DEMAND-DRIVEN PROPAGATION:

EVIDENCE FROM THE GREAT RECESSION

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ABSTRACT

This paper shows that U.S. counties with higher pre-existing exposure to *tradable industries* experienced larger job losses in *non-tradable sectors* during the Great Recession. This was arguably because laid-off tradable workers cut their consumption, which hurts local non-tradable firms. The finding is not driven by exposure to the construction sector, by the collapse in house prices, or by credit supply problems. In addition, the spillover is stronger when the focus is on the job losses of more income-elastic non-tradable sectors. The evidence suggests a demand driven spillover of job losses from tradable to non-tradable sectors.

JEL code: E24, E62

Keyword: Demand-driven propagation, Great Recession, job losses

1. INTRODUCTION

Economists and policy makers have been concerned about downward demand spirals in recessions- the idea that initial job losses can lead to additional cuts in consumption, and as a consequence, further job losses. Since the start of the Great Recession, the concern has been raised again by many economists. Paul Krugman, for example, at the height of the economic crisis, argued that "*rising unemployment will lead to further cuts in consumer spending. Weak consumer spending will lead to cutbacks in business investment plans. And the weakening economy will lead to more job cuts, provoking a further cycle of contraction…To pull us out of this downward spiral, the federal government will have to provide economic stimulus in the form of higher spending and greater aid to those in distress*" (New York Times, November 14, 2008).

This paper provides empirical evidence to support the demand-driven propagation channel. My identification strategy is as follows: I exploit the pre-existing variation in the exposure to tradable sectors across U.S. counties. I find that counties with higher pre-existing exposure to *tradable industries* experience stronger job losses in *non-tradable sectors* during the Great Recession. Across counties, a 1% increase in pre-existing tradable exposure is associated with a 0.49% decrease in non-tradable employment between 2007 and 2010. This could arguably be caused by laid-off tradable workers cutting their consumption, consequently hurting local non-tradable firms.

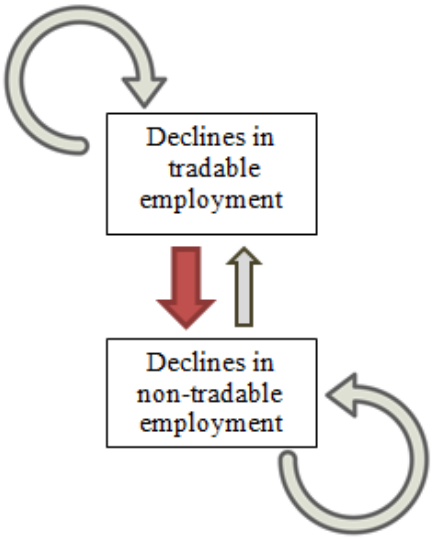

Figure 1.1: Intertwined feedback loops of job losses

There has been little empirical evidence so far to support the demand propagation channel. This is partly because it is very difficult to separate different rounds of job losses in the data. In other words, we are not certain if one's job loss causes others' job losses, or the other way around. As can be seen in Figure 1.1, initial declines in tradable employment could hurt tradable and non-tradable employment. In turn, the drop in non-tradable employment could lead to further job losses in in non-tradable and tradable sectors. For example, laid-off automobile workers could postpone purchasing new TV sets, and cut back their restaurant meals. If this were the case, restaurant workers would then lose their jobs and would no longer be able to afford new cars, which would affect the jobs of automobile workers. The impacts of unemployment are intertwined, occur at the same time, and are difficult to separate.

To overcome this difficulty, I focus on only one direction of propagation: the impacts of tradable job losses on non-tradable job losses (the large red arrow in Figure 1.1). The innovation of my identification strategy is that to a county, tradable job losses are exogenous, that is, they function as shocks to the county.

This is the case because demand for tradable goods comes largely from the rest of the U.S. Since there are more than 3000 counties in the U.S., by and large, a county's own demand has little effect on the county's tradable production.

A relevant measure for tradable job losses is the job losses as a fraction of the population. It captures the intensity of the shocks that tradable job losses inflict on local communities. The higher the number of laid-off tradable workers relative to the local population, the more severe the shock should be. Alternatively, one could use counties' tradable exposure (measured by pre-crisis tradable employment as a fraction of population) as a good proxy for tradable job losses.

Let's take Elkhart County- Indiana, as an example. Elkhart is best known for producing recreation vehicles (RV). It has been referred to as the "RV Capital of the World". Before the recession, one in every four jobs in Elkhart was tied to the service or manufacturing of RV and component parts. The county suffered badly when the recession hit, and demand for recreational vehicles came to a halt. The county's unemployment rate reached 18.8% in April 2009 -- the highest in the nation at the time. The job losses in the RV industry came as a shock to the county; they were driven by the county's pre-existing exposure to the RV industry. I find that in counties that were more exposed to tradable industries like Elkhart, the non-tradable sectors (specifically, retail and restaurants) also suffered significant job losses. This is the basic evidence for the demand propagation channel.

I do not find evidence for nominal wage declines in non-tradable sectors. More precisely, counties that were more exposed to tradable employment did not see their nominal wage drop more during the Great Recession. This is an evidence against the reallocation of labor from tradable sector to non-tradable sector. Since the wage adjustment was not in place, the quantity of non-tradable labor has to fall to cope with the collapse in demand.

I pay particular attention to competing channels. First, I argue that the relationship between tradable exposure and non-tradable job losses is not driven by county-specific supply factors. It is also not driven by construction job losses or a collapse in house prices, two prominent factors in the Great Recession. Additionally, the relationship is not driven by the credit channel, i.e., the possibility that the negative spillover from tradable job losses to non-tradable job losses is due to credit supply issues. For example, underwater tradable firms may default to local banks, who would then be unable to provide credit to the non-tradable firms. However, I show econometrically that this is not the case.

In addition, I find that negative spillovers from tradable job losses are stronger and more statistically significant for more income-elastic non-tradable sectors than for less income-elastic ones. This finding strengthens the argument for demand-driven spillovers. Finally, I focus on the exposure to hardest hit tradable industries, such as automobiles, oil and gas. The results are stronger than the baseline results: areas with higher exposure to these industries witness larger job losses in non-tradable sectors.

The paper is organized as follows: section 2 provides a literature review; section 3 presents the identification strategy in details; section 4 discusses the data; section 5 reports the main results; section 6 discusses four alternative hypotheses and argues that they are not driving the results; section 7 presents two extensions; section 8 discusses further insights, where I argue that Mian and Sufi (2014)'s core result is downward biased; finally, section 9 concludes.

2. LITERATURE REVIEW

Recent literature has increasingly focused on demand channels. On the empirical front, a series of papers by Atif Mian, Amir Sufi and other co-authors show that in counties that have steeper pre-crisis house price run-up and higher household leverage, consumption cuts and employment losses during the crisis are higher

(Mian and Sufi, 2010; Mian, Sufi and Rao, 2013; Mian and Sufi 2014; Mian, Sufi and Trebbi, 2015). This is because when house price slumps, deleveraging households have to cut consumption, which leads to job losses. This paper takes the demand channel one step further. While Mian and Sufi's papers discuss the job losses due to deleveraging households, this paper focuses instead on the spillovers from tradable job losses to non-tradable job losses, and argues this as evidence for demand propagation in the Great Recession.

Related to the approach in my paper, Autor et al (2013) and Acemoglu et al (2015) analyze long-term local impacts of trade competition. They show that import competition from China depresses manufacturing jobs in the U.S., but there is no significant spillover effect to non-manufacturing job losses. Their finding differs to mine, probably because of two reasons. First, the impact of import competition is more gradual and less intense than the impact of the demand collapse in the Great Recession. Second, the timeframe they consider is longer (i.e., from 1990 to 2007), which could allow for wage and sector adjustments. Indeed, Autor et al (2013) find that nonmanufacturing wages fall in areas that house import-competing manufacturing industries. They consider this as evidence for a "*combination of a negative demand shocks and positive shocks to nonmanufacturing labor supply, as workers leaving manufacturing seek jobs outside of the sector*" (Autor et al, 2013, page 2148). In contrast, during the Great Recession, I find that local wage tends to be sticky[2]. The swift and dramatic demand collapse during the Great Recession might have prevented local labor markets from adjusting.

This paper is also related to a large, and hotly debated, literature on fiscal multipliers. Estimated fiscal multipliers vary widely (see Ramney, 2011 for a

[2] Mian and Sufi (2014) also find little evidence of local nominal wage adjustment during the Great Recession.

literature review). Many have found multipliers that are smaller than one, and potentially close to zero, while others have found substantially larger multipliers. For the U.S., Barro and Redlick (2011) find that the multiplier for temporary defense spending is 0.4-0.5 contemporaneously and 0.6-0.7 over two years. Ramney (2011) uses a narrative approach to construct U.S. government spending news variables, and obtains the multipliers in the range from 0.6 to 1.2. Nakamura and Steinsson (2014) exploit regional variations in military buildups to estimate the multiplier of military procurement in the range of 1.4-1.9. In Serrato and Wingender (2014) and Shoah (2015), the estimated multipliers are as high as 1.88 and 2.12. More recently, Kraay (2012, 2014) use World Bank lending to low-income countries as an instrument to arrive at the estimated fiscal multiplier of around 0.4 to 0.5. Ilzetzki, Mendoza and Vegh (2013) find that the magnitude of the multipliers varies with a country's development, with the exchange rate regime and indebtedness.

On the theory side of demand, early sticky-price models emphasize the role of aggregate demand as a key driver of the business cycle (see, e.g., Christiano, Eichenbaum and Evans, 2005; Galı, 2010; Woodford, 2003). More recently, theoretical papers, motivated by the crisis, discuss the aggregate demand effects. Eggertsson and Krugman (2012) build a simple new Keynesian model of debt-driven slumps, in which deleveraging agents depress aggregate demand. The paradox of thrift, a multiplier and demand propagation emerge naturally from their model. Guerrieri and Lorenzoni (2011) model an economy's responses to an unexpected, permanent tightening of borrowing capacity. In that environment, constrained consumers are forced to repay their debt, and unconstrained consumers increase their precautionary savings. This depresses the interest rate and causes output loss. Heathcote and Perri (2015) focus on self-fulfilling unemployment. In their model, since households expect high employment, they

have strong pre-cautionary incentives to cut spending, making the expectation of high employment a reality.

3. IDENTIFICATION STRATEGY

The identification strategy rests on the notion of exposure to tradable employment. To see the intuition, let's walk through a hypothetical example. Consider two counties A and B. Both have the population of 1000 people. Before the Great Recession, A is more exposed to RV manufacturing than B: A had 500 workers in the RV industry, while B had only 100 workers. Suppose in the Recession, RV companies fired 50% of their workforces. County A now has 250 unemployed RV workers. Since county B is less exposed to RV manufacturing, it has only 50 unemployed workers. Even though the percentage declines of tradable employment within the RV industry are the same for the two counties, the size of tradable job losses (as a fraction of population) in county A is larger. As a consequence, the local service sector in A should be affected more. For that reason, I do not use percentage change of tradable employment as the main explanatory variable. Rather, I focus on the change of tradable employment relative to the population, and on the exposure to tradable employment.

Two related specifications are used. In the first specification, I exploit *variation in the pre-existing exposure to tradable employment* across U.S. counties to proxy for the first round of job losses. The pre-existing exposure of a county is measured as the county's tradable employment divided by the county's population in 2007. Related to this, Mian and Sufi (2014) find that in counties with higher pre-crisis household leverage, non-tradable job losses during the crisis are larger. This is because deleveraging households cut consumption. While the cuts in tradable consumption affect jobs and firms elsewhere, the cuts in non-tradable consumption affect mostly the home county. My identification strategy is to show that counties with heavier exposure to tradable employment witness larger

percentage declines in non-tradable employment, *even after controlling for household's leverage.* Moreover, it turns out that since household leverage and tradable exposure are correlated, we have to control for household leverage in all of our regressions.

In the second specification, I exploit the *variation in the tradable job losses (normalized by population)* across U.S. counties during the Great Recession. The argument is that since a county is small, tradable job losses are driven largely by external demand, and hence are exogenous to a county's fundamentals. The tradable job losses are measured as tradable employment in 2010 minus that in 2007, divided by population in 2007. The second specification is related to the first one. We will see that exposure to tradable employment and tradable job losses are strongly correlated. Both yield robust results for the spillovers.

The labor market outcome of interest is the change in non-tradable employment, i.e. the log change of non-tradable employment between 2007 and 2010.

The regression of the first specification is as follows:

$$\log(NT)_{c,2010} - \log(NT)_{c,2007} = \beta_1 \frac{T_{c,2007}}{Pop_{c,2007}} + lev_c + \varepsilon_c \quad (1)^3$$

where $\log(NT)_{c,2010}$ is the log of non-tradable employment in county c in 2010, $\log(NT)_{c,2007}$ is the log of non-tradable employment in county c in 2007. $T_{c,2007}$ is tradable employment of county c in 2007, and $Pop_{c,2007}$ is the county's population in 2007. Lev_c represents the two proxies for household leverage in the county. Note that all standard errors in this paper are robust, and clustered at the state level. They are also weighted by a county's number of households

[3] This specification is similar to Autor et al (2013)'s approach.

In the second specification, the explanatory variable is tradable job losses in county c, as a fraction of population:

$$\log(NT)_{c,2010} - \log(NT)_{c,2007} = \beta_2 \frac{T_{c,2010} - T_{c,2007}}{Pop_{c,2007}} + lev_c + \varepsilon_c \qquad (2)$$

Two robustness checks are conducted. In the first one, I find that the results are robust to an alternative measure of non-tradable employment, namely, change in non-tradable employment between 2007 and 2010, as a fraction of population in 2007 (see section 5.4). The reason for choosing log change of non-tradable employment as the benchmark dependent variable is to make the results comparable with the literature (see Autor et al (2013) and Mian and Sufi (2014) for example). In addition, the results are also robust if total employment in 2007 is used (instead of population in 2007) to calculate tradable exposure. The reason for choosing population is that I would like to capture a county's "total purchasing power". Many people without jobs, such as retirees or college students, have income (retirement income or parental support, respectively) and consume goods. For that reason, population in 2007 is chosen, although the results are robust to both (see section 5.5).

4. DATA

Three major sources of data are used in the paper. The first source is the Census Bureau. County level population data are obtained from the Population Estimates from the Census. County employment data by industry are from the County Business Patterns (CBP) dataset. CBP data are recorded in March each year. Employment data in 2007 and 2010 are chosen, because March of 2007 and March of 2010 are closest to the bottom and peak of the nation's unemployment

rate. CBP data at the four-digit industry level are used.[4] I place each of the four-digit industries into one of four categories: non-tradable, tradable, construction and others. As in Mian and Sufi (2014), a 4-digit NAICS industry is defined as *tradable* if it has imports plus exports equal to at least $10,000 per worker, or if total exports plus imports exceed $500M. Also following Mian and Sufi (2014), *non-tradable* industries are defined as the retail sector and restaurants. They account for about 20% of the workforce. *Construction* industries are those that are related to construction, real estate, or land development. The remaining industries are classified as *others*.

Table A.1 in the Appendix shows the list of non-tradable industries. They represent retail sectors, restaurants and bars in a county. They account for a substantial fraction of employment. In 2007, they accounted for 19.6% of the nation's total employment. Their demand is generally income elastic (with many durable good retailers and restaurants), which makes them ideal candidates for spillover impacts. In section 7.1, I will further break them down to more income-elastic and less income-elastic industries.

The second source of data is from the Bureau of Labor Statistics (BLS). The BLS' Quarterly Census of Employment and Wages provide average weekly wages within a quarter for every NAICS 4-digit to 6-digit industry, across U.S. counties. For the analysis on non-tradable wage rigidity, I choose average weekly nominal wage for *Full-Service Restaurants* (NAICS code 48-49). This is because the industry has the highest labor share among the non-tradable industries considered in this paper (see Table A.1), and hence arguably is the most representative. To be

[4] County data at the four-digit industry level are sometimes suppressed for confidentiality reasons. However, the Census Bureau provides a range within which the employment number lies. As in Mian and Sufi (2014), I take the mean of this range as a proxy for the missing employment number in such cases.

consistent with the timing of employment data, average weekly wages during quarter I, 2007 and during quarter I, 2010 are chosen.

The third major source of data is from the work of Atif Mian, Amir Sufi and other co-authors. Data for county-level household leverage in 2006 is taken from Mian, Rao and Sufi (2013). It is calculated as households' debt to income ratio. Data for the change in housing net worth and wages are from Mian and Sufi (2014). The two proxies are strongly correlated. Other pre-crisis county-level control variables are also from Mian and Sufi (2014): 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.

Table 4.1 presents the summary statistics of the variables used in the paper. Most of the variables have full coverage, except wages and the leverage proxies. Household leverage in 2006 has more coverage (about 2200 counties) than the change in housing net worth (about 939 counties). On average, around 5% of a county's population (or 15% of employment) works in tradable industries, while 6.8% of a county's population (or 21% of a county's total employment) works in the non-tradable industries. Tradable exposure has a larger variation across counties than non-tradable exposure. Between 2007 and 2010, tradable industries, on average across counties, lost 19% of their employment (more precisely, the change in log of tradable employment is -0.19), while non-tradable industries on average lost 4.4% of their pre-crisis employment. Average nominal restaurant weekly wage increased 9%.[5]

[5] Note that federal minimum wage increased 40% (from $5.15 to $7.25 an hour) during the same period.

	N	mean	SD	10th	90th
Tradable employment/Population, 2007	3082	0.050	0.047	0.008	0.103
Non-tradable employment/Population, 2007	3129	0.068	0.029	0.035	0.102
Construction employment/Population, 2007	3128	0.041	0.025	0.019	0.066
Tradable employment/Employment, 2007	3085	0.15	0.11	0.03	0.29
Non-tradable employment/Employment, 2007	3132	0.21	0.06	0.14	0.28
Construction employment/Employment, 2007	3131	0.13	0.07	0.07	0.21
Change in log of tradable employment, 2007-2010	3048	-0.190	0.407	-0.609	0.133
Change in log of non-tradable employment, 2007-2010	3132	-0.044	0.151	-0.183	0.111
Change in log of construction employment, 2007-2010	3126	-0.177	0.269	-0.484	0.122
Change in log of weekly average wage, 2007-2010	2233	0.093	0.134	-0.030	0.248
Number of households, 2007	3135	36939	110855	2420	72622
Household leverage (debt/income), 2006	2219	1.573	0.584	0.971	2.366
Change in housing net worth, 2006-2009	944	-0.065	0.085	-0.172	0.003
% white, 2007	3135	86.997	15.017	65.834	98.827
Median Household Income ($), 2007	3135	35597	9147	26312	46608
% owner occupied, 2007	3135	74.063	7.541	64.320	81.818
% with less than a highschool diploma, 2007	3135	22.565	8.705	12.584	34.965
% with only a highschool diploma, 2007	3135	34.706	6.571	26.398	42.903
Unemployment rate, 2007	3135	0.058	0.027	0.030	0.091
Poverty rate, 2007	3135	0.142	0.065	0.073	0.226
% urban, 2007	3135	39.318	30.881	0.000	84.608

Table 4.1 Summary Statistics

Finally, house prices over time by counties are provided by Zillow Research. I use the house prices in March 2010 and March 2007, to match with the timing of the employment data. Due to house price data limitations, there are only 989 counties with house prices.

5. MAIN RESULTS

In this section, I show that counties with higher tradable exposure in 2007 see steeper job losses in retail and restaurants. The relationship is robust to pre-crisis county characteristics such as 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 urbanization.

5.1 Tradable exposure and tradable job losses

Before proceed to the main results, it is useful to examine the relationship between tradable exposure and tradable job losses. Table 5.1 shows a negative relationship between tradable exposure and the change in tradable employment between 2007 and 2010, as a fraction of population in 2007. The result shows that counties with higher tradable exposure witness larger declines in tradable employment (relative to the population). Figure 5.1 shows the scatter plot, where large counties with the heaviest tradable exposure are labelled.

VARIABLES	(Tradable Empl 2010 - Tradable Empl 2007) / Population 2007
Tradable exposure	-0.189***
	[0.017]
Constant	0.001
	[0.001]
Observations	3,082
R-squared	0.312

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5.1: Tradable exposure and tradable job losses

Figure 5.1: Scatter plot for Table 1
Note: Only large counties with more than 20,000 households are included

5.2 Baseline results

Table 5.2 presents the first set of results regarding the demand propagation channels. It has two blocks for the two specifications. The first block, columns [1] to [3], shows the OLS regressions between log change in non-tradable employment and tradable exposure. Column [1] does not include the proxies for household leverage, while columns [2] and [3] do. The two main proxies for household leverage are household leverage in 2006, and change in housing net worth between 2006 and 2009. After the inclusion of the household leverage proxies, the relationship between tradable exposure and non-tradable job losses becomes negative and highly significant.[6] Overall, a 1% increase in tradable

[6] This is because tradable exposure and household leverage are negatively correlated, a point to which I will return at the end of the paper.

exposure causes a 0.48% larger decline in non-tradable employment between 2007 and 2010.

The second block, columns [4] to [6], shows the OLS regressions between log change in non-tradable employment and change in tradable employment as a fraction of population. The positive coefficients in columns [5] and [6] imply that higher tradable job losses during the Great Recession led to stronger declines in non-tradable employment. Across counties, a 1% increase in tradable job losses (relative to the population) causes a 0.98% increase in non-tradable job losses.

VARIABLES	Log(NT Employment 2010) - log(NT Employment 2007)					
	[1]	[2]	[3]	[4]	[5]	[6]
Tradable exposure	-0.054	-0.346***	-0.480***			
	[0.126]	[0.117]	[0.165]			
Δ T Employment 2007-2010, as a fraction of 2007 population				0.315	0.752***	0.984***
				[0.196]	[0.174]	[0.275]
Leverage 2006		-0.039***	-0.034***		-0.036***	-0.032***
		[0.006]	[0.009]		[0.005]	[0.009]
Δ housing net worth, 2006-2009			0.081*			0.067
			[0.047]			[0.050]
Constant	-0.051***	0.035*	0.039	-0.051***	0.019	0.021
	[0.013]	[0.019]	[0.026]	[0.009]	[0.014]	[0.022]
Observations	3,081	2,219	939	3,081	2,219	939
R-squared	0.000	0.118	0.176	0.002	0.110	0.157

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5.2: Baseline results

5.3. With other control variables

From this section on, for brevity, I focus on tradable exposure as the main explanatory variable, although the results are also very strong and robust to the use of tradable job losses. Table 5.3 presents the results with other control

variables. Note that compared to the sample used in Table 5.2, I have removed 3 outliers in Table 5.3.

VARIABLES	Log(NT Empl 2010)-Log(NT Empl 2007)			
	[1]	[2]	[3]	[4]
Tradable Exposure	-0.351***	-0.489***	-0.346***	-0.466***
	[0.116]	[0.162]	[0.076]	[0.109]
Leverage 2006	-0.039***	-0.035***	-0.036***	-0.027***
	[0.006]	[0.009]	[0.007]	[0.010]
Δ housing net worth, 2006-2009		0.071		0.091
		[0.045]		[0.057]
% white			0.016	0.002
			[0.021]	[0.026]
Median Household Income			0.000	0.000***
			[0.000]	[0.000]
% owner occupied			-0.130**	-0.110*
			[0.053]	[0.056]
% with less then highschool diploma			-0.007	0.070
			[0.057]	[0.080]
% with only a highschool diploma			0.043	0.124
			[0.114]	[0.135]
Unemployment rate			-0.287	-0.432*
			[0.178]	[0.243]
Poverty rate			0.124	0.305*
			[0.119]	[0.161]
% urban			-0.036***	-0.055***
			[0.008]	[0.015]
Constant	0.034*	0.039	0.095**	0.025
	[0.019]	[0.026]	[0.038]	[0.055]
Observations	2,216	936	2,216	936
R-squared	0.132	0.208	0.156	0.257

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5.3: With other control variables

Table 5.3 shows that counties with higher tradable exposure see significantly larger non-tradable employment declines during the Great Recession (columns [1] and [2]). A 1% increase in pre-crisis tradable exposure causes a 0.489% decline in non-tradable employment between 2007 and 2010. This is after I control for the impact of household leverage on non-tradable employment (the channel captured

in Mian and Sufi, 2014). This result provides the basic evidence for the demand propagation channel.

Columns [3] and [4] of Table 5.3 show that the relationship is robust to a series of county characteristics: 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 coefficients of interest are largely unchanged.

Figure 5.3 shows the scatter plot depicting the correlation between tradable exposure and non-tradable employment growth, after controlling for the two proxies of household leverage (i.e. the scatter plot for column [2] in Table 5.3). Note that counties with the highest tradable exposure are labelled. The results do not depend on these counties: when they are removed, the results (not shown here) remain significant.

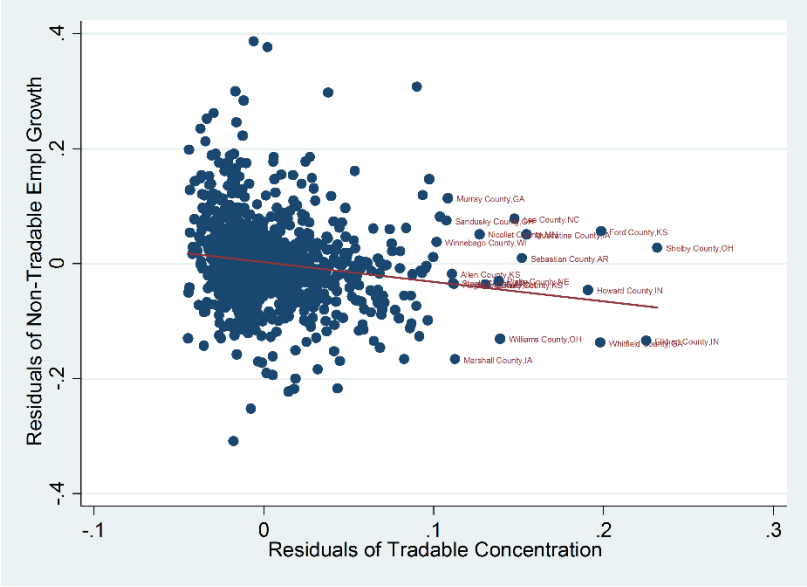

Figure 5.3: Scatterplot between non-tradable employment growth residuals and tradable exposure residuals (column [2], table 5.3)
Note: Only large counties with more than 20,000 households are included.

5.4 Robustness check 1

The result is robust to using an alternative measure for non-tradable job losses, namely, the change in non-tradable employment between 2007 and 2010, as a fraction of population in 2007. Table 5.4 shows that tradable exposure still has a statistically significant and negative impact on non-tradable employment, with this alternative measure. Note that the setup is biased against obtaining a negative relationship, because the dependent and explanatory variables have the same denominator.

VARIABLES	(NT Emp 2010 - NT Emp 2007)/Population 2007			
	[1]	[2]	[3]	[4]
Tradable exposure	-0.073***	-0.084***	-0.062***	-0.070***
	[0.020]	[0.029]	[0.015]	[0.020]
Leverage 2006	-0.006***	-0.005***	-0.006***	-0.004**
	[0.002]	[0.002]	[0.001]	[0.002]
Δ housing net worth, 2006-2009			0.009**	0.007
			[0.004]	[0.005]
% white			0.000***	0.000***
			[0.000]	[0.000]
Median Household Income			-0.023***	-0.020***
			[0.006]	[0.007]
% owner occupied			-0.001	0.009
			[0.010]	[0.010]
% with less then highschool diploma			0.002	0.002
			[0.017]	[0.019]
% with only a highschool diploma			0.038	0.056
			[0.028]	[0.036]
Unemployment rate			0.020	0.030
			[0.021]	[0.025]
Poverty rate			-0.007***	-0.012***
			[0.002]	[0.003]
% urban		0.013*		0.018**
		[0.007]		[0.007]
Constant	0.004	0.004	0.001	-0.003
	[0.004]	[0.005]	[0.008]	[0.011]
Observations	2,216	936	2,216	936
R-squared	0.100	0.145	0.137	0.221

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5.4: Robustness check with a different measure of non-tradable job losses

5.5 Robustness check 2

The results are also robust to using total employment in 2007, instead of population in 2007, to calculate tradable exposure. In Table 5.4, a county's tradable exposure is defined as tradable employment in 2007 divided by the county's total employment in 2007. The results are as strong as in the benchmark case. However, conceptually, as discussed in section 3, using population is my preferred choice, because population arguably better captures a county's pre-crisis total purchasing power.

VARIABLES	Log(NT Empl 2010)-Log(NT Empl 2007)			
	[1]	[2]	[3]	[4]
Tradable employment 2007,	-0.096***	-0.121**	-0.096***	-0.137***
as a fraction of total employment, 2007	[0.035]	[0.052]	[0.016]	[0.031]
Leverage 2006	-0.037***	-0.033***	-0.034***	-0.024**
	[0.005]	[0.010]	[0.007]	[0.010]
Δ housing net worth, 2006-2009		0.057		0.088
		[0.049]		[0.058]
% white			0.015	-0.000
			[0.020]	[0.026]
Median Household Income			0.000	0.000***
			[0.000]	[0.000]
% owner occupied			-0.123**	-0.102
			[0.058]	[0.063]
% with less then highschool diploma			-0.010	0.062
			[0.058]	[0.083]
% with only a highschool diploma			0.053	0.143
			[0.121]	[0.147]
Unemployment rate			-0.229	-0.354
			[0.176]	[0.240]
Poverty rate			0.158	0.354**
			[0.119]	[0.161]
% urban			-0.041***	-0.064***
			[0.008]	[0.016]
Constant	0.026	0.026	0.070*	-0.005
	[0.017]	[0.025]	[0.036]	[0.054]
Observations	2,216	936	2,216	936
R-squared	0.120	0.179	0.145	0.237

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 5.5: Robustness check with a different measure of tradable exposure

In summary, section 5 shows a very strong and robust relationship between a county's tradable exposure and non-tradable employment losses during the Great Recession. The correlation is not driven by outliers or by particular specifications. In the next section, I will focus on examining competing hypotheses to the demand channel.

6. ALTERNATIVE HYPOTHESES

First of all, it is not guaranteed that a drop in tradable employment will cause non-tradable employment losses. For example, Autor et al (2013) and Acemoglu et al (2015) find that import competition from China depresses manufacturing jobs in the U.S., but there is no spillover effect from manufacturing job losses to non-tradable job losses. Theoretically, if wages are flexible, a drop in tradable employment could even lead to a *rise* in non-tradable employment, because now there is an increase in labor supply.

I find little evidence for the downward adjustments of nominal wages in non-tradable sectors. Nominal wages tend to be sticky, in the sense that they do not decline more in areas more exposed to tradable employment. Wages are measured as the average weekly wage during the first quarter of 2007, and that during the first quarter of 2010, for *Full Service Restaurants* sector (NAICS code 7221).

Table 6.0 shows the regression between the change in log wages and tradable exposure, with other control variables. Counties with higher pre-Recession tradable exposure do not seem to see stronger declines in wages. This indicates that cross-sectoral reallocation of labor, from tradable to non-tradable sectors, did not likely occur during the Great Recession. If there were hiring of unemployed tradable workers from restaurants, we would expect to see either hourly wages drop, or less hours worked per worker, both of which would result in lower average weekly wage. The wage stickiness result stands in contrast with what

Autor et al (2013) find: wages fall in areas more exposed to industries facing competition from China. This is considered as evidence for a combination of negative demand and labor reallocation from manufacturing to non-manufacturing. Note that the period Autor et al (2013) consider is longer (1990 to 2007), which might have allowed for gradual wage adjustments. In contrast, the massive collapse of demand during the Great Recession took place in such a short time, preventing local wages to adjust.

	Log(average weekly wage Q1 2010)-Log(average weekly wage Q1 2007)			
	[1]	[2]	[3]	[4]
Tradable Exposure	0.213	0.233	0.124*	0.150*
	[0.138]	[0.164]	[0.065]	[0.082]
Leverage 2006	-0.018**	-0.001	-0.011**	-0.006
	[0.008]	[0.010]	[0.004]	[0.007]
Δ housing net worth, 2006-2009		0.056		0.008
		[0.053]		[0.060]
% white			-0.001	-0.012
			[0.029]	[0.035]
Median Household Income			-0.000***	-0.000***
			[0.000]	[0.000]
% owner occupied			0.161***	0.137***
			[0.034]	[0.051]
% with less then highschool diploma			-0.014	-0.057
			[0.068]	[0.070]
% with only a highschool diploma			-0.205	-0.208*
			[0.127]	[0.117]
Unemployment rate			-0.263	-0.050
			[0.225]	[0.257]
Poverty rate			0.013	-0.108
			[0.185]	[0.223]
% urban			-0.044***	-0.061**
			[0.013]	[0.024]
Constant	0.065***	0.029	0.167*	0.206*
	[0.023]	[0.024]	[0.091]	[0.122]
Observations	1,800	853	1,800	853
R-squared	0.038	0.028	0.177	0.190

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 6.0: On nominal wage rigidity

Local nominal wage rigidity matters a great deal for demand driven propagation of job losses. If wages were flexible, we could still obtain full employment even with a negative demand shock, because wages would adjust to absorb additional labor. If local wages are sticky, the only way non-tradable firms adjust to the demand shock is to shed labor and scale down their businesses.

Even in the case that a drop in non-tradable employment accompanies a decline in tradable employment, it still does not mean the transmission operates through the demand channel. In the following sections, I examine in detail competing hypotheses: county specific supply shocks, exposure to construction, house prices and credit supply problems. I argue that none of the competing hypotheses square well with the data.

6.1 County specific supply shocks

It is possible that an exogenous negative county-specific supply shock could hurt both tradable and non-tradable production, causing declines in employment of both sectors. If this were the case, the association between tradable and non-tradable job losses would be driven by a common third factor, invalidating the demand propagation channel. Among the factors, the most prominent one is a credit crunch. For example, if banks in a county reduce lending to both tradable and non-tradable sectors, employment in both sectors would have to decline. More generally, any negative supply shocks could hurt both tradable and non-tradable employment in a similar manner.

Nevertheless, Mian and Sufi (2014) argue that credit factors were not the problem. They argue that survey evidence from business owners shows that only 3% of respondents report financing as their main problem in 2007. Furthermore, there is no significant increase in the response rate as the Recession unfolds. Instead, businesses started complaining about poor sales and government regulations more during the Recession.

More broadly, county specific supply shocks are not likely the common causes because the correlation between Δlog(NT Employment) and Δlog(T Employment) is very small (0.0217), and is not significantly different from zero. If there is a common supply factor, it should affect non-tradable and tradable employment in a similar way, which would imply that there is a positive correlation between Δlog(NT Employment) and Δlog(T Employment). This is clearly not the case. Instead, what I observe is a very strong and robust relationship between tradable exposure, $\frac{T_{c,2007}}{Pop_{c,2007}}$, and Δlog(NT Employment), which is more consistent with a demand story.

6.2 Construction

The collapse in the construction industry was very pronounced in the Great Recession. Construction employment fell by 17.7% between 2007 and 2010 (Table 4.1). It is possible that in counties with high tradable exposure, construction activities before the recession were also high, and the construction collapse during the Great Recession was larger. A concern is that the decline in construction employment, not the decline in tradable employment, caused the decline in non-tradable employment.

Table 6.2 shows this is not the case. The results show that after including the change in construction employment, and construction exposure, the coefficient for tradable exposure remains highly significant with a similar magnitude. Construction job losses are correlated to non-tradable job losses. However, it is difficult to infer causality, since construction job losses are highly endogenous.

VARIABLES	Log(NT Empl 2010)-Log(NT Empl 2007)				
	[1]	[2]	[3]	[4]	[5]
Tradable Exposure	-0.351***	-0.339***	-0.354***	-0.342***	-0.341***
	[0.116]	[0.098]	[0.072]	[0.108]	[0.072]
Leverage 2006	-0.039***	-0.027***	-0.026***	-0.037***	-0.036***
	[0.006]	[0.003]	[0.006]	[0.005]	[0.007]
Δ log(Construction emp)		0.079***	0.071***		
		[0.017]	[0.014]		
Construction exposure				-0.206	-0.306
				[0.189]	[0.184]
% white			0.021		0.014
			[0.019]		[0.021]
Median Household Income			0.000		0.000
			[0.000]		[0.000]
% owner occupied			-0.104*		-0.129**
			[0.053]		[0.054]
% with less then highschool diploma			0.023		-0.018
			[0.057]		[0.057]
% with only a highschool diploma			0.026		0.005
			[0.102]		[0.113]
Unemployment rate			-0.274*		-0.365**
			[0.156]		[0.173]
Poverty rate			0.081		0.101
			[0.104]		[0.128]
% urban			-0.030***		-0.036***
			[0.008]		[0.008]
Constant	0.034*	0.030*	0.082**	0.040*	0.139***
	[0.019]	[0.016]	[0.039]	[0.024]	[0.052]
Observations	2,216	2,216	2,216	2,216	2,216
R-squared	0.132	0.163	0.179	0.135	0.161

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 6.2: Construction

6.3 Housing

The house price collapse is one of the most dramatic characterizations of the Great Recession. Using Zillow Research's house price index, I estimate that house prices on average fell 11.2% between March 2007 and March 2010, across 945 counties where Zillow has data. With such a massive change, a reasonable concern is that housing could contaminate the proposed channel, in the following way: tradable job losses could depress house prices in a county, which then would reduce the net

worth of locals. Bearing a negative wealth effect, they have to cut consumption, hurting the non-tradable sector. The spillover effect operates through the housing market. This is a closely related channel to the demand propagation, but is not the same.

	Log(house price 2010) - Log(house price 2007)	
Tradable exposure	-3.913**	-2.541
	[1.800]	[1.866]
Housing supply elasticity		0.081***
		[0.021]
Constant	-0.223***	-0.354***
	[0.051]	[0.076]
Observations	944	530
R-squared	0.027	0.175

Robust standard errors in bra
*** p<0.01, ** p<0.05, * p<0.1

Table 6.3: Tradable exposure and house prices

I do not see the housing channel in operation here. Table 6.3 shows the impact of tradable exposure on house prices, with and without housing supply elasticity. Housing supply elasticity (Saiz, 2010) measures how abundantly land for development is available. It has been shown, by Mian and Sufi (2014) and others, to be powerful in explaining the run up in house prices before Great Recession, and the collapse of house prices during the Recession. There is no evidence that tradable exposure causes the decline in house prices between 2007 and 2010, after housing supply elasticity is included (Table 6.3, column [2]).

6.4 Credit

The most prominent competing hypothesis is credit-led spillovers, that is, the spillovers from the tradable sector to the non-tradable sector could take place via the credit market. For example, under-water tradable firms are late in their loan repayments, which weakens local banks' balance sheet. This in turn affects local

lending to non-tradable firms. A decline in non-tradable employment therefore could be due to local credit problems, not local demand problems.

Table 6.4, however, shows this is not likely the case. Similar to Mian and Sufi (2014), I organize the regressions in two blocks. The first block, columns [1] to [6], shows the log change of the number of non-tradable establishments between 2007 and 2010, by size (1 to 4 workers, 5 to 9 workers, 10 to 19 workers etc). If credit channel were the problem, smaller non-tradable firms should get hit more in counties more exposed to tradable employment, on the ground that smaller firms have more difficult access to credit. This is not the case here, as the coefficients become more negative for larger establishments. That is, higher tradable exposure hurts larger non-tradable firms more than it does smaller ones. The second block, columns [7] and [8], splits the counties into two groups, one with more national banks (National=1), and one with more local banks (Local=1). If credit were to play a key role in the transmission, we would see that non-tradable job losses are more sensitive to tradable exposure in counties with more local banks, as local banks would be less likely to get help from outside their respective counties. I do not see that case in columns [7] and [8]. If anything, high tradable exposure reduces non-tradable employment more in counties with more national banks.

	Δ log(number of NT establishments)						Δ log(NT employment)	
VARIABLES	1 to 4	5 to 9	10 to 19	20 to 49	50 to 99	100 plus	National=1	Local=1
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Tradable Exposure	-0.412*	-0.421***	-0.273*	-0.433***	-0.571***	-0.731***	-0.390**	-0.270***
	[0.237]	[0.136]	[0.144]	[0.133]	[0.210]	[0.246]	[0.164]	[0.078]
Leverage 2006	-0.013	-0.012	0.009	-0.033***	-0.032*	-0.075***	-0.040***	-0.036***
	[0.010]	[0.007]	[0.008]	[0.007]	[0.017]	[0.011]	[0.007]	[0.007]
Constant	-0.004	0.030	-0.003	0.028	-0.009	0.086***	0.040	0.022
	[0.032]	[0.023]	[0.026]	[0.019]	[0.040]	[0.025]	[0.025]	[0.015]
Observations	2,216	2,216	2,216	2,212	2,031	1,848	1,181	1,035
R-squared	0.024	0.017	0.011	0.031	0.010	0.051	0.164	0.060

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 6.4: The credit channel

7. EXTENSIONS

Three extensions to the benchmark results are provided. In the first extension, non-tradable sector is disaggregated to income-elastic and income-inelastic groups. In the second extension, a falsification test is conducted, in which tradable exposure of neighboring counties is used. In the third extension, I focus on exposure to the most vulnerable sectors. As it will be clear, the purpose of the extensions is to strengthen the argument for the demand-driven propagation of job losses.

7.1 Extension 1: Income-elastic v.s. income-inelastic non-tradable sectors

In this extension, non-tradable sectors are disaggregated into income-elastic and income-inelastic groups. If the impact of tradable exposure on job losses of income-elastic non-tradable sectors is *larger* than that of income-inelastic sectors, the finding would further support the demand-driven spillovers. This is because if non-demand factors were behind the spillovers, there is no reason to expect that the impacts on income-elastic sectors are larger.

Table A.2 in the Appendix presents the categorization of income-elastic and income-inelastic sectors. Grocery, specialty food (e.g. meat, seafood, and bakery), beer, wine and liquor, health care and personal care, gasoline stations and used merchandise stores are considered more necessary for our day to day living when our income declines. They belong to the income-inelastic group. The remaining sectors belong to the income-elastic group.

VARIABLES	Δ **elastic** NT employment, 2007-2010		Δ **inelastic** NT employment, 2007-2010	
	[1]	[2]	[3]	[4]
Tradable exposure	-0.355***	-0.499***	-0.286*	-0.371*
	[0.118]	[0.162]	[0.145]	[0.203]
Leverage 2006	-0.044***	-0.039***	-0.022*	-0.016
	[0.005]	[0.009]	[0.011]	[0.013]
Δ housing net worth, 2006-2009		0.072		0.089
		[0.046]		[0.070]
Constant	0.036*	0.041	0.023	0.022
	[0.019]	[0.025]	[0.028]	[0.036]
Observations	2,219	939	2,219	939
R-squared	0.116	0.191	0.019	0.031

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7.1: Impacts on income elastic and income inelastic non-tradable sectors

Table 7.1 presents the findings. The job loss spillover to *income elastic* non-tradable sectors is much larger and more significant than that to *income inelastic* counterparts (columns [1] and [2] v.s. columns [3] and [4]). This implies that the income-inelastic non-tradable sectors were less affected by the tradable job losses. The finding strengthens the argument for a demand-driven propagation from tradable job losses to non-tradable job losses.

The same story is observed for household leverage in 2006: income-elastic sector employment is more responsive to pre-crisis household leverage than income-inelastic sector employment is. This confirms Amir and Sufi (2014)'s key result: deleveraging households cut consumption and caused unemployment.

7.2 Extension 2: A falsification test

In this section, a falsification test is conducted. For every county, I construct the average tradable exposure of other counties within the same state (referred to as neighboring counties). Their average tradable exposure is calculated as the total tradable employment in these counties in 2007, divided by the total population of

these counties in 2007. If the demand-driven propagation channel is in place, a county's non-tradable sector during the Great Recession should be little affected by the pre-existing tradable exposure of neighboring counties.

VARIABLES	Log(NT Empl 2010)-Log(NT Empl 2007)		
	[1]	[2]	[3]
Tradable exposure of neighboring counties	-0.578*	-0.379	-0.411
	[0.322]	[0.296]	[0.313]
Tradable Exposure		-0.267***	-0.383***
		[0.080]	[0.128]
Leverage 2006	-0.039***	-0.041***	-0.036***
	[0.006]	[0.006]	[0.009]
Δ housing net worth, 2006-2009			0.074
			[0.046]
Constant	0.043	0.050*	0.055*
	[0.027]	[0.027]	[0.033]
Observations	2,215	2,215	935
R-squared	0.128	0.139	0.216

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 7.2 Impacts of neighboring counties' tradable exposure

Table 7.2 shows this is the case. Tradable exposure of neighboring counties has some negative effects, but they are not significant at 5% level. When a county's tradable exposure is included (column [2]), the impact of neighboring counties' tradable exposure disappears.

7.3 Extension 3: Tradable sectors with the most dramatic declines

In this extension, I focus on only tradable industries that had the most dramatic declines in employment during the Great Recession. Table A.3 in the Appendix shows the 39 chosen industries whose nation-wide employment fell more than 10% between 2007 and 2009. After identifying those industries, I construct a county's exposure to these industries, and estimate the impact of this exposure on

non-tradable employment. The results is expected to be stronger because the focus is on the hardest hit tradable industries. The results are indeed quantitatively larger. The coefficient in column [4] of Table 7.3 is more negative than that in column [2]. Intuitively, this is because the hardest hit tradable industries suffered stronger job losses, which had more severe impacts on the local non-tradable sectors.

VARIABLES	Δ NT employment, 2007-2010			
	[1]	[2]	[3]	[4]
Tradable concentration 2007	-0.351***	-0.489***		
	[0.116]	[0.162]		
Tradable concentration 2007			-0.455***	-0.604**
of hardest hit industries			[0.167]	[0.263]
Leverage 2006	-0.039***	-0.035***	-0.037***	-0.034***
	[0.006]	[0.009]	[0.005]	[0.010]
Δ housing net worth, 2006-2009		0.071		0.062
		[0.045]		[0.046]
Constant	0.034*	0.039	0.024	0.027
	[0.019]	[0.026]	[0.017]	[0.025]
Observations	2,216	936	2,207	931
R-squared	0.132	0.208	0.124	0.188

Robust standard errors in brackets

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

Table 7.3: Impact of hardest hit tradable industries

8. ADDITIONAL INSIGHTS

I find that tradable exposure is negatively correlated with the pre-recession household leverage. In other words, counties with heavier tradable exposure were less leveraged, as shown in the scatterplot in Figure 8.1. This makes intuitive sense, because counties with abundant land are more likely chosen as the location for tradable firms. Since land is abundant, the run-up in the house prices could be less dramatic, therefore households would have fewer means to leverage.

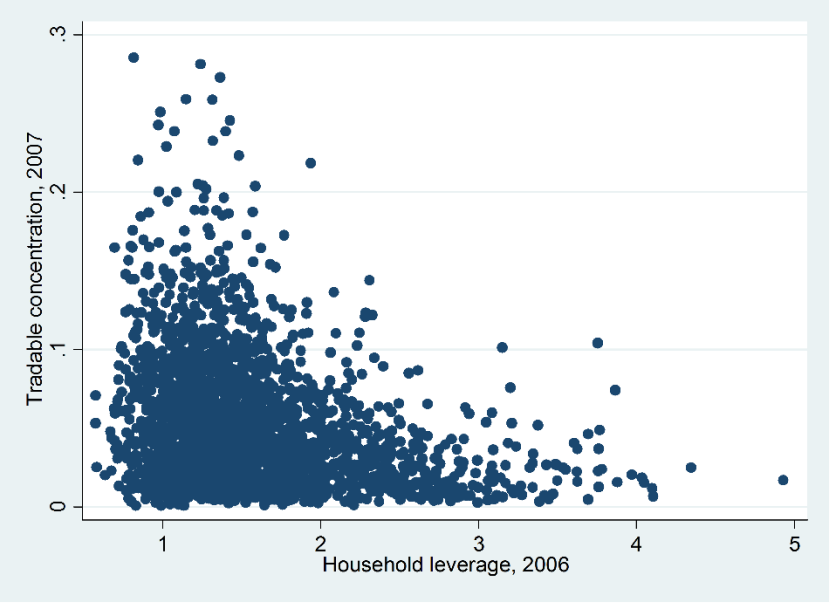

Figure 8.1: Tradable exposure in 2007 and household leverage in 2006

This observation has two implications: First, households in areas with heavy tradable exposure were unfortunate in the Great Recession because the shock hit them via tradable exposure, not their leveraging. Second, Mian and Sufi (2014)'s core result is understated. Mian and Sufi (2014) find that in counties with higher pre-crisis household leverage (and sharper collapses in housing net worth), non-tradable employment declines were larger during the Great Recession. Since Mian

and Sufi (2014) do not control for tradable exposure, their results also capture the second round spillovers from tradable job losses to non-tradable job losses. Since regions with higher tradable exposure happen to be less leveraged, non-tradable job losses affected directly from deleveraging households are understated in Mian and Sufi (2014)'s results.

Table 8.1 confirms the conjecture. After tradable exposure in 2007 is included, the impact of household leverage on non-tradable employment becomes more negative (see column [4] versus column [3], and column [2] versus column [1]).

VARIABLES	Δ NT employment, 2007-2010			
	[1]	[2]	[3]	[4]
Tradable concentration 2007		-0.346***		-0.480***
		[0.117]		[0.165]
Leverage 2006	-0.034***	-0.039***	-0.030***	-0.034***
	[0.005]	[0.006]	[0.010]	[0.009]
Δ housing net worth, 2006-2009			0.069	0.081*
			[0.052]	[0.047]
Constant	0.010	0.035*	0.009	0.039
	[0.013]	[0.019]	[0.021]	[0.026]
Observations	2,219	2,219	939	939
R-squared	0.099	0.118	0.143	0.176

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 8.1: On the downward bias of Mian and Sufi (2014)'s core results

9. CONCLUSION

The Great Recession was a very painful period in the world economic history. Behind the dry numbers are actual people and communities that suffer from job losses and the resulting hardship. It is important to understand, to the best as we can, the impacts of the Great Recession, among them, how shocks transmit across economic sectors and geographic areas.

This paper is among the effort to understand the Great Recession better. It provides empirical evidence for demand-driven propagation of job losses. It shows that in counties with heavier exposure to tradable employment, non-tradable employment losses during the Great Recession are higher. The result is statistically very significant and robust across different specifications and control variables, suggesting a powerful role of demand. The finding is not driven by the exposure to the construction sector, by the collapse in house prices, or by the credit shortage problem. Moreover, the propagation are stronger when I focus on the job losses of income-elastic non-tradable sectors, which provides further evidence for a demand story. Given the massive tradable employment losses, where some industries lost 30% to 40% of their workforce in such a short time span, it is not very surprising that counties could not absorb or respond to such massive shocks.

The paper has policy implications. First of all, demand-driven mechanisms matter. This finding suggests a role for demand stabilizing policies to contain demand driven transmissions of negative shocks. Without such policies in place to assist hardest hit population and sectors, negative demand shocks can spread through other healthier sectors of the economy, and worsen the scale and scope of a recession.

10. APPENDIX

NAICS	Industry name	Percentage of total employment, 2007
4411	Automobile dealers	1.05
4412	Other motor vehicle dealers	0.15
4413	Automotive parts accessories and tire stores	0.41
4421	Furniture stores	0.23
4422	Home furnishing stores	0.27
4431	Electronics and appliance stores	0.42
4451	Grocery stores	2.13
4452	Speciaty food stores	0.15
4453	Beer wine and liquor stores	0.13
4461	Health and personal care stores	0.89
4471	Gasoline stations	0.73
4481	Clothing stores	1.06
4482	Shoe stores	0.18
4483	Jewelry luggage and leather goods stores	0.14
4511	Sporting goods hobby and musical instrument stores	0.38
4512	Book periodical and music stores	0.16
4521	Department stores	1.36
4529	Other general merchandise stores	1.12
4531	Florists	0.09
4532	Office supplies stationery and gift stores	0.27
4533	Used merchandise stores	0.12
4539	Other misc store retailers	0.23
7221	Full-service restaurants	3.76
7222	Limited-service eating places	3.4
7223	Special food services	0.49
7224	Drinking places (alcoholic beverages)	0.31
	Total	19.63

Table A.1: Non-tradable industries

NAICS	Industry name	Income-elastic
4411	Automobile dealers	yes
4412	Other motor-vehicle dealers	yes
4413	Automotive parts, accessories and tire stores	yes
4421	Furniture stores	yes
4422	Home furnishing stores	yes
4431	Electronics and appliances stores	yes
4481	Clothing stores	yes
4482	Shoe stores	yes
4483	Jewelry, luggage and leather good stores	yes
4511	Sporting goods, hobby and musical instrument stores	yes
4512	Book, periodical and music stores	yes
4521	Department stores	yes
4529	Other general merchandise stores	yes
4531	Florists	yes
4532	Office supply, stationary and gift stores	yes
4539	Other misc store retailers	yes
7221	Full-service restaurants	yes
7222	Limited service eating places	yes
7223	Special food services,catering	yes
7224	Drinking places (e.g. bars)	yes
4451	Grocery	no
4452	Specialty food stores (e.g. meat, seafood, bakery)	no
4453	Beer, wine and liquor stores	no
4461	Health care and personal care stores	no
4471	Gasoline stations	no
4533	Used merchandise stores	no

Table A.2: Income-elastic v.s. income-inelastic non-tradable sectors

Industry	Log change in employment, 2007-2009
Motor vehicle body and trailer manufacturing	-0.392
Motor vehicle manufacturing	-0.338
Motor vehicle parts manufacturing	-0.303
Clay product and refractory manufacturing	-0.298
Apparel knitting mills	-0.288
Manufacturing and reproducing magnetic and optical media	-0.252
Leather and hide tanning and finishing	-0.240
Other textile product mills	-0.225
Fabric mills	-0.224
Hardware manufacturing	-0.224
Oil and gas extraction	-0.217
Audio and video equipment manufacturing	-0.210
Other leather and allied product manufacturing	-0.210
Household appliance manufacturing	-0.208
Plastics product manufacturing	-0.196
Other chemical product and preparation manufacturing	-0.195
Fiber yarn and thread mills	-0.194
Alumina and aluminum production and processing	-0.190
Other miscellaneous manufacturing	-0.188
Other nonmetallic mineral product manufacturing	-0.188
Spring and wire product manufacturing	-0.188
Textile furnishings mills	-0.183
Semiconductor and other electronic component manufacturing	-0.181
Textile and fabric finishing and fabric coating mills	-0.179
Foundries	-0.176
Office furniture (including fixtures) manufacturing	-0.158
Nonmetallic mineral mining and quarrying	-0.152
Forest nurseries and gathering of forest products	-0.147
Commercial and service industry machinery manufacturing	-0.145
Cutlery and handtool manufacturing	-0.133
Metalworking machinery manufacturing	-0.128
Ventilation heating air-conditioning and commercial refrigeration	-0.126
Industrial machinery manufacturing	-0.125
Other chemical product and preparation manufacturing	-0.120
Printing and related support activities	-0.115
Sugar and confectionery product manufacturing	-0.108
Computer and peripheral equipment manufacturing	-0.103
Nonferrous metal (except aluminum) production and processing	-0.103
Tobacco manufacturing	-0.103
Rubber product manufacturing	-0.102

Table A.3: Hardest hit tradable industries in the Recession

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