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WHAT EXPLAINS THE 2007–2009 DROP IN EMPLOYMENT?

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We show that deterioration in household balance sheets, or the *housing net worth channel*, played a significant role in the sharp decline in U.S. employment between 2007 and 2009. Counties with a larger decline in housing net worth experience a larger decline in non-tradable employment. This result is not driven by industry-specific supply-side shocks, exposure to the construction sector, policy-induced business uncertainty, or contemporaneous credit supply tightening. We find little evidence of labor market adjustment in response to the housing net worth shock. There is no significant expansion of the tradable sector in counties with the largest decline in housing net worth. Further, there is little evidence of wage adjustment within or emigration out of the hardest hit counties.

KEYWORDS: Great Recession, employment, household debt, new worth, house prices.

0. INTRODUCTION

THE 2007 TO 2009 RECESSION LED to the largest decline in employment in the United States since the Great Depression. The employment to population ratio dropped from 63% in 2007 to 58% in 2009, a loss of 8.6 million jobs. Understanding large drops in employment is one of the central questions in macroeconomics. Why did employment decline so drastically between 2007 and 2009? We approach this question with a particular focus on the *housing net worth channel*.

The *housing net worth channel* refers to a decline in employment because of a sharp reduction in the housing net worth of households. A decline in housing net worth could reduce employment by suppressing consumer demand either through a direct wealth effect or through tighter borrowing constraints driven by the fall in collateral value. Mian, Rao, and Sufi (2013) provided evidence that spending declined substantially more from 2006 to 2009 in U.S. counties with a large decline in housing net worth.

The housing net worth channel predicts a differential response of non-tradable versus tradable employment across U.S. counties. Non-tradable em-

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ployment relies heavily on local demand, while tradable employment relies more broadly on national or even global demand. A natural prediction of the housing net worth channel is that while the change in non-tradable employment should be *positively* correlated with the change in housing net worth in the cross-section of counties, the change in tradable employment should not be as strongly positively correlated. In fact, if general equilibrium adjustment mechanisms (such as local wage adjustment) are operational, then the change in tradable employment could even be *negatively* correlated with the change in housing net worth.

We take these key predictions to the data using detailed four-digit industry employment data by county. We classify industries into tradable and non-tradable sectors using two independent methods. The first method defines retail- and restaurant-related industries as non-tradable, and industries that show up in global trade data as tradable. Our second method is based on the idea that industries that rely on national demand will tend to be geographically concentrated, while industries relying on local demand will be more uniformly distributed. An industry's geographical concentration index across the country therefore serves as an index of "tradability."

We find strong support for the cross-sectional predictions of the housing net worth channel. Job losses in the non-tradable sector between 2007 and 2009 are significantly higher in counties with a large decline in housing net worth, the same counties that saw the largest decline in spending (Mian, Rao, and Sufi (2013)). A 10 percentage point decline in housing net worth is associated with a 3.7 percentage point decline in non-tradable employment.

The strong correlation between the housing net worth decline and the decline in non-tradable employment is not driven by alternative explanations, such as industry-specific supply-side shocks. Using housing supply elasticity instrument as well as direct controls for construction, we show that the relationship between the housing net worth shock and the change in non-tradable employment is not driven by exposure to construction-related sectors. We also control for the share of employment in a county for each of the 23 two-digit industries to show that our result is not driven by differential exposure to certain industries in counties that are more impacted by the housing net worth decline.

We also consider the possibility that our results might be driven by tighter credit constraints faced by establishments in areas with a large decline in housing net worth, but find no support for this hypothesis. We split our sample by establishment size and show that the correlation between the change in non-tradable employment and the housing net worth shock is *stronger* among large establishments that are less likely to suffer from credit constraints. Moreover, there is no significant cross-sectional correlation between the employment loss in the tradable sector and the housing net worth shock. If credit constraints were behind the non-tradable sector correlation, we should find a similar relationship for the tradable sector as well.

While there is a strong positive correlation between the change in non-tradable employment and the change in housing net worth, the correlation

should be significantly weakened for the tradable sector that relies more on national or global demand. We outline a simple model that shows that additional labor market adjustment mechanisms—such as a stronger reduction in wages in more negatively impacted counties—may introduce a negative correlation between the change in tradable employment and the change in housing net worth.

We find *zero* correlation on average between the housing net worth shock and the change in tradable employment in the cross-section from 2007 to 2009. We also provide direct evidence on labor market adjustment on the wage and migration dimension in the cross-section. We find little evidence of a strong wage response to the housing net worth shock—local wages tend to be sticky in the sense that nominal wages do not fall more in areas that were harder hit by the housing net worth decline. We also find little evidence of net labor mobility from counties with a large decline in housing net worth to less-affected counties.

Our paper is related to recent theoretical work that shows how demand shocks driven by a weakness in household balance sheet translate into a decline in real activity due to the presence of nominal or labor market rigidities (see, e.g., Eggertsson and Krugman (2012), Guerrieri and Lorenzoni (2011), Hall (2011), Midrigan and Philippon (2011), and Farhi and Werning (2013)).

This paper is one of the first empirical studies that exploit detailed cross-sectional variation to explicitly test the employment consequences of housing net worth shocks.[2] Stumpner (2013) extended the methodology in this paper to show that the trade channel acts as a powerful mechanism to transmit the impact of housing net worth shocks throughout the United States.

The rest of the paper is structured as follows. Section 1 describes the data; Section 2 provides the main empirical results regarding the effect of net housing shock on non-tradable employment. Section 3 outlines a simple model that discusses potential adjustment mechanisms in the labor market in reaction to the impact on the non-tradable sector. Section 4 tests for the presence of these labor market adjustments and Section 5 concludes.

1. DATA, INDUSTRY CLASSIFICATION, AND SUMMARY STATISTICS

1.1. *Data*

We build a county-level data set that includes employment data by four-digit industry, household balance sheet information including total debt and housing value, wages, and other demographic and income information.

County by industry employment and payroll data are from the County Business Patterns (CBP) data set published by the U.S. Census Bureau. CBP data

[2]Bils, Klenow, and Malin (2013) used a strategy based on variation in demand shocks for nondurable and durable goods to estimate the effect of demand shocks on employment.

are recorded in March each year. We use CBP data at the four-digit industry level, so we know the breakdown of employees and total payroll bill within a county for every four-digit industry.[3] We place each of the four-digit industries into one of four categories: non-tradable, tradable, construction, and other. We discuss the classification scheme in the next subsection. We supplement the CBP data with hourly wage data from the annual American Community Survey (ACS). ACS is based on a survey of 3 million U.S. residents conducted annually.

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 $NW_t^i = S_t^i + B_t^i + H_t^i - D_t^i$, 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.

Mian, Rao, and Sufi (2013) provided a more detailed discussion of the construction of the net worth variable. The change in total net worth between 2006 and 2009 due to the housing shock can be written as $\Delta \log p_{06-09}^{H,i} * H_{2006}^i$, or $\Delta HNW = \frac{\Delta \log p_{06-09}^{H,i} * H_{2006}^i}{NW_{2006}^i}$ in percentage terms. The latter term, ΔHNW, is what we call the *housing net worth shock*. The housing net worth shock calculation ignores the possibility of debt write-off due to default. However, our Equifax data on household debt has very accurate information on defaults and write-downs, and accounting for debt write-downs does not change any of our core results.

1.2. *Classifying Industries Into Tradable and Non-Tradable Categories*

We provide two independent methods of industry classification:

1. Retail and world trade based classification. The first classification scheme defines a four-digit NAICS industry as *tradable* if it has imports plus exports equal to at least $10,000 per worker, or if total exports plus imports for the NAICS four-digit industry exceeds $500M.[4] *Non-tradable* industries are de-

[3]County data at the four-digit industry level is at times suppressed for confidentiality reasons. However, in these situations the Census Bureau provides a "flag" that tells us of the range within which the employment number lies. We take the mean of this range as a proxy for the missing employment number in such scenarios.

[4]The industry level trade data for the United States are taken from Robert Feenstra's website http://cid.econ.ucdavis.edu. The trade data are based on 2006 numbers.

fined as the retail sector and restaurants. A third category is *construction*, which includes industries related to construction, real estate, or land development. Any industry in the construction category is not included in either the tradable or non-tradable category. The remaining industries are classified as *other*. Table I, Panel A presents the top 20 tradable and non-tradable industries by employment, while Appendix Table I in the Supplemental Material (Mian and Sufi (2014)) lists all 294 four-digit industries and their classification.[5]

2. Geographical Concentration Based Classification. Our second classification uses geographical concentration of industries. It is based on the idea that the production of tradable goods requires specialization and scale, so industries producing tradable goods should be more concentrated geographically. Similarly, certain goods and services (such as vacation beaches and amusement parks) are concentrated geographically and rely on national demand, making them tradable for our purposes. In contrast, non-tradable industries are needed everywhere by definition and therefore should be geographically dispersed.

We construct a geographical Herfindahl index for each industry based on the share of an industry's employment that falls in each county. The geographical concentration index is 0.018 for industries that we classify as tradable in our first classification scheme, and 0.004 for non-tradable industries. This is a large difference given that the mean and standard deviation of the Herfindahl index are 0.016 and 0.023, respectively.

Table I, Panel B lists the top 20 most concentrated industries and whether they are classified as tradable according to our previous categorization. A number of new industries, such as securities exchanges, sightseeing activities, amusement parks, and internet service providers, show up as tradable. This is sensible given that these activities cater to broader national-level demand. Similarly, the bottom 30 industries according to the concentration index reveal a number of new industries classified as non-tradable, including lawn and garden stores, death care services, child care services, religious organizations, and nursing care services. These are all industries that cater mostly to local demand but were missed in our previous classification.

We categorize the top and bottom quartile of industries by geographical concentration as tradable and non-tradable, respectively. We also use the concentration index as a continuous measure of "tradability" in some specifications. Appendix Table I lists the concentration index for all 294 four-digit industries.

1.3. *Summary Statistics*

Table II presents summary statistics. The average (population weighted) housing net worth shock between 2006 and 2009 is 9.5% with a large standard

[5]The shares of total 2007 employment are: tradable (11%), non-tradable (20%), construction (11%), and other (59%).

TABLE I

INDUSTRY CATEGORIZATION[a]

Non-Tradable Industries			Tradable Industries		
NAICS	Industry Name	NT?	NAICS	Industry Name	T?
Panel A: Industry classification based on retail, restaurants, and US—world trade					
7221	Full-service restaurants	1	3261	Plastics product manufacturing	0
7222	Limited-service eating places	1	3231	Printing and related support activities	0
4451	Grocery stores	1	3363	Motor vehicle parts manufacturing	0
4521	Department stores	1	3116	Animal slaughtering and processing	0
4529	Other general merchandise stores	1	3364	Aerospace product & parts manufacturing	1
4481	Clothing stores	0	3327	Machine shops; screw nut & bolt manuf.	0
4461	Health and personal care stores	1	3345	Navigational & control instruments manuf.	0
4471	Gasoline stations	1	3344	Semiconductor and other electronic manuf.	1
7223	Special food services	0	3399	Other miscellaneous manufacturing	0
4511	Sporting goods hobby and music stores	1	5112	Software publishers	1
7224	Drinking places (alcoholic beverages)	0	3391	Medical equipment and supplies manuf.	0
4532	Office supplies stationery and gift stores	1	3222	Converted paper product manufacturing	0
4539	Other miscellaneous store retailers	1	3118	Bakeries and tortilla manufacturing	0
4482	Shoe stores	0	3339	Other general purpose machinery manuf.	0
4512	Book, periodical, and music stores	0	3329	Other fabricated metal product manuf.	0
4452	Specialty food stores	0	3254	Pharmaceutical and medicine manuf.	0
4483	Jewelry luggage and leather goods stores	1	3331	Agriculture and mining machinery manuf.	0
4453	Beer wine and liquor stores	1	3361	Motor vehicle manufacturing	1
4533	Used merchandise stores	1	3251	Basic chemical manufacturing	1
4531	Florists	1	3114	Fruit & vegetable preserving & manuf.	0

(*Continues*)

TABLE I—*Continued*

Non-Tradable Industries			Tradable Industries		
NAICS	Industry Name	NT?	NAICS	Industry Name	T?
Panel B: Industry classification based on geographical concentration of industries					
4442	Lawn and garden equipment stores	0	5232	Securities and commodity exchanges	0
4245	Farm product raw material wholesalers	0	4861	Pipeline transportation of crude oil	0
4471	Gasoline stations	1	3152	Cut and sew apparel manufacturing	1
2123	Nonmetallic mineral mining & quarrying	0	5121	Motion picture and video industries	0
4529	Other general merchandise stores	1	7114	Agents for artists, entertainers, etc.	0
7212	RV parks and recreational camps	0	4831	Deep sea / great lakes water transportation	0
3211	Sawmills and wood preservation	0	5152	Cable and other subscription programming	0
4531	Florists	1	5122	Sound recording industries	0
8122	Death care services	0	3122	Tobacco manufacturing	1
5323	General rental centers	0	7115	Independent artists, writers and performers	0
4543	Direct selling establishments	0	3365	Railroad rolling stock manufacturing	1
4441	Building material and supplies dealers	0	4879	Scenic and sightseeing transportation other	0
4412	Other motor vehicle dealers	1	7131	Amusement parks and arcades	0
6231	Nursing care facilities	0	4872	Sightseeing transportation water	0
4413	Automotive accessories and tire stores	1	5231	Securities and commodity intermediation	0
1133	Logging	0	5181	Internet Sservice Pproviders	0
4842	Specialized freight trucking	0	2122	Metal ore mining	1
3273	Cement and concrete manufacturing	0	4883	Support activities for water transportation	0
3219	Other wood product manufacturing	0	4243	Apparel piece goods and wholesalers	0
6232	Mental health & substance abuse facilities	0	4889	Other support activities for transportation	0

[a]This table presents the top 20 industries classified as "tradable" / "non-tradable" for each of the two classification methods. Panel A presents the top 20 industries based on employment within the first classification method, and Panel B presents top 20 based on geographical concentration rank. "NT?" / "T?" columns are coded 0/1 depending on whether the industry is classified as non-tradable / tradable according to the alternative classification method. Appendix Table I provides a complete list of industries and their classification for each of the 294 four-digit industries.

TABLE II

SUMMARY STATISTICS[a]

	N	Mean	SD	10th	90th	Weighted Mean	Weighted SD
Housing net worth shock, 2006 to 2009	944	−0.065	0.085	−0.172	0.003	−0.095	0.100
Number of households, 2000	944	98,197	187,506	12,841	237,783	455,860	666,240
Labor force growth, 2007 to 2009	944	0.014	0.030	−0.018	0.050	0.014	0.025
Total employment, 2007	944	110,725	235,669	9,652	267,278	543,470	809,861
Employment growth, 2007 to 2009	944	−0.052	0.066	−0.123	0.021	−0.053	0.047
Average wage, 2007	944	7.338	2.414	5.234	9.985	9.727	3.790
Average wage growth, 2007 to 2009	944	0.028	0.071	−0.044	0.100	0.026	0.056
Housing supply elasticity (Saiz)	540	2.204	1.117	0.943	3.589	1.718	0.990
Non-tradable employment growth, 2007 to 2009	944	−0.029	0.086	−0.110	0.063	−0.040	0.061
Food industry employment growth, 2007 to 2009	944	−0.012	0.090	−0.093	0.089	−0.021	0.063
Tradable employment growth, 2007 to 2009	944	−0.115	0.192	−0.337	0.062	−0.116	0.136
Construction employment growth, 2007 to 2009	944	−0.163	0.164	−0.368	0.023	−0.161	0.136
Other employment growth, 2007 to 2009	944	−0.021	0.082	−0.103	0.070	−0.026	0.052
Industry geographical Herfindahl, 2007	294	0.016	0.023	0.0034	0.0338	0.0083	0.011
Hourly wage, 2007	944	18.978	3.447	15.484	23.354	21.086	3.692
Hourly wage, 10th percentile, 2007	944	5.801	0.830	4.834	7.000	6.241	0.774
Hourly wage, 25th percentile, 2007	944	9.052	1.450	7.500	10.955	9.808	1.464
Hourly wage, median, 2007	944	22.975	4.697	18.269	29.101	25.683	5.109
Hourly wage, 75th percentile, 2007	944	34.714	7.487	27.404	44.535	39.478	8.658
Hourly wage, 90th percentile, 2007	944	14.494	2.710	11.731	18.229	15.984	2.880
Wage growth, 2007 to 2009	943	0.012	0.089	−0.099	0.124	0.011	0.066
Wage growth, 10th percentile, 2007 to 2009	943	0.053	0.064	−0.022	0.137	0.048	0.049
Wage growth, 25th percentile, 2007 to 2009	943	0.058	0.055	−0.006	0.134	0.051	0.041
Wage growth, median, 2007 to 2009	943	0.050	0.068	−0.030	0.136	0.040	0.048
Wage growth, 75th percentile, 2007 to 2009	943	0.066	0.057	−0.001	0.137	0.056	0.042
Wage growth, 90th percentile, 2007 to 2009	943	0.039	0.057	−0.031	0.107	0.032	0.039

[a]This table presents summary statistics for the county-level data used in the analysis. Employment data are from the Census County Business Patterns, wage data are from the American Community Survey, debt data are from Equifax, and income data are from the IRS. The last two columns are weighted by the number of households in the county as of 2000, except industry-level Herfindahl, which is weighted by an industry's 2007 total employment. The data are restricted to the 944 counties for which the housing net worth shock variable can be constructed. These counties represent 80% of total U.S. population.

deviation of 10.0%. The employment drop from 2007 to 2009 is 5.3% overall, 16.1% for construction, 11.6% for tradable goods, 4.0% for non-tradable goods, and 2.6% for other sectors. Nominal wage growth computed from the CBP data is positive. However, this wage is computed as total payroll divided by the number of employees and as such the change in wage includes possible changes in the number of hours worked. We therefore also construct hourly wage data from the American Community Survey (ACS). The median hourly wage is $25.7 and grows by 4.0% from 2007 to 2009.

2. HOUSING NET WORTH AND THE DECLINE IN NON-TRADABLE EMPLOYMENT

2.1. *The Housing Net Worth Channel*

Housing net worth shocks can have important consequences for spending and employment, especially in the presence of nominal and real rigidities. Mian, Rao, and Sufi (2013) showed that counties with large decline in housing net worth cut back sharply on spending. What are the employment consequences for each percentage decline in housing net worth? Estimating this parameter is complicated by the fact that reduction in spending as a result of net worth decline in an area impacts employment *everywhere* through the trade channel, making it difficult to trace the employment effect of local net worth shocks.

Our solution to this problem lies in isolating the impact of change in net worth on employment in the non-tradable sector. The non-tradable sector relies on spending in its geographical proximity by definition. Therefore, we can test if housing net worth shocks translate into employment losses by estimating the following equation for non-tradable employment:

$$\Delta \log E_i^{\mathrm{NT}} = \alpha + \eta * \Delta HNW_i + \varepsilon_i,$$

where $\Delta \log E_i^{\mathrm{NT}}$ is the log change in non-tradable employment (excluding construction) in county i between 2007 and 2009, ΔHNW_i is the housing net worth shock defined as $\frac{\Delta \log p_{06-09}^{H,i} * H_{2006}^i}{NW_{2006}^i}$, and η is the elasticity of interest.[6]

Figure 1 plots $\Delta \log E_i^{\mathrm{NT}}$ against ΔHNW_i for the two definitions of non-tradable employment. The left panel is based on restaurants and retail stores as the non-tradable sector definition. There is a strong positive correlation between the two variables. Counties with bigger decline in housing net worth experience a larger decline in non-tradable employment from 2007 to 2009. The thin black line in the left panel plots the nonparametric relationship between the change in employment in the non-tradable sector and the change in

[6]Note that the change in housing net worth is larger when the change in house price is larger *and* when household leverage is higher.

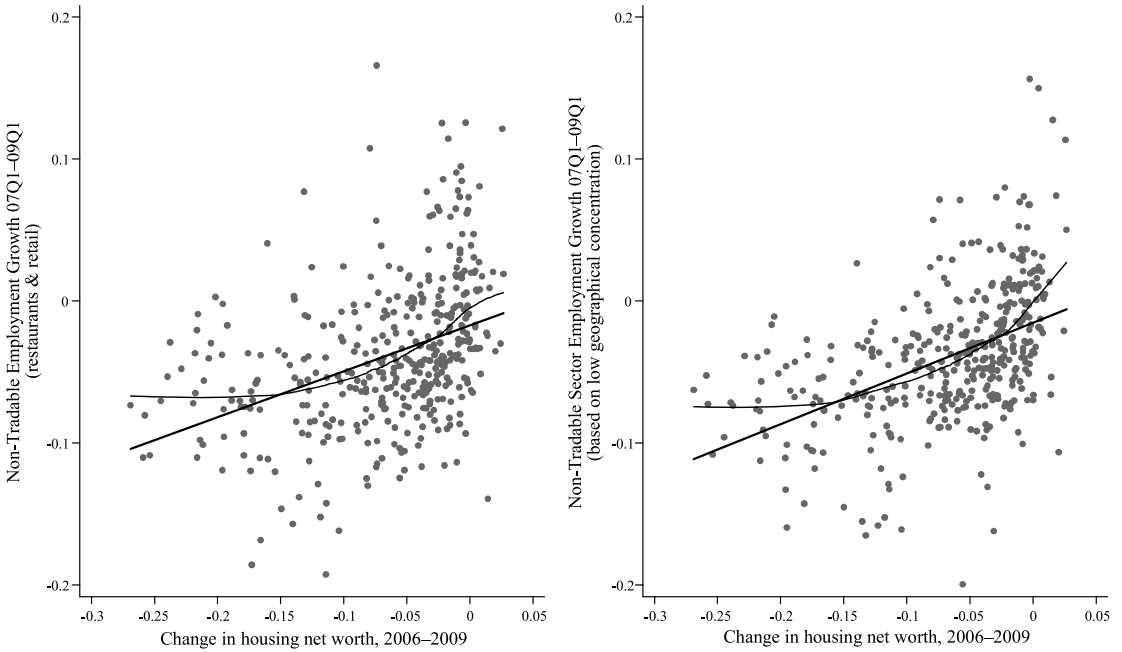

FIGURE 1.—Non-tradable employment and the housing net worth shock. This figure presents scatter-plots of county-level non-tradable employment growth from 2007Q1 to 2009Q1 against the change in housing net worth from 2006 to 2009. The left panel defines industries in restaurant and retail sector as non-tradable, and the right panel defines industries as non-tradable if they are geographically dispersed throughout the United States. The sample includes counties with more than 50,000 households. The thin black line in the left panel is the non-parametric plot of non–tradable employment growth against change in housing net worth.

housing net worth, and shows that there is some convexity in the relationship between the two variables.

The right panel of Figure 1 repeats the exercise using the second definition of non-tradable based on the geographical concentration of each four-digit industry. While the set of industries defined as non-tradable under the second definition is quite distinct from those defined as non-tradable under the first definition, the results are remarkably similar.[7] Columns 1 and 2 of Table III report regressions of the change in non-tradable employment using the two definitions of non-tradable employment on change in housing net worth. The correlation documented in Figure 1 is strong and significant at the 1% level.

All standard errors in this paper are clustered at the state level to allow for spatial correlation across counties within a state, and to allow for correlation within a state due to state-specific foreclosure, bankruptcy, or other labor market laws. We also report standard errors (in square brackets) that allow for spatial correlation among counties irrespective of state. In particular, we compute the distance between all county-pairs and allow for county-pairs to have a correlation that varies inversely with the distance between them. State-clustered standard errors tend to be larger and we report these standard errors in the rest of the paper.

2.2. *Supply-Side Sector-Specific Shocks*

One concern with columns 1 and 2 is that the ΔHNW_i may be spuriously correlated with supply-side industry-specific shocks that impact both employment and housing net worth. In particular, certain industries may be harder hit during the recession, and counties with greater exposure to these industries may naturally experience both a larger decline in housing net worth and larger fall in employment.

We control for such supply-side sector-specific concerns in columns 3 and 4 by including the share of a county's employment in 2006 that is in *each of the 23 two-digit industries*. There are therefore 23 additional control variables that allow for separate industry effects for industries such as agriculture, mining, utilities, construction, wholesale trade, retail trade, finance, real estate, construction, and health care.[8]

The results show that the coefficient on the housing net worth shock does not change in any statistically significant sense, despite the fact that the R^2 increases significantly. In the Supplemental Material, we use this information to also conduct an omitted variable bias test as suggested by Oster (2014) based on the work of Altonji, Elder, and Taber (2005).

[7]For visual clarity, we exclude some outlier counties with large decline in housing net worth (below −0.3). However, all these counties are included in the regression analysis and hence are not excluded from our formal analysis.

[8]Table III lists all of the 23 two-digit industries.

TABLE III

NON-TRADABLE EMPLOYMENT GROWTH AND THE HOUSING NET WORTH SHOCK[a]

	Employment Growth, Non-Tradable Industries, 2007–2009									
Non-Tradable Definition Used:	Rest. & Retail (1)	Geog. Concen. (2)	Rest. & Retail (3)	Geog. Concen. (4)	Rest. & Retail (5)	Geog. Concen. (6)	Rest. & Retail (7)	Rest. & Retail (8)	Geog. Concen. (9)	Rest. & Retail (10)
Δ Housing Net Worth, 2006–2009	0.190**	0.199**	0.174**	0.166**	0.374**	0.208*	0.489**	0.440**	0.212*	0.133**
	(0.042)	(0.049)	(0.043)	(0.046)	(0.132)	(0.086)	(0.127)	(0.140)	(0.091)	(0.036)
	[0.022]	[0.017]	[0.021]	[0.016]	[0.081]	[0.067]	[0.118]	[0.072]	[0.057]	[0.022]
Δ*HNW* ∗ (Construction Share 07)								−1.99*	−0.325	
								(0.856)	(0.561)	
Construction Share 07								−0.082	−0.183	
								(0.158)	(0.126)	
Δ Construction Employment, 2007–2009										0.079**
										(0.027)
Constant	−0.022**	−0.021**	0.176	0.070	0.445	1.233**	−0.102	0.254	0.072	0.162
	(0.007)	(0.007)	(0.443)	(0.286)	(0.536)	(0.438)	(0.57)	(0.428)	(0.290)	(0.430)
Specification	OLS	OLS	OLS	OLS	IV	IV	IV	OLS	OLS	OLS
Industry controls?			YES	YES	YES	YES	YES	YES	YES	YES
Other controls?							YES			
N	944	944	944	944	540	540	540	944	944	944
R^2	0.096	0.156	0.175	0.236	0.158	0.275	0.144	0.188	0.239	0.194

[a]This table reports regression estimates of non-tradable employment growth from 2007 to 2009 on the housing net worth shock at the county level. Regressions are weighted by the total number of households in a county. The IV specification uses housing supply elasticity as an instrument for the housing net worth shock. Standard errors in parentheses are clustered at the state level, and in square brackets are adjusted for spatial correlation with correlation proportional to the inverse of the distance between any two counties. The industry controls are the 2006 employment share in a county for 23 two-digit industries: Agriculture, Mining, Utilities, Construction, Manufacturing (3 two-digit industries), Wholesale Trade, Retail Trade (2 two-digit industries), Transportation (2 two-digit industries), Information, Finance, Real Estate, Professional Services, Management, Administrative Services, Education, Health Care, Entertainment, Accommodation and Food Services, Other Services. The other controls include pre-recession percentage white, median household income, percentage owner-occupied, percentage with less than high school diploma, percentage with only a high school diploma, unemployment rate, poverty rate, and percentage urban. **,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively.

The Great Recession was particularly harsh on the construction sector, and one may worry that places where house prices and hence housing net worth fell the most also had greater exposure to the construction sector. We conduct a number of checks to test this concern.

Our first test uses the Saiz (2010) housing supply elasticity as an instrument for the change in housing net worth. Mian, Rao, and Sufi (2013) showed that while the Saiz instrument is strongly correlated with ΔHNW_i, it is *not* correlated with either the share of employment in construction sector in a county, or the growth in construction sector employment prior to 2007.

Columns 5 and 6 instrument ΔHNW_i with housing supply elasticity. The IV coefficients are stronger than their OLS counterpart, showing that our results are robust to construction sector concerns. The number of observations declines because the housing supply elasticity variable is not available for all counties. In unreported regressions, we show that the increase in coefficient relative to the OLS version is not driven by the smaller sample size.

The estimated coefficients in Table III are large. For example, the IV estimate in column 5 implies that going from the 90th to the 10th percentile of change in housing net worth distribution in the cross-section leads to a loss in non-tradable employment of 8.2%. As a comparison, non-tradable employment declines by 12% when we move from the 90th to the 10th percentile. The elasticity of spending with respect to housing net worth is estimated to be 0.77 in Mian, Rao, and Sufi (2013), which implies an elasticity of non-tradable employment with respect to spending of 0.48.[9]

While the instrument is orthogonal to construction sector exposure, there may be a concern that it is correlated with other county-level demographic attributes in a way that biases the IV estimate. We test for this concern by including a number of county-level control variables in column 7, including percentage white, median household income, percentage owner-occupied, percentage with less than high school diploma, percentage with only a high school diploma, unemployment rate, poverty rate, and percentage urban. The coefficient of interest remains materially unchanged.

An alternative test for the concern regarding the construction sector is presented in columns 8 and 9 that interact ΔHNW_i with the share of employment in the construction sector in 2007. The coefficient on the un-interacted ΔHNW_i reflects the (out of sample) predicted impact of ΔHNW_i on the change in non-tradable employment for counties with zero construction sector exposure. This predicted impact remains strong and significant.

Column 10 explicitly *controls* for job losses in construction between 2007 and 2009. It is an extreme test because including the change in construction employment on the right hand side is likely to "over control": the spending

[9]The calculation of moving from 10th to 90th percentile is based on the IV sample with 540 counties. Elasticity of spending is from Table III, column 4 of Mian, Rao, and Sufi (2013), and $0.48 = 0.37/0.77$.

response to the housing net worth decline will impact the construction sector as well. Nonetheless, column 10 shows that the coefficient on change in housing net worth remains positive and statistically significant at the 1% confidence level.

2.3. *The Business Uncertainty Hypothesis*

We next consider if the effect of the housing net worth shock on non-tradable employment can be explained by the business uncertainty hypothesis, or the idea that policy or other government-induced uncertainty is responsible for the decline in the economy. The canonical argument, as illustrated by Bloom (2009), is that uncertainty causes firms to temporarily pause their investment and hiring.[10]

In its most basic form, an increase in business uncertainty at the *aggregate* level does not explain the stark *cross-sectional* patterns in non-tradable employment losses that we have documented above. If the business uncertainty hypothesis were to qualify as an explanation for our results, it would have to be the case that the increase in business uncertainty was somehow larger in counties that experienced a large decline in housing net worth.

Of course, if businesses face more uncertainty because of a large decline in local demand in these areas, then this is simply another manifestation of the housing net worth channel. The alternative explanation must involve greater uncertainty in areas with large housing net worth decline for reasons other than the decline in local demand itself. For example, perhaps there is more uncertainty regarding state government policies in states with severe housing problems.

Appendix Figures 1 and 2 in the Supplemental Material present an additional test of the uncertainty hypothesis based on state-level survey data from the *National Federation of Independent Businesses*. They show that business owners' concerns regarding regulation and government policy increased significantly later than the decline in employment. Moreover, there is no relationship between the increase in concerns regarding government taxation/regulation and change in housing net worth, or the change in employment at the state level.

These results suggest that the uncertainty hypothesis is unlikely to be driving our main result. There is additional evidence that further corroborates this view. As we will see below, there is no correlation between the housing net worth shock and the change in tradable employment in a county. If supply-side driven business uncertainty were responsible for high non-tradable job losses

[10]Also see Baker, Bloom, and Davis (2011), Bloom (2009), Bloom, Foetotto, and Jaimovich (2010), Fernandez-Villaverde, Guerron-Quintana, Kuester, and Rubio-Ramirez (2011), and Gilchrist, Sim, and Zakrajsek (2010).

in counties with large housing net worth decline, then we would have expected the same result for tradable sector job loss as well.

In the Supplemental Material, we also address one additional form of uncertainty suggested by Mericle, Shoag, and Veuger (2012). Governments in states with housing problems may need to cut expenditures dramatically, thus raising business uncertainty.[11] However, we show that such state government cuts were concentrated in 2009 (Appendix Figure 3), much later than when job losses started. Further, we can control directly for mid-year state budget cuts and our results are robust (Appendix Table II).

2.4. *The Credit Supply Hypothesis*

Another alternative explanation for the relation between the change in nontradable employment and the housing net worth shock is based on the possibility that firms in counties with a larger decline in housing net worth face a larger decline in credit supply, forcing them to lay off workers. For example, firms using real estate as collateral for funding might experience a more severe reduction in credit supply in counties harder hit by the decline in house prices.

While credit supply shocks can be important drivers of firm investment, survey evidence from business owners presented in Appendix Figure 1 shows that only 3% of respondents report financing as their main problem in 2007. Further, there is no appreciable increase in the response rate as the recession unfolds. Instead, businesses start complaining about poor sales and government regulation at a significantly higher rate during the recession.

A second result that goes against the credit supply hypothesis is presented in the next section where we show that the change in tradable sector employment is not correlated with the housing net worth shock. If a reduction in credit supply were making firms fire workers, we would expect the drop in employment to take place in both tradable and non-tradable sectors.

Finally, one may argue that business credit supply shocks only affect nontradable industries. We test whether the relationship between the change in non-tradable employment and housing net worth shocks is driven by credit supply tightening in Table IV. County business pattern data break down county-level employment in each four-digit industry further by the size of the underlying reporting establishment. If our main result were driven by credit supply tightening, then we would expect the result to be stronger among smaller establishments that are more likely to be credit-constrained.

Panel A splits the change in non-tradable employment by establishment size and regresses it on the change in housing net worth. Panel B repeats this exercise using the IV specification. If differential credit supply shocks in counties with a large decline in housing net worth were driving our results, we would expect our effect to be stronger for smaller establishments. Instead we find

[11] We are grateful to Daniel Shoag for highlighting this issue and providing data.

TABLE IV

IS NON-TRADABLE EMPLOYMENT GROWTH DRIVEN BY CREDIT SUPPLY TIGHTENING?[a]

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A (OLS): Effect of change in housing net worth on non-tradable employment growth by establishment size ($N = 944$ counties)						
	Establishment Size in Terms of Number of Employees:					
	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100+
Δ Housing Net Worth, 2006–2009	0.070**	0.032	0.022	0.134**	0.152	0.434**
	(0.025)	(0.036)	(0.044)	(0.032)	(0.097)	(0.061)
Panel B (IV): Effect of change in housing net worth on non-tradable employment growth by establishment size ($N = 540$ counties)						
	Establishment Size in Terms of Number of Employees:					
	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4	1 to 4
Δ Housing Net Worth, 2006–2009	−0.134	0.000	−0.022	0.193*	0.335	0.770**
	(0.147)	(0.125)	(0.109)	(0.086)	(0.191)	(0.208)
Panel C: Effect of change in housing net worth on non-tradable employment growth by banking type						
	Banking Type:					
	National (OLS, $N = 472$)	Local (OLS, $N = 304$)	National (IV, $N = 472$)	Local (IV, $N = 236$)		
Δ Housing Net Worth, 2006–2009	0.186**	0.306	0.233**	0.308**		
	(0.041)	(0.178)	(0.068)	(0.107)		

[a]This table reports regression estimates of non-tradable employment growth from 2007 to 2009 on the housing net worth shock at the county level. Panels A and B reports the OLS and IV coefficient estimates, respectively, for establishments of varying sizes. Panel C reports the coefficients separately for national and local banking markets. Non-tradable employment is defined as employment in restaurant and retail industries at the four-digit industry level and then aggregated up separately for each county. All regressions are weighted using the total number of households in a county as weights. The instrumental variables specifications use the housing supply elasticity as an instrument for the change in housing net worth in the first stage. Standard errors are clustered at the state level. **,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively.

completely the opposite. Larger firms in hard hit counties see a larger decline. This is inconsistent with the credit supply view.

Panel C performs a different test of the credit supply hypothesis. It splits our sample into counties that are primarily served by national banks, and counties that are largely served by local banks. Using the summary of deposits data from the FDIC, for every bank, we calculate the share of deposits of that bank in every county. Then, for every county, we average this statistic over the banks located in the county.[12] A county that has banks that have a very low fraction of their deposits in that county is considered a national banking county. They therefore should not be as sensitive to local credit supply conditions. However, we find that the same pattern between non-tradable employment growth and housing net worth change holds within both national and local banking counties.

3. UNDERSTANDING THE ADJUSTMENT MECHANISMS: THEORY

The decline in county-level non-tradable employment in response to the decline in housing net worth potentially represents a partial equilibrium response of the local labor market. The overall impact of these shocks depends on general equilibrium adjustments. For example, if wages are flexible and search frictions minimal, a negative shock to non-tradable employment might be compensated by a fall in local wages and increased employment in the tradable sector.

If such adjustment mechanisms are strong enough, the negative impact documented above might not be important for the aggregate employment picture. On the other hand, the presence of real and nominal rigidities can make the effect of the housing net worth shock more durable. We discuss the possible adjustment mechanisms through the lens of a simple model.

3.1. *Baseline Model*

Consider an economy made up of S equally sized counties or "islands" indexed by c. Each county produces two types of goods, tradable (T) and non-tradable (N). Counties can freely trade the tradable good, but must consume the non-tradable good produced in their own county. We impose the restriction that labor cannot move across islands but can move freely between the tradable and non-tradable sectors within an island.

Each island has D_c units of total (nominal) consumer demand. Consumers have Cobb–Douglas preferences over the two consumption goods, and spend consumption shares $P_c^N C_c^N = \alpha D_c$ and $P^T C_c^T = (1-\alpha) D_c$ on the non-tradable and tradable good, respectively.

[12] We weight this average by the amount of deposits the bank has in the county.

All islands face the same tradable good price, while the non-tradable good price may be county-specific since each county must consume its own production of the non-tradable good. Production is governed by a constant returns technology for tradable and non-tradable goods with labor (e) as the only factor input and produces output according to $y_c^T = be_c^T$, and $y_c^N = ae_c^N$, respectively.

Total employment on each island is normalized to 1 with $e_c^T + e_c^N = 1$. Wages in the non-tradable and tradable sectors are given by $w_c^N = aP_c^N$ and $w_c^T = bP^T$, respectively. Free mobility of labor across sectors equates the two wages, making the non-tradable good price independent of its county, that is, $P_c^N = \frac{b}{a}P^T$. Goods market equilibrium in non-tradable and tradable sectors implies that $y_c^N = C_c^N$ on each island and $\sum_{c=1}^{S} y_c^S = \sum_{c=1}^{S} C_c^T$.

We first solve the model under the symmetry assumption that, in the initial steady state, all islands have the same nominal demand $D_c = D_0$. Solving for output, employment, and prices, and denoting the initial steady state by superscript (*), we obtain

$$e_c^{*N} = \alpha, \quad e_c^{*T} = (1-\alpha), \quad P_c^{*N} = \frac{D_0}{a},$$

$$P_c^{*T} = \frac{D_0}{b}, \quad w_c^{*N} = w_c^{*T} = D_0.$$

The model is "money neutral" with nominal shocks translating one for one into prices and wages. Real allocation across islands remains unchanged in response to the shock, with employment in non-tradable and tradable sectors given by α and $(1-\alpha)$, respectively.

We next consider what happens if counties are hit with differing household expenditure shocks driven by the shocks to housing net worth discussed above. We normalize the initial nominal demand $D_0 = 1$ and introduce the possibility of negative demand shocks (δ_c) that differ across counties such that $D_c = 1 - \delta_c$.[13] Without loss of generality, we index counties such that $\delta_{c+1} > \delta_c$ and the average of the demand shocks is $\overline{\delta}$.

With the introduction of county-specific demand shocks, there are two different scenarios to consider: one without nominal or real rigidities and another with rigidities.

3.2. *No Nominal or Real Rigidity*

Suppose prices and wages are perfectly flexible (no nominal rigidity), and there are no search or other frictions for labor to switch sectors (no real rigidity). Then there is deflation in response to negative demand shocks and an

[13]Both Eggertsson and Krugman (2012) and Guerrieri and Lorenzoni (2011) modeled the demand shock as a tightening of the borrowing constraint on levered households who respond by reducing consumption.

expansion in the tradable sector in certain counties. As we show in the Supplemental Material, the change in prices and wages in the flexible price equilibrium is given by $\Delta P_c^T = -\frac{\overline{\delta}}{b}$, $\Delta P_c^N = -\frac{\overline{\delta}}{a}$, $\Delta w_c^N = \Delta w_c^T = -\overline{\delta}$.

The downward adjustment in prices and wages allows the economy to remain at full employment after the shock, with the change in non-tradable and tradable employment in each county given by $\Delta e_c^N = -\alpha(\frac{\delta_c - \overline{\delta}}{1-\overline{\delta}})$, and $\Delta e_c^T = \alpha(\frac{\delta_c - \overline{\delta}}{1-\overline{\delta}})$. As a result, counties with more negative demand shocks see a larger decline in non-tradable employment, which is completely compensated by an equivalent increase in tradable employment in these counties.[14]

3.3. *Full Nominal or Real Rigidity*

Suppose instead that prices and wages are fully rigid, fixed at their initial steady state level of P_c^{*N}, P_c^{*T}, w_c^{*N}, and w_c^{*T}. With fixed prices, the goods and labor markets become "demand constrained" as in Hall (2011) and Bils, Klenow, and Malin (2013). Output and employment in the non-tradable sector is then governed by the new local demand for non-tradable goods at old steady state prices, giving us $e_c^N = \alpha(1 - \delta_c)$.

Output and employment in the tradable sector, however, depend on the average demand for tradable goods across all islands, giving us $e_c^T = (1 - \alpha) \times (1 - \overline{\delta})$. Let $Y_c^N = -\Delta e_c^N$ and $Y_c^T = -\Delta e_c^T$ denote total employment loss in county c in the non-tradable and tradable sectors, respectively. Then total employment loss, $Y_c = Y_c^N + Y_c^T$, can be written as

$$Y_c = \alpha\delta_c + (1 - \alpha)\overline{\delta}.$$

With nominal rigidity, job losses in a county have a non-tradable component that depends only on the county-specific household expenditure shock, and a tradable component that depends on the overall expenditure shock hitting the entire economy. Recall that under flexible prices, tradable employment increases in high δ_c counties, thereby compensating for jobs lost in the non-tradable sector in these counties. However, under price rigidity, there is no such adjustment in the tradable sector, generating zero correlation between tradable employment growth and δ_c.

We would obtain a similar result if, instead of nominal rigidity, we introduced real rigidity, or the assumption that workers cannot easily switch from non-tradable to tradable sector jobs. However, allowing for labor mobility across islands will tend to reduce the dispersion across islands in labor market outcomes. We will therefore test in the empirical section if labor systematically migrates from highly impacted counties to less impacted counties.

[14]This solution holds under the assumption that there are no corner solutions in any island, that is, $\alpha\frac{(1-\delta_c)}{(1-\overline{\delta})} = e_c^N \leq 1$, which translates into $\delta_1 \geq \frac{\overline{\delta}-(1-\alpha)}{\alpha}$. See Supplemental Material for full details.

4. UNDERSTANDING THE ADJUSTMENT MECHANISMS: EMPIRICS

4.1. *Housing Net Worth Shock and Tradable Sector Employment*

With flexible prices, the negative impact of the housing net worth shock on non-tradable employment is reversed by a gain in employment in the tradable sector. The top two panels in Figure 2 test this by plotting the change in tradable employment against the change in housing net worth across counties. The top-left panel uses the first definition of tradable employment based on industries that are traded internationally, while the top-right panel uses the second definition based on geographical concentration of industries. Despite the fact that the two definitions have many non-overlapping industries, there is no evidence of gain in tradable employment in counties that experience a larger decline in housing net worth.

Columns 1 and 2 of Table V report regressions of tradable employment growth in a county, using both definitions of "tradable," on the housing net worth shock. The estimated coefficients are close to zero and precisely estimated. The difference between the coefficients for tradable job losses in columns 1 and 2 of Table V and those for non-tradable job losses in columns 1 and 2 of Table III are also statistically significant at the 1% level. Columns 3 and 4 add the share of employment in each of 23 two-digit industries in 2006 to control for differences in industry exposure across counties. The housing net worth shock coefficient estimate is materially unchanged. The constants in columns 1 and 2 are negative and large, implying that tradable sector employment declines uniformly regardless of the size of the local housing net worth shock.

Column 5 uses data at the county-industry level and interacts the change in housing net worth with the industry-specific geographical Herfindahl index listed in Appendix Table I in the Supplemental Material. The specification uses a continuous definition of tradability for *all* industries to test whether the effect of housing net worth shock is stronger for more non-tradable industries. Each county-industry observation is weighted by the total employment in that cell in 2007.

The estimated coefficient on the change in housing net worth shock is positive and significant, implying that job losses in the least concentrated (most non-tradable) industries are more severe in counties with a large housing net worth decline. The interaction term is negative and significant, implying that the effect of housing net worth diminishes as industries become more geographically concentrated. The implied effect of the housing net worth shock on employment for an industry at the 90th percentile of geographical concentration is 0.031 with standard error of 0.062, and it is -0.055 with a standard error of 0.076 at the 95th percentile. The standard errors are computed using the Delta method. While the effect of the housing net worth shock on employment gets close to zero for industries with a high degree of geographical

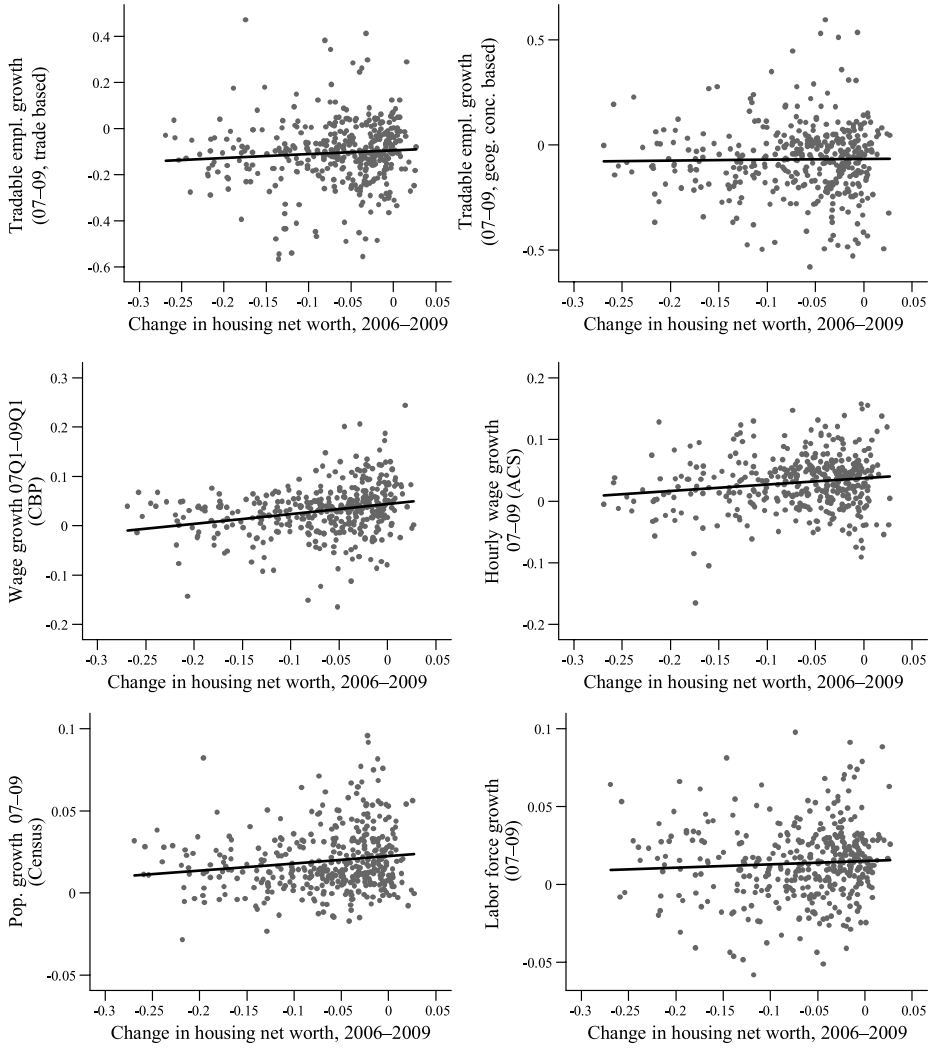

FIGURE 2.—Tradable employment, wages, labor mobility, and the housing net worth shock. The top panel presents scatter-plots of county-level tradable employment growth from 2007Q1 to 2009Q1 against the change in housing net worth from 2006 to 2009. The top-left panel defines industries as tradable if they appear in U.S. global trade, and the top-right panel defines industries as tradable if they are geographically concentrated in the United States. The middle panels plot wage growth (using payroll data) and hourly wage growth (using ACS data) against the change in housing net worth. The bottom panel plots population growth and labor force growth against the change in housing net worth. The sample includes counties with more than 50,000 households.

TABLE V

TRADABLE EMPLOYMENT GROWTH AND THE HOUSING NET WORTH SHOCK[a]

	Employment Growth, Tradable Industries, 2007–2009				Employment Growth, 2007–2009 (County–Four Digit Industry Level)			
					All Industries		Tradable Industries	
Tradable Definition Used:	Global Trade (1)	Geog. Conc. (2)	Global Trade (3)	Geog. Conc. (4)	Geog. Conc. (5)	Geog. Conc. (6)	Global Trade (7)	Global Trade (8)
Δ Housing Net Worth, 2006–2009	0.018	−0.085	0.064	−0.063	0.198**	—	−0.096	—
	(0.099)	(0.063)	(0.098)	(0.074)	(0.058)		(0.137)	
Industry Geographical Herfindahl Index					−2.936**	—		
					(0.606)			
Δ*HNW** (Geographical Herfindahl)					−11.733**	−7.328**		
					(3.254)	(1.367)		
Trade per worker (Mil. $)							−0.262	—
							(0.238)	
Δ*HNW** (Trade per worker)							−1.274	−1.409
							(1.386)	(0.980)
Constant	−0.114**	−0.091**	−0.286	0.542	−0.077**	—	−0.233**	—
	(0.012)	(0.012)	(0.950)	(1.144)	(0.010)		(0.015)	
Two-digit 2006 employment share controls?			Yes	Yes				
Four-digit Industry Fixed Effects						Yes		Yes
County Fixed Effects						Yes		Yes
N	944	944	944	944	180,756	180,756	31,970	31,970
R^2	0.000	0.002	0.079	0.064	0.004	0.18	0.0014	0.19

[a]This table reports regression estimates of tradable employment growth from 2007 to 2009 on the housing net worth shock at the county level. Tradable employment is defined at the four-digit industry level and then aggregated up separately for each county in columns 1 through 4. We use two different definitions of tradable industries, one based on US imports and exports, and another based on an industry's geographical concentration within the United States. There are 23 two-digit industry employment share variables as controls in columns 3 and 4. A unit of observation in columns 5 through 8 is county—four digit industry. There are 294 four-digit industry and 944 county fixed effects in columns 6 and 8. All regressions are weighted using the total number of households as weights. Standard errors are clustered at the state level. **,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively.

concentration (i.e., the most tradable industries), it does not turn significantly negative.[15]

Column 6 adds four-digit industry fixed effects (294 industries) and county fixed effects (944 counties). The industry fixed effects force comparison to be made within the same four-digit industry across counties. Such fixed effects therefore control for aggregate shifts at the industry level during the 2007–2009 period. The county fixed effects nonparametrically take out any county-specific changes over 2007–2009. Despite the inclusion of these fixed effects, our key result remains unchanged: the effect of the housing net worth shock on employment is stronger for non-tradable industries that are geographically least concentrated across the United States.

The regressions reported in columns 7 and 8 restrict sample to industries defined as tradable according to global trade and interact the change in housing net worth with the level of trade per worker in an industry. The interaction terms are not significant, showing that the effect of housing net worth on employment does not vary within the tradable sector.

4.2. *Housing Net Worth Shock, Wage Flexibility, and Labor Mobility*

Columns 1 and 2 of Table VI and the middle-left panel of Figure 2 use county-level data on payroll wage growth to show that counties with large decline in housing net worth experience a small relative decline in payroll wage growth from 2007 to 2009. However, the coefficient is small in magnitude and statistically significant only with two-digit industry controls.[16]

Payroll wage growth also includes changes in the number of hours worked that could differentially affect counties with a greater decline in housing net worth. In columns 3 and 4 and the middle-right panel of Figure 2, we use hourly wage growth as the dependent variable, which shows no strong relation with the housing net worth shock.

Following Blanchard and Katz (1992), we also evaluate mobility. The bottom-left panel of Figure 2 and columns 5 and 6 of Table VI correlate county-level population growth from 2007 to 2009 with the change in housing net worth. While population growth is uncorrelated with the change in housing net worth by itself, the correlation turns significant with two-digit industry share controls (column 6). However, this result is not robust to alternative definitions of mobility. Columns 7 and 8 use the American Community Survey data on propensity of respondents to have migrated into their current

[15]It is only at the extreme end of the tradability distribution that the effect of housing net worth becomes negative and significant. For example, at the 99th percentile, the effect is −0.48 with standard error of 0.18.

[16]There are a number of other papers independently arguing for the presence of price and wage rigidities in the Great Recession, in particular, Daly, Hobijn, and Lucking (2012), Daly, Hobijn, and Wiles (2011), Fallick, Lettau, and Wascher (2011), and Hall (2011).

TABLE VI

WAGES, MOBILITY, AND THE HOUSING NET WORTH SHOCK[a]

	Total Wage Growth, 2007 to 2009, CBP		Average Hourly Wage Growth, 2007 to 2009, ACS		Population Growth, 2007–2009		In-Migration Growth, 2007–2009		Labor Force Growth, 2007–2009	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Δ Housing Net Worth, 2006–2009	0.061	0.078*	0.054	0.056	0.019	0.057**	−0.042	−0.128	−0.0094	0.0032
	(0.041)	(0.037)	(0.039)	(0.035)	(0.021)	(0.021)	(0.11)	(0.127)	(0.020)	(0.024)
Constant	0.031**	−0.325	0.037**	0.078	0.021**	−0.103	−0.010**	−0.530	0.0136	0.030
	(0.007)	(0.250)	(0.003)	(0.20)	(0.004)	(0.137)	(0.015)	(1.778)	(0.004)	(0.24)
Two-digit 2006 employment share controls?		Yes		Yes		Yes		Yes		Yes
N	944	944	943	943	939	939	943	943	944	944
R^2	0.012	0.16	0.018	0.076	0.009	0.25	0	0.027	0.001	0.12

[a]Columns 1 through 4 present coefficients from regressions relating wage growth in a county from 2007 to 2009 to the housing net worth shock. The specifications in columns 1 and 2 use total wages from the Census County Business Patterns data, and columns 3 and 4 use hourly wage growth data from the American Community Survey. Columns 5 through 10 present coefficients from regressions relating mobility and labor force participation in a county from 2007 to 2009 to the change in housing net worth. Columns 5 and 6 use census data on population growth, columns 7 and 8 use growth in in-migration from the American Community Survey, and columns 9 and 10 use labor force growth from the Bureau of Labor Statistics. All regressions are weighted using the total number of households in a county as weights. Standard errors are clustered at the state level. **,* Coefficient statistically different than zero at the 1% and 5% confidence level, respectively.

county of residence. There is no evidence that in-migration growth is faster in counties that are less negatively impacted by the housing net worth shock. Further support for this result is provided by Yagan (2014), who used geo-coded individual-level data from tax returns to show that individuals experiencing negative employment shocks were not able to insure against these shocks by moving to areas with lower unemployment rates.

Finally, the bottom-right panel of Figure 2 and columns 9 and 10 correlate labor force growth with the change in housing net worth and show there is no clear relationship. Overall, the results in Figure 2 and Table VI show that the migration of workers from counties with a large decline in housing net worth to counties with smaller declines is unlikely to explain the drop in non-tradable employment in counties with a large decline in housing net worth.

5. CONCLUSION

The Great Recession resulted in a remarkable loss of jobs between 2007 and 2009. This paper outlines the importance of the housing net worth shock and shows that housing net worth losses led to significant non-tradable sector job losses in the cross-section. This result is not driven by supply-side industry-specific shocks (such as construction) or credit supply conditions. We also do not find strong evidence of labor market adjustment through wages, labor mobility, or expansion in tradable employment in harder hit counties.

Our results are robust to two distinct definitions of non-tradable and tradable sectors. Our second definition of non-tradable and tradable sectors, based on the geographical concentration of each four-digit industry, is new to the literature and can be used more generally in empirical studies exploiting regional or international shocks.

An important question for future research concerns the effect of the *housing boom* on employment. Our study uses the collapse in housing net worth as its starting point. However, the housing boom itself may have affected employment patterns before the recession, and as such the job losses that we document may represent the return to more "normal" housing conditions. For example, Charles, Hurst, and Notowidigo (2012) argued that the positive employment effects of the housing boom masked the broader fall in employment due to a decline in manufacturing.

Another question for future research is about the *persistence* of high levels of unemployment beyond 2009. A recent paper by Hagedorn, Karahan, Manovskii, and Mitman (2013) argued that unemployment benefit extensions explain a large part of the persistently high level of unemployment after 2009. In another paper, Jaimovich and Siu (2013) argued that the automation of routine tasks over time leads to job polarization in the face of a sudden downturn. This generates "jobless recoveries" where the fall in employment in non-routine employment is more permanent. Understanding the longer term decline in employment to population ratio remains a very important question for further investigation.

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