in employment.

Our findings offer evidence that shocks to household wealth can have long-lasting local employment effects. Thus, it contrasts with the standard view in macroeconomics that household demand shocks could account for short-run fluctuations, but that long-run movements are better explained by changes in technology or other slow-moving institutional factors.

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A Additional robustness and sensitivity analysis

A.1 Additional figures on stylized facts

Figure A.1: Change in Housing Net-Worth and Change in Employment (Detrended by Counties)

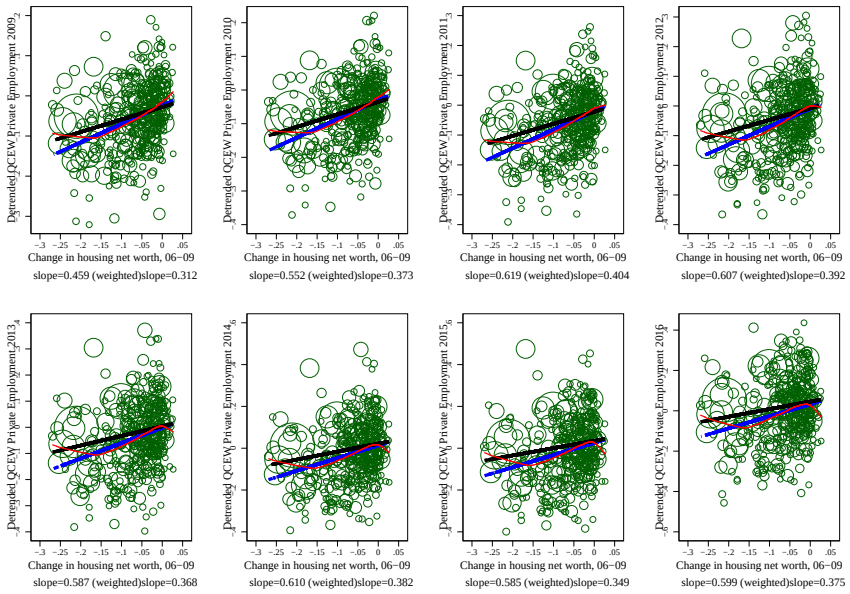


Figure A.2: Change in Housing Net-Worth and Change in Employment (by CBSA)

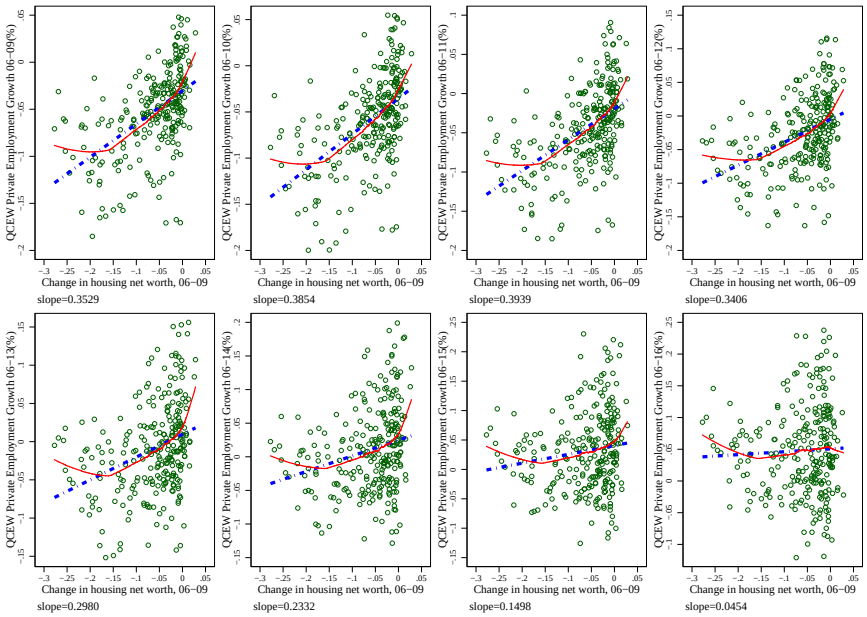
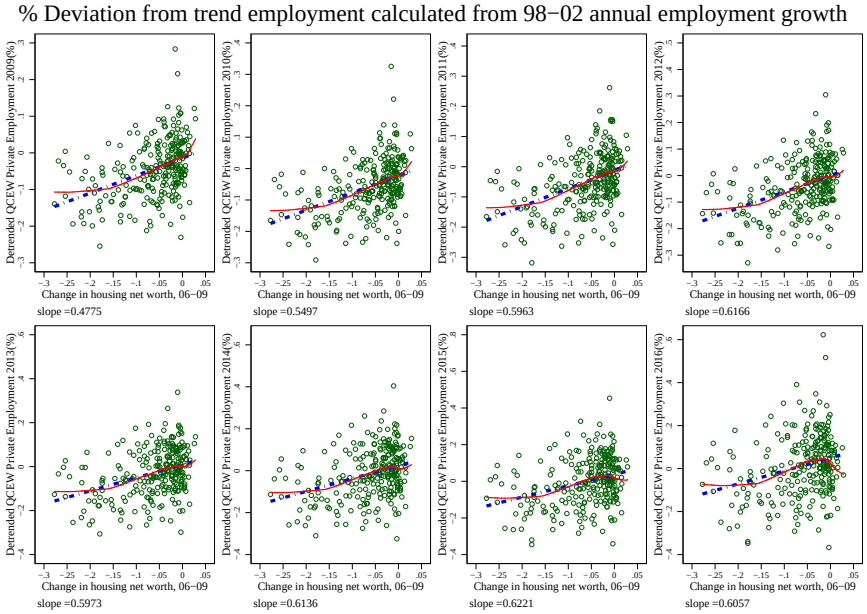
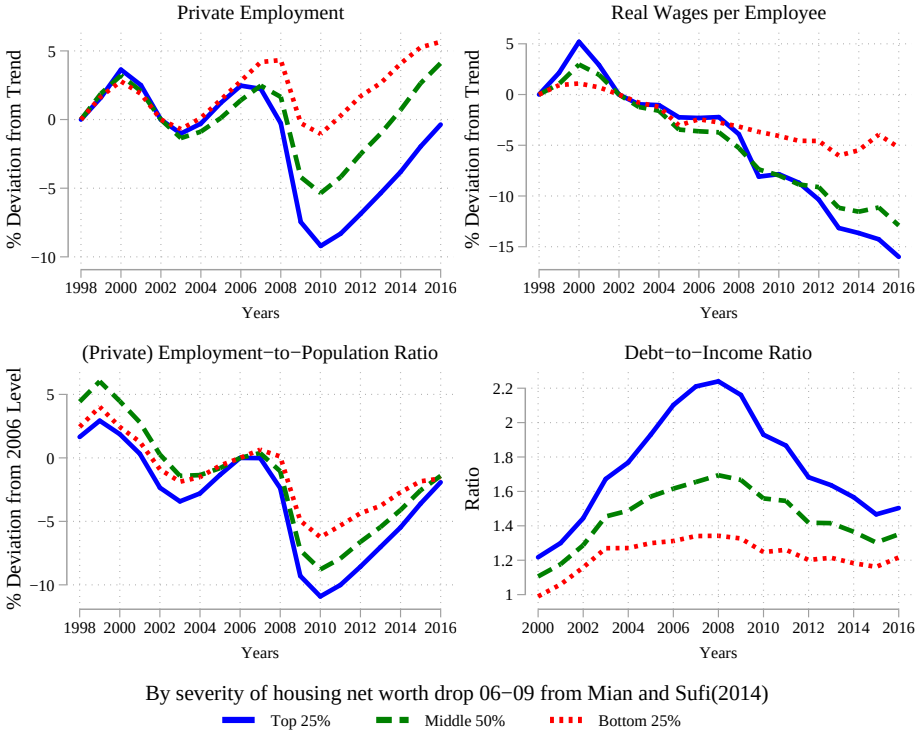


Figure A.3: Change in Housing Net-Worth and Change in Employment (Detrended, by CBSA)



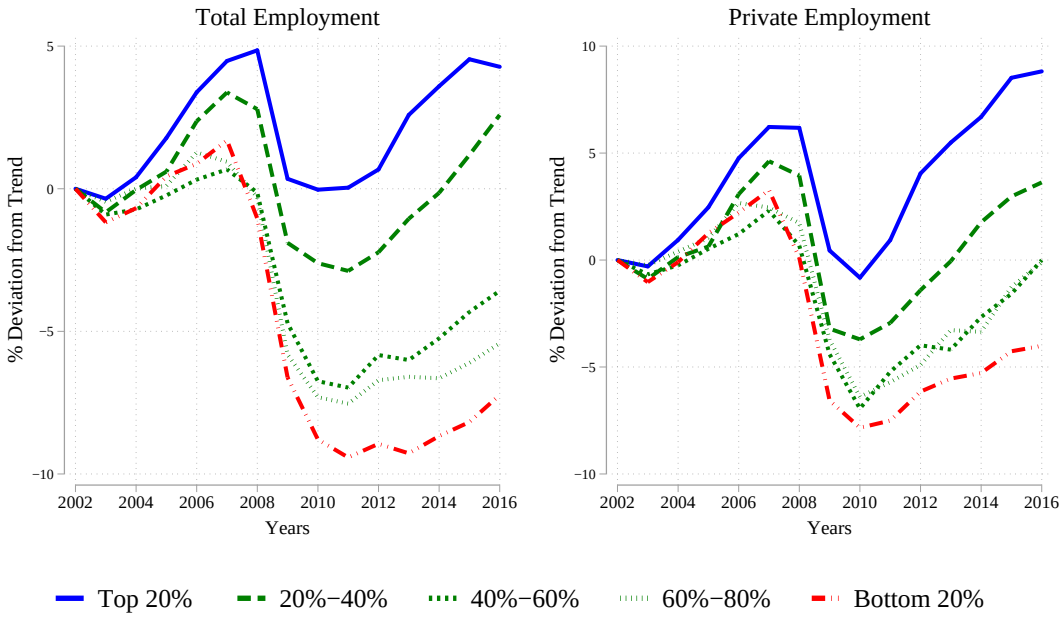
Notes: Employment trend is calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

Figure A.4: Changes in Variables by Housing Net-Worth Quantiles (Detrended, by CBSA)



Notes: Employment and wage trends are calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

Figure A.5: Changes in Variables by Housing Supply Elasticity Quantiles (Detrended, by CBSA)



Notes: Employment and wage trends are calculated by taking average growth rates between 1998 and 2002 for each locality and using those to project 2002 employment linearly into the future. Detrended employment values are deviations from that trend.

A.2 Robustness and sensitivity analysis

Here we show how our results depend on particular specifications. We start by showing the results using OLS to provide a descriptive sense of the key relationships before allowing for potential endogeneity. Those appear in Table A.1 below.

Next, in Table A.2 we show how the yearly results change once we allow for a full set of control variables but maintaining the OLS estimator.[10]

Table A.3 shows the results for each year in the IV estimate with all the controls. The coefficients are larger than in our baseline specification.

Table A.4 excludes counties in the "Sand States", (California, Nevada, Arizona and Florida) from the sample, given recent work pointing out that those states accounted for much of the housing boom-bust cycle. There is little change in the point-estimates, but the smaller sample size widens standard errors.

Table A.5 shows OLS results for the evolution of wages. There is now a positive coefficient, with a 10% reduction in housing net-worth implying a 1.55% decline in nominal wages by 2016. Together with the OLS point estimate for the private employment impact of the housing net-worth shock of about 2.2% they imply a wage elasticity of about 0.7, close to prior findings by Beraja

[10] We include as controls the share of 23 industries in our baseline regressions, as well as the pre-trends (growth rate in employment between 1998 and 2002 and between 2003 and 2006). In full set of controls, additionally, we include various socio-economic characteristics of the population of the region (race, income, home ownership, education, unemployment rates, poverty and urbanization). We also include in full set of controls construction, oil industry, and government employment shares as controls.

et al. (2016). Table A.6 shows the break-down of the nominal wage effect by sector and Table A.7 the break-down of the real wage effect by sector. It shows that, whereas the total wage impact of the housing shock is indistinguishable from zero, there is substantial wage declines in the non-tradable and construction sectors. Tables A.8 and A.9 show that the zero overall impact of the housing shock on wages is also present when we run regressions at the CBSA level or allow for all the controls. Finally, Table A.11 shows how employment changes at the regional level by skill and age, confirming that most of the employment reduction occurs among the highly skilled workers.

Table A.1: Changes in Employment and Housing Net-Worth Shock by Year (OLS)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in	0.229***	0.260***	0.273***	0.257***	0.246***	0.241***	0.218***	0.197**
Housing Net-Worth(06-09)	(0.063)	(0.064)	(0.063)	(0.065)	(0.068)	(0.077)	(0.081)	(0.082)
R-squared	0.409	0.423	0.406	0.365	0.349	0.350	0.359	0.358
Observations	943	943	943	943	943	943	943	943
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.245***	0.264***	0.263***	0.241***	0.224***	0.223***	0.217**	0.194**
Housing Net-Worth(06-09)	(0.064)	(0.063)	(0.062)	(0.067)	(0.071)	(0.080)	(0.086)	(0.086)
R-squared	0.409	0.413	0.397	0.349	0.327	0.328	0.318	0.315
Observations	941	941	941	941	941	941	941	941
Specification	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.2: Changes in Employment and Housing Net-Worth Shock by Year (OLS with All Controls)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in	0.234***	0.261***	0.269***	0.254***	0.253***	0.252***	0.253***	0.240***
Housing Net-Worth(06-09)	(0.071)	(0.071)	(0.068)	(0.068)	(0.071)	(0.077)	(0.079)	(0.082)
R-squared	0.532	0.548	0.542	0.511	0.503	0.513	0.536	0.529
Observations	912	912	912	912	912	912	912	912
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.258***	0.278***	0.274***	0.254***	0.246***	0.249***	0.248***	0.233**
Housing Net-Worth(06-09)	(0.075)	(0.072)	(0.069)	(0.072)	(0.075)	(0.082)	(0.088)	(0.090)
R-squared	0.518	0.523	0.518	0.483	0.475	0.486	0.481	0.474
Observations	912	912	912	912	912	912	912	912
Specification	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.3: Changes in Employment and Housing Net-Worth Shock by Year (IV with All Controls)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in	0.349**	0.401**	0.403**	0.382*	0.455**	0.555**	0.683**	0.722**
Housing Net-Worth(06-09)	(0.146)	(0.172)	(0.181)	(0.199)	(0.230)	(0.253)	(0.292)	(0.322)
1st stage F-stat	7.06	7.06	7.06	7.06	7.06	7.06	7.06	7.06
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.345**	0.406**	0.395**	0.382*	0.451*	0.540*	0.648**	0.677*
Housing Net-Worth(06-09)	(0.157)	(0.178)	(0.188)	(0.215)	(0.251)	(0.281)	(0.320)	(0.349)
1st stage F-stat	7.07	7.07	7.07	7.07	7.07	7.07	7.07	7.07
Observations	523	523	523	523	523	523	523	523
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.4: Changes in Employment and Housing Net-Worth Shock by Year (Without CA/FL/NV/AZ)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in	0.313***	0.361***	0.370**	0.350**	0.338*	0.412*	0.463*	0.457
Housing Net-Worth(06-09)	(0.116)	(0.130)	(0.144)	(0.165)	(0.192)	(0.225)	(0.271)	(0.307)
1st stage F-stat	10.37	10.37	10.37	10.37	10.37	10.37	10.37	10.37
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.273**	0.302**	0.313*	0.310	0.313	0.400	0.463	0.440
Housing Net-Worth(06-09)	(0.125)	(0.138)	(0.151)	(0.189)	(0.222)	(0.260)	(0.298)	(0.333)
1st stage F-stat	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
Observations	479	479	479	479	479	479	479	479
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Without CA/FL/AZ/NV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.5: Changes in Wages and Housing Net-Worth Shock by Year (OLS)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in nominal wages per employees (QCEW)								
Changes in	0.058**	0.069**	0.081***	0.120***	0.144***	0.155***	0.136***	0.120***
Housing Net-Worth(06-09)	(0.023)	(0.029)	(0.027)	(0.025)	(0.027)	(0.028)	(0.033)	(0.028)
R-squared	0.232	0.227	0.280	0.308	0.304	0.323	0.255	0.219
Observations	943	943	943	943	943	943	943	943
Panel B: Dependent variable: Change in (adjusted) nominal hourly wages (ACS) - PUMA level								
Changes in	0.051	0.074*	0.160***	0.100**	0.109***	0.126**	0.184***	0.170***
Housing Net-Worth(06-09)	(0.033)	(0.043)	(0.043)	(0.046)	(0.031)	(0.048)	(0.055)	(0.039)
R-squared	0.095	0.119	0.136	0.126	0.119	0.187	0.250	0.201
Observations	973	973	973	973	973	973	973	973
Specification	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.6: Changes in Nominal Wages per Employees and Housing Net-Worth Shock by Sector

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in nominal wages per employees (QCEW) : Tradable								
Change in	-0.278**	-0.441***	-0.412**	-0.165	-0.230	-0.241	-0.303	-0.083
Housing Net-Worth(06-09)	(0.130)	(0.157)	(0.172)	(0.167)	(0.196)	(0.270)	(0.233)	(0.226)
Observations	472	472	472	472	472	472	472	472
1st stage F-stat	17.58	17.58	17.58	17.58	17.58	17.58	17.58	17.58
Panel B: Dependent variable: Change in nominal wages per employees (QCEW) : Non-Tradable								
Change in	0.221***	0.283***	0.551***	0.607***	0.558***	0.552***	0.529***	0.551***
Housing Net-Worth(06-09)	(0.081)	(0.072)	(0.116)	(0.119)	(0.109)	(0.115)	(0.108)	(0.111)
Observations	538	538	538	538	538	538	538	538
1st stage F-stat	16.15	16.15	16.15	16.15	16.15	16.15	16.15	16.15
Panel C: Dependent variable: Change in nominal wages per employees (QCEW) : Construction								
Change in	-0.009	0.068	0.122	0.241*	0.262*	0.367**	0.382***	0.487***
Housing Net-Worth(06-09)	(0.107)	(0.122)	(0.147)	(0.145)	(0.146)	(0.152)	(0.134)	(0.127)
Observations	539	539	539	539	539	539	539	539
1st stage F-stat	18.50	18.50	18.50	18.50	18.50	18.50	18.50	18.50
Panel D: Dependent variable: Change in nominal wages per employees (QCEW) : High-skilled services								
Change in	0.022	0.005	-0.002	-0.017	0.117	0.052	0.029	0.062
Housing Net-Worth(06-09)	(0.069)	(0.076)	(0.085)	(0.087)	(0.113)	(0.116)	(0.135)	(0.130)
Observations	534	534	534	534	534	534	534	534
1st stage F-stat	17.97	17.97	17.97	17.97	17.97	17.97	17.97	17.97
Panel E: Dependent variable: Change in nominal wages per employees (QCEW) : Others								
Change in	-0.032	-0.084	-0.020	-0.024	0.006	0.030	0.041	-0.085
Housing Net-Worth(06-09)	(0.080)	(0.086)	(0.092)	(0.100)	(0.098)	(0.103)	(0.102)	(0.148)
Observations	534	534	534	534	534	534	534	534
1st stage F-stat	19.99	19.99	19.99	19.99	19.99	19.99	19.99	19.99
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.7: Changes in Real Wages per Employees and Housing Net-Worth Shock by Sector

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in real wages per employees (QCEW) : Tradable								
Change in	-0.261**	-0.468***	-0.485***	-0.220	-0.295	-0.306	-0.242	-0.011
Housing Net-Worth(06-09)	(0.133)	(0.162)	(0.175)	(0.173)	(0.194)	(0.267)	(0.269)	(0.256)
Observations	472	472	472	472	472	472	472	472
1st stage F-stat	17.63	17.63	17.63	17.63	17.63	17.63	17.63	17.63
Panel B: Dependent variable: Change in real wages per employees (QCEW) : Non-Tradable								
Change in	0.220***	0.270***	0.553***	0.603***	0.523***	0.526***	0.595***	0.623***
Housing Net-Worth(06-09)	(0.073)	(0.071)	(0.128)	(0.137)	(0.127)	(0.138)	(0.157)	(0.164)
Observations	538	538	538	538	538	538	538	538
1st stage F-stat	18.01	18.01	18.01	18.01	18.01	18.01	18.01	18.01
Panel C: Dependent variable: Change in real wages per employees (QCEW) : Construction								
Change in	-0.029	0.018	0.043	0.164	0.173	0.285	0.423**	0.542**
Housing Net-Worth(06-09)	(0.127)	(0.142)	(0.173)	(0.178)	(0.180)	(0.185)	(0.207)	(0.212)
Observations	539	539	539	539	539	539	539	539
1st stage F-stat	19.03	19.03	19.03	19.03	19.03	19.03	19.03	19.03
Panel D: Dependent variable: Change in real wages per employees (QCEW) : High-skilled services								
Change in	0.028	-0.015	-0.054	-0.066	0.063	-0.002	0.084	0.136
Housing Net-Worth(06-09)	(0.074)	(0.076)	(0.092)	(0.110)	(0.133)	(0.143)	(211)	(0.217)
Observations	534	534	534	534	534	534	534	534
1st stage F-stat	19.79	19.79	19.79	19.79	19.79	19.79	19.79	19.79
Panel E: Dependent variable: Change in real wages per employees (QCEW) : Others								
Change in	-0.043	-0.129	-0.096	-0.102	-0.078	-0.061	0.064	-0.046
Housing Net-Worth(06-09)	(0.072)	(0.081)	(0.108)	(0.118)	(0.112)	(0.115)	(0.148)	(0.153)
Observations	534	534	534	534	534	534	534	534
1st stage F-stat	19.42	19.42	19.42	19.42	19.42	19.42	19.42	19.42
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.8: Changes in Nominal Wages and Housing Net-Worth Shock by Year (CBSA)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in nominal wages per employees (QCEW)								
Changes in	-0.002	-0.009	0.025	0.084	0.047	0.048	0.009	-0.020
Housing Net-Worth(06-09)	(0.048)	(0.045)	(0.061)	(0.073)	(0.085)	(0.090)	(0.107)	(0.112)
1st stage F-stat	10.95	10.95	10.95	10.95	10.95	10.95	10.95	10.95
Observations	156	156	156	156	156	156	156	156
Panel B: Dependent variable: Change in adjusted nominal hourly wages (ACS)								
Changes in	0.055	-0.027	0.158*	-0.073	-0.081	-0.059	0.192**	0.206
Housing Net-Worth(06-09)	(0.091)	(0.111)	(0.091)	(0.118)	(0.141)	(0.155)	(0.096)	(0.151)
1st stage F-stat	12.66	12.66	12.66	12.66	12.66	12.66	12.66	12.66
Observations	187	187	187	187	187	187	187	187
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.9: Changes in Nominal Wages and Housing Net-Worth Shock by Year (IV with All Controls)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in nominal wages per employees (QCEW)								
Changes in	-0.070	-0.103	-0.053	0.015	-0.018	-0.060	-0.087	-0.093
Housing Net-Worth(06-09)	(0.09)	(0.095)	(0.105)	(0.127)	(0.160)	(0.175)	(0.202)	(0.205)
1st stage F-stat	7.01	7.01	7.01	7.01	7.01	7.01	7.01	7.01
Observations	523	523	523	523	523	523	523	523
Panel B: Dependent variable: Change in adjusted nominal hourly wages (ACS) - PUMA level								
Changes in	-0.173**	-0.345***	-0.137	-0.237**	-0.518***	-0.242*	-0.137	-0.312*
Housing Net-Worth(06-09)	(0.071)	(0.118)	(0.134)	(0.113)	(0.143)	(0.124)	(0.160)	(0.166)
1st stage F-stat	17.86	17.86	17.86	17.86	17.86	17.86	17.86	17.86
Observations	770	770	770	770	770	770	770	770
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.10: Changes in Employment and Housing Net-Worth Shock by Year (QCEW - PUMA level)

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in total employment(QCEW)								
Changes in	0.276***	0.342***	0.348***	0.328***	0.318***	0.322**	0.289*	0.295*
Housing Net-Worth(06-09)	(0.068)	(0.083)	(0.091)	(0.103)	(0.112)	(0.128)	(0.149)	(0.163)
1st stage F-stat	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34
R-squared	0.697	0.724	0.724	0.690	0.662	0.656	0.699	0.669
Observations	772	772	772	772	772	772	772	772
Panel B: Dependent variable: Change in private employment (QCEW)								
Changes in	0.277***	0.320***	0.319***	0.304***	0.297**	0.308**	0.307*	0.319*
Housing Net-Worth(06-09)	(0.077)	(0.091)	(0.102)	(0.117)	(0.126)	(0.143)	(0.160)	(0.174)
1st stage F-stat	32.68	32.68	32.68	32.68	32.68	32.68	32.68	32.68
R-squared	0.711	0.734	0.729	0.684	0.647	0.638	0.606	0.561
Observations	770	770	770	770	770	770	770	770
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pre-trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

Table A.11: Changes in ACS Employment by Skill-Age and Housing Net-Worth Shock

	2006-2009	2006-2010	2006-2011	2006-2012	2006-2013	2006-2014	2006-2015	2006-2016
Panel A: Dependent variable: Change in ACS employment : Education <= 12								
Changes in	0.075	0.268	0.210	0.276	0.406*	0.372	0.515*	0.395
Housing Net-Worth(06-09)	(0.152)	(0.179)	(0.156)	(0.213)	(0.225)	(0.254)	(0.285)	(0.274)
1st stage F-stat	31.69	31.69	31.69	31.69	31.69	31.69	31.69	31.69
Panel B: Dependent variable: Change in ACS employment : Education > 12								
Changes in	0.276**	0.274	0.431**	0.391*	0.498**	0.458**	0.513**	0.539**
Housing Net-Worth(06-09)	(0.128)	(0.215)	(0.218)	(0.202)	(0.235)	(0.196)	(0.237)	(0.237)
1st stage F-stat	31.69	31.69	31.69	31.69	31.69	31.69	31.69	31.69
Panel C: Dependent variable: Change in ACS employment : Age 25 - 40								
Changes in	0.305**	0.302	0.338	0.444**	0.580***	0.490**	0.617***	0.507***
Housing Net-Worth(06-09)	(0.144)	(0.199)	(0.211)	(0.198)	(0.219)	(0.195)	(0.214)	(0.197)
1st stage F-stat	31.69	31.69	31.69	31.69	31.69	31.69	31.69	31.69
Panel D: Dependent variable: Change in ACS employment : Age 41 - 55								
Changes in	0.068	0.125	0.288	0.218	0.268	0.290	0.373	0.335
Housing Net-Worth(06-09)	(0.150)	(0.198)	(0.198)	(0.190)	(0.243)	(0.220)	(0.251)	(0.266)
1st stage F-stat	31.69	31.69	31.69	31.69	31.69	31.69	31.69	31.69
Observations	772	772	772	772	772	772	772	772
Specification	IV	IV	IV	IV	IV	IV	IV	IV
Industry controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors (clustered by state-level) are reported in parentheses. Sample weights (by number of households) are applied to all specifications. ***,**, * denotes statistical significance at 1%, 5%, and 10% levels respectively.

B Data

1. **Employment and wages measure**
   (a) **QCEW county-level employment**
      i. QCEW monthly employment data represent the number of covered workers who worked during, or received pay for, the pay period that included the 12th day of the month.
      ii. Sample period 1990-2016
         A. Main analysis: 2006-2009(16) changes in employment
         B. Control for pre-trends: 1998-2002 and 2002-2006 changes in employment
         C. Placebos: use 1998-2002 changes in employment, and controlling for 1990-1994 and 1994-1998 changes in employment
      iii. Use annual averages of quarterly employment in each county
      iv. Total, private, and government employment(federal, local, and state government employment)
      v. 5 sectoral employment by NAICS 4-digit QCEW employment
         A. Tradable / non-tradable / construction / high-skilled service sectors / others
         B. NAICS 4-digit QCEW code are in Appendix.
      vi. Industry controls (employment share controls)
         A. NAICS 2-digit QCEW sectoral employment shares of private employment (23 industries)
   (b) **QCEW CBSA and state level employment**
      i. Aggregate the county-level employment by CBSA or by state
   (c) **QCEW wages data**
      i. QCEW wages data represent the total compensation paid during the calendar quarter, regardless of when the services were performed.
      ii. Use annual averages of quarterly wages in each county
2. **Population**
   (a) U.S. Census Bureau Annual County Resident Population Estimates (from 2000-2016)
   (b) For pre-2000, use Census U.S. Intercensal County Population Data, 1970-2014 from NBER (http://www.nber.org/data/census-intercensal-county-population.html)
   (c) Use total population by each county
3. **Housing Net-Worth**
   (a) Mian and Sufi (2014)

(b) "One of our key right hand side variables is the change in household net worth between the end of 2006 and 2009. We define net worth for households living in county i at time t as $NW_{it} = S_{it} + B_{it} + H_{it} - D_{it}$, where the four terms on the right hand side represent market values of stocks, bonds, housing, and debt owed, respectively. We compute the market value of stock and bond holdings (including deposits) in a given county using IRS Statistics of Income (SOI) data. We estimate the value of housing stock owned by households in a county using the 2000 Decennial Census data as the product of the number of home owners and the median home value. We then project the housing value into later years using the Core Logic zip code level house price index and an estimate of the change in homeownership and population growth. Finally, we measure debt using data from Equifax Predictive Services that tells us the total borrowing by households in each county in a given year."

4. **DTI control**

(a) Compute DTI at different geographical levels using data on household debt from the Equifax/Federal Reserve Bank of New York Consumer Credit Panel (CCP), and the data on household income from the Bureau of Labor Statistics (BLS).

(b) Calculate DTI as the ratio of aggregate household debt from Equifax (excluding student loans) to aggregate income (from BLS).

i. Calculate aggregate household debt by summing individual household debt in the CCP within each geographical area and multiplying by the sampling ratio.

ii. Use data from the BLS, which reports income earned by workers covered by unemployment insurance programs overseen by the Department of Labor. Income is reported quarterly and aggregated to annual amounts for each geographic region, including counties, CBSAs, and states.

5. **ACS data**

(a) To construct adjusted nominal wage data, we use data from the 2000 Census and the 2001-2014 American Community Surveys (ACS). Following Beraja et al. (2016), we calculate hourly nominal wages for prime-age males by restricting our sample to only males between the ages of 25 and 54, who live outside of group-quarters, have no self-employment income and who are not in the military. We calculate the hours worked by multiplying weeks worked last year and usual hours worked per week. We divide wage and salary income by the hours worked to calculate the hourly wages for each individual. We exclude any individual with a zero wage and truncate the measured wage distribution at the top and bottom one percent.

We adjust the hourly wages by creating a composition-adjusted wage measure following Katz and Murphy (1992). We divide our sample into six age bins (25-29, 30-34, 35-39, 40-44, 45-49, 50-54) and four education bins (completed years of schooling < 12, $= 12$,

between 13 and 15, and 16+). We then adjust the wage index by averaging over those wages for 24 groups with fixed weights to calculate the wage for different educational and age groups within each geographic unit and estimate an adjusted wage index by averaging over those wages with fixed weights. We use the share of each demographic group in each geographic level during 2005 as the fixed weights.

(b) To construct ACS employment measure, we restrict our sample to people (both male and female) who live outside of group-quarters.

6. **Others**

(a) Quality of life data by David Albouy (Are Big Cities Bad Places to Live? Estimating Quality of Life across Metropolitan Areas : http://davidalbouy.net/improvingqol.pdf)

(b) Amenities index (Natural amenities scale: https://www.ers.usda.gov/data-products/natural-amenities-scale/)

7. All regressions are weighted by the 2000 total number of households from Census.

B.1 Industry categorization

- Tradable
  - 1132 Forest nurseries and gathering of forest products
  - 1141 Fishing
  - 2111 Oil and gas extraction
  - 2121 Coal mining
  - 2122 Metal ore mining
  - 2123 Nonmetallic mineral mining and quarrying
  - 3111 Animal food manufacturing
  - 3112 Grain and oilseed milling
  - 3113 Sugar and confectionery product manufacturing
  - 3114 Fruit and vegetable preserving and specialty food manufacturing
  - 3115 Dairy product manufacturing
  - 3116 Animal slaughtering and processing
  - 3117 Seafood product preparation and packaging
  - 3118 Bakeries and tortilla manufacturing
  - 3119 Other food manufacturing
  - 3121 Beverage manufacturing
  - 3122 Tobacco manufacturing
  - 3131 Fiber yarn and thread mills
  - 3132 Fabric mills
  - 3133 Textile and fabric finishing and fabric coating mills
  - 3141 Textile furnishings mills
  - 3149 Other textile product mills
  - 3151 Apparel knitting mills
  - 3152 Cut and sew apparel manufacturing
  - 3159 Apparel accessories and other apparel manufacturing
  - 3161 Leather and hide tanning and finishing
  - 3162 Footwear manufacturing
  - 3169 Other leather and allied product manufacturing
  - 3221 Pulp paper and paperboard mills
  - 3222 Converted paper product manufacturing
  - 3231 Printing and related support activities
  - 3241 Petroleum and coal products manufacturing
  - 3251 Basic chemical manufacturing
  - 3252 Resin synthetic rubber and artificial synthetic fibers and filaments manufacturing
  - 3253 Pesticide fertilizer and other agricultural chemical manufacturing
  - 3254 Pharmaceutical and medicine manufacturing
  - 3255 Paint coating and adhesive manufacturing
  - 3256 Soap cleaning compound and toilet preparation manufacturing
  - 3259 Other chemical product and preparation manufacturing
  - 3261 Plastics product manufacturing
  - 3262 Rubber product manufacturing
  - 3271 Clay product and refractory manufacturing
  - 3272 Glass and glass product manufacturing
  - 3279 Other nonmetallic mineral product manufacturing
  - 3311 Iron and steel mills and ferroalloy manufacturing
  - 3313 Alumina and aluminum production and processing
  - 3314 Nonferrous metal (except aluminum) production and processing

  - 3315 Foundries
  - 3322 Cutlery and handtool manufacturing
  - 3324 Boiler tank and shipping container manufacturing
  - 3325 Hardware manufacturing
  - 3326 Spring and wire product manufacturing
  - 3327 Machine shops; turned product; and screw nut and bolt manufacturing
  - 3329 Other fabricated metal product manufacturing
  - 3331 Agriculture construction and mining machinery manufacturing
  - 3332 Industrial machinery manufacturing
  - 3333 Commercial and service industry machinery manufacturing
  - 3334 Ventilation heating air-conditioning and commercial refrigeration manufacturing
  - 3335 Metalworking machinery manufacturing
  - 3336 Engine turbine and power transmission equipment manufacturing
  - 3339 Other general purpose machinery manufacturing
  - 3341 Computer and peripheral equipment manufacturing
  - 3342 Communications equipment manufacturing
  - 3343 Audio and video equipment manufacturing
  - 3344 Semiconductor and other electronic component manufacturing
  - 3345 Navigational measuring electromedical and control instruments manufacturing
  - 3346 Manufacturing and reproducing magnetic and optical media
  - 3351 Electric lighting equipment manufacturing
  - 3352 Household appliance manufacturing
  - 3353 Electrical equipment manufacturing
  - 3359 Other electrical equipment and component manufacturing
  - 3361 Motor vehicle manufacturing
  - 3362 Motor vehicle body and trailer manufacturing
  - 3363 Motor vehicle parts manufacturing
  - 3364 Aerospace product and parts manufacturing
  - 3365 Railroad rolling stock manufacturing
  - 3366 Ship and boat building
  - 3369 Other transportation equipment manufacturing
  - 3372 Office furniture (including fixtures) manufacturing
  - 3391 Medical equipment and supplies manufacturing
  - 3399 Other miscellaneous manufacturing
  - 5112 Software publishers

- Non-tradable

  - 4411 Automobile dealers
  - 4412 Other motor vehicle dealers
  - 4413 Automotive parts accessories and tire stores
  - 4421 Furniture stores
  - 4422 Home furnishings stores
  - 4431 Electronics and appliance stores
  - 4451 Grocery stores
  - 4452 Specialty food stores
  - 4453 Beer wine and liquor stores
  - 4461 Health and personal care stores
  - 4471 Gasoline stations
  - 4481 Clothing stores
  - 4482 Shoe stores

  - 4483 Jewelry luggage and leather goods stores
  - 4511 Sporting goods hobby and musical instrument stores
  - 4512 Book periodical and music stores
  - 4521 Department stores
  - 4529 Other general merchandise stores
  - 4531 Florists
  - 4532 Office supplies stationery and gift stores
  - 4533 Used merchandise stores
  - 4539 Other miscellaneous store retailers
  - 7221 Full-service restaurants
  - 7222 Limited-service eating places
  - 7223 Special food services
  - 7224 Drinking places (alcoholic beverages)

- Construction

  - 1133 Logging
  - 2361 Residential building construction
  - 2362 Nonresidential building construction
  - 2371 Utility system construction
  - 2372 Land subdivision
  - 2373 Highway street and bridge construction
  - 2381 Foundation structure and building exterior contractors
  - 2382 Building equipment contractors
  - 2383 Building finishing contractors
  - 2389 Other specialty trade contractors
  - 3211 Sawmills and wood preservation
  - 3212 Veneer plywood and engineered wood product manufacturing
  - 3219 Other wood product manufacturing
  - 3273 Cement and concrete product manufacturing
  - 3323 Architectural and structural metals manufacturing
  - 3371 Household and institutional furniture and kitchen cabinet manufacturing
  - 4233 Lumber and other construction materials merchant wholesalers
  - 4441 Building material and supplies dealers
  - 4442 Lawn and garden equipment and supplies stores
  - 5311 Lessors of real estate
  - 5312 Offices of real estate agents and brokers
  - 5313 Activities related to real estate
  - 5413 Architectural engineering and related services

- High-skilled services

  - 5111 Newspaper periodical book and directory publishers
  - 5121 Motion picture and video industries
  - 5122 Sound recording industries
  - 5151 Radio and television broadcasting
  - 5152 Cable and other subscription programming
  - 5161 Internet Publishing and Broadcasting
  - 5171 Wired telecommunications carriers
  - 5172 Wireless telecommunications carriers (except satellite)

- 5173 Telecommunications Resellers
- 5174 Satellite telecommunications
- 5175 Cable and Other Program Distribution
- 5179 Other telecommunications
- 5181 Internet Service Providers and Web Search Portals
- 5182 Data processing hosting and related services
- 5191 Other information services
- 5211 Monetary authorities- central bank
- 5221 Depository credit intermediation
- 5222 Non-depository credit intermediation
- 5223 Activities related to credit intermediation
- 5231 Securities and commodity contracts intermediation and brokerage
- 5232 Securities and commodity exchanges
- 5239 Other financial investment activities
- 5241 Insurance carriers
- 5242 Agencies brokerages and other insurance related activities
- 5259 Other investment pools and funds
- 5411 Legal services
- 5412 Accounting tax preparation bookkeeping and payroll services
- 5414 Specialized design services
- 5415 Computer systems design and related services
- 5416 Management scientific and technical consulting services
- 5417 Scientific research and development services
- 5418 Advertising public relations and related services
- 5419 Other professional scientific and technical services
- 5511 Management of companies and enterprises
- 5611 Office administrative services
- 5612 Facilities support services
- 5613 Employment services
- 5614 Business support services
- 5615 Travel arrangement and reservation services
- 5616 Investigation and security services
- 5617 Services to buildings and dwellings
- 5619 Other support services
- 5621 Waste collection
- 5622 Waste treatment and disposal
- 5629 Remediation and other waste management services
- 6111 Elementary and secondary schools
- 6112 Junior colleges
- 6113 Colleges universities and professional schools
- 6114 Business schools and computer and management training
- 6115 Technical and trade schools
- 6116 Other schools and instruction
- 6117 Educational support services
- 6211 Offices of physicians
- 6212 Offices of dentists
- 6213 Offices of other health practitioners
- 6214 Outpatient care centers
- 6215 Medical and diagnostic laboratories
- 6216 Home health care services
- 6219 Other ambulatory health care services
- 6221 General medical and surgical hospitals
- 6222 Psychiatric and substance abuse hospitals

- 6223 Specialty (except psychiatric and substance abuse) hospitals
- 6231 Nursing care facilities
- 6232 Residential mental retardation mental health and substance abuse facilities
- 6233 Community care facilities for the elderly
- 6239 Other residential care facilities
- 6241 Individual and family services
- 6242 Community food and housing and emergency and other relief services
- 6243 Vocational rehabilitation services
- 6244 Child day care services

- Others

  - 1131 Timber tract operations
  - 1142 Hunting and trapping
  - 1151 Support activities for crop production
  - 1152 Support activities for animal production
  - 1153 Support activities for forestry
  - 2131 Support activities for mining
  - 2211 Electric power generation transmission and distribution
  - 2212 Natural gas distribution
  - 2213 Water sewage and other systems
  - 2379 Other heavy and civil engineering construction
  - 3274 Lime and gypsum product manufacturing
  - 3312 Steel product manufacturing from purchased steel
  - 3321 Forging and stamping
  - 3328 Coating engraving heat treating and allied activities
  - 3379 Other furniture related product manufacturing
  - 4231 Motor vehicle and motor vehicle parts and supplies merchant wholesalers
  - 4232 Furniture and home furnishing merchant wholesalers
  - 4234 Professional and commercial equipment and supplies merchant wholesalers
  - 4235 Metal and mineral (except petroleum) merchant wholesalers
  - 4236 Electrical and electronic goods merchant wholesalers
  - 4237 Hardware plumbing and heating equipment and supplies merchant wholesalers
  - 4238 Machinery equipment and supplies merchant wholesalers
  - 4239 Miscellaneous durable goods merchant wholesalers
  - 4241 Paper and paper product merchant wholesalers
  - 4242 Drugs and druggists' sundries merchant wholesalers
  - 4243 Apparel piece goods and notions merchant wholesalers
  - 4244 Grocery and related product merchant wholesalers
  - 4245 Farm product raw material merchant wholesalers
  - 4246 Chemical and allied products merchant wholesalers
  - 4247 Petroleum and petroleum products merchant wholesalers
  - 4248 Beer wine and distilled alcoholic beverage merchant wholesalers
  - 4249 Miscellaneous nondurable goods merchant wholesalers
  - 4251 Wholesale electronic markets and agents and brokers
  - 4541 Electronic shopping and mail-order houses
  - 4542 Vending machine operators
  - 4543 Direct selling establishments
  - 4811 Scheduled air transportation
  - 4812 Nonscheduled air transportation
  - 4831 Deep sea coastal and great lakes water transportation

- 4832 Inland water transportation
- 4841 General freight trucking
- 4842 Specialized freight trucking
- 4851 Urban transit systems
- 4852 Interurban and rural bus transportation
- 4853 Taxi and limousine service
- 4854 School and employee bus transportation
- 4855 Charter bus industry
- 4859 Other transit and ground passenger transportation
- 4861 Pipeline transportation of crude oil
- 4862 Pipeline transportation of natural gas
- 4869 Other pipeline transportation
- 4871 Scenic and sightseeing transportation land
- 4872 Scenic and sightseeing transportation water
- 4879 Scenic and sightseeing transportation other
- 4881 Support activities for air transportation
- 4882 Support activities for rail transportation
- 4883 Support activities for water transportation
- 4884 Support activities for road transportation
- 4885 Freight transportation arrangement
- 4889 Other support activities for transportation
- 4921 Couriers and express delivery services
- 4922 Local messengers and local delivery
- 4931 Warehousing and storage
- 5321 Automotive equipment rental and leasing
- 5322 Consumer goods rental
- 5323 General rental centers
- 5324 Commercial and industrial machinery and equipment rental and leasing
- 5331 Lessors of non-financial intangible assets (except copyrighted works)
- 7111 Performing arts companies
- 7112 Spectator sports
- 7113 Promoters of performing arts sports and similar events
- 7114 Agents and managers for artists athletes entertainers
- 7115 Independent artists writers and performers
- 7121 Museums historical sites and similar institutions
- 7131 Amusement parks and arcades
- 7132 Gambling industries
- 7139 Other amusement and recreation industries
- 7211 Traveler accommodation
- 7212 RV (recreational vehicle) parks and recreational camps
- 7213 Rooming and boarding houses
- 8111 Automotive repair and maintenance
- 8112 Electronic and precision equipment repair and maintenance
- 8113 Commercial and industrial machinery and equipment
- 8114 Personal and household goods repair and maintenance
- 8121 Personal care services
- 8122 Death care services
- 8123 Drycleaning and laundry services
- 8129 Other personal services
- 8131 Religious organizations
- 8132 Grantmaking and giving services
- 8133 Social advocacy organizations
- 8134 Civic and social organizations
- 8139 Business professional labor political and similar organizations