The great recession and job loss spillovers: impact of tradable employment shocks on supporting services

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Abstract

This paper explores the spillover effects of job losses via input–output linkages during the Great Recession. Exploiting exogenous variation in tradable employment shocks across US counties, the paper finds that job losses in a county’s tradable industries cause further job losses in the county’s supporting services. A 10% exogenous decline in tradable employment reduces supporting industries’ employment by 3.1%. In addition, a county’s regional supporting services are relatively less affected by its tradable job losses than its local supporting services, reinforcing the argument that the spillovers are due to input–output linkages.

JEL Classification E32 · J46

1 Introduction

It is important to understand if, how, and to what extent unemployment spreads across sectors and geographic areas during a recession. Such propagation, if proven true, could provide a basis for government intervention in times of economic recession to prevent the ripple effects of adverse employment shocks from cascading through the economy.

The Great Recession provides a unique context for studying this issue as it was the most devastating economic event in the world economy since the 1930s, probably barring the Covid-19 pandemic. During the Great Recession, unemployment in the USA reached even as high as 10%. Employment in many industries, such as

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automobile, oil, and gas, dropped as much as 30 to 40% between 2007 and 2010 (Nguyen 2015). Such economic fluctuations have left economists puzzled about many aspects of unemployment: Why was it so high? Did job losses propagate from one sector to another, and if so, how? The answers to these questions can help guide policy responses in future recessions.

This paper examines how job losses propagated across sectors via input–output linkages during the Great Recession. Although many economists would agree that job losses could propagate, few have successfully captured the magnitude of this phenomenon, given the difficulty of pinpointing an exogenous source of employment declines. Since employment across various industries is interrelated, overcoming endogeneity bias is a formidable obstacle to accurately measuring this effect.

The identification strategy we utilize in this paper is the following: We exploit exogenous variation in *the change in tradable employment* in a US county and examine the subsequent spillover effect on its *local supporting service industries*, i.e., those that provide support to tradable production, such as warehousing, transportation, human resource management, marketing, and IT support.¹ These exogenous job losses are *a county's tradable job losses only driven by declines in national tradable employment*, not by county-specific issues. The idea is based on Bartik (1991). We refer to this exogenous source of job losses as Bartik job losses for brevity. Using the Bartik job losses as the instrument for total tradable job losses, we find that US counties with greater exogenous losses in tradable employment experienced more severe job losses in supporting service industries. Quantitatively, a 10 percent decline in tradable jobs led to a 3.12 percent decline in a county's supporting services employment during the Great Recession. This finding is the main contribution of this paper. The finding provides evidence for a channel of the cascading of job losses during a recession: from tradable jobs to supporting jobs.

To strengthen the evidence for such a channel, we show that the transmission is stronger for more local supporting services. To that end, we split the supporting services, based on two Herfindahl indices, into industries dealing with more local support and those dealing with more regional support. Supporting industries with smaller Herfindahl indices are considered local, as their diffused market concentration suggests that they serve a more localized area. The job loss spillover is much more significant for the more local supporting sectors. Tradable job losses of 10% cause a 3.8% decline in local supporting services employment. As discussed in detail later, this may be due to local industries' greater dependence on the success of the county's tradable industries. In turn, we find that more regional supporting industries are not significantly affected by the county's tradable job losses, given that these industries' have greater geographic coverage. The finding helps strengthen the argument for the spillover from tradable job losses to supporting service job losses via input–output linkages.

Although supporting sectors only accounts for a small fraction of employment, this does not imply that job losses spillovers via input–output linkages are insignificant. We focus on the relationship between tradable and supporting sectors because

¹ The detailed list of supporting service sectors is in Sect. 4.

the econometric identification is clearer. Spillovers via input–output linkages could operate via other channels, such as intra-county tradable–tradable linkages (e.g., car assembly plants and car parts producers within a county) or inter-county linkages. However, these channels are more difficult to identify and establish a relationship.

The paper is organized in the following way: Sect. 2 gives a literature review; Sect. 3 presents the data; Sect. 4 describes our identification strategy in greater detail; Sect. 5 examines the main results; Sect. 6 presents extensions; and Sect. 7 concludes.

2 Literature review

Bodrin et al. (2020), using US national data, examine job loss propagation from the construction sector to other sectors. They argue that this channel has important effects on aggregate employment. Li and Martin (2019), also using national data at the sector level, find the financial sector to be the “epicenter” during the Great Recession, which emanates job loss spillovers into other sectors. Unlike those two papers, we utilize *sectoral* data at the *county* level, and for that reason, we are less concerned about the endogeneity issue.

This paper is also related to a growing literature on trade and production networks (see Bernard and Moxnes, 2018 for a review). Arnarson and Gullstrand (*forthcoming*) use Swedish firm data to establish an impact of localized exports on local service sales. Debaere et al. (2013) show that business and computing services increase firms’ foreign sourcing of materials. Using national employment data at the sectoral level, Acemoglu et al. (2016) study the transmission of trade shocks across US manufacturing industries via input–output linkages. The trade shock they refer to is the rising import competition from China. They find that inter-industry linkages magnify the employment effects of trade shocks. Our paper differs from this literature. Our paper does not make a trade argument; rather, it uses tradable job losses as an instrument to provide evidence about job loss spillover via input–output linkages.

Our paper is related to the literature on the severe decline in demand during the Great Recession. Most prominently, Mian, Sufi, and other co-authors have examined the effects of the decline in housing net worth on consumption and employment during the crisis. Mian et al. (2013) find that ZIP codes with higher pre-crisis household leverage (and steeper subsequent declines in housing net worth in the Great Recession) cut their consumption more sharply during this period. Similarly, Mian and Sufi (2014) find that housing net worth declines drove consumption cuts and job losses during the Recession. Nguyen (2015) examines job loss spillovers driven by the demand channel. In particular, he argues that job losses in the tradable sector caused further job losses in local retail and restaurant industries via the aggregate demand channel.

Our paper is related to the literature that uses the Bartik instrument to isolate exogenous changes in labor demand.² For example, Blanchard and Katz (1992) construct exogenous employment shocks at the state level from 1970 to 1989 and estimate the effects of the shocks on unemployment and wages. However, since they include all industries in all sectors, they do not estimate the spillover effects of job losses. Moretti (2010) uses three years of data (1980, 1990, and 2000) and a Bartik-typed instrument to estimate the *long-term* employment multiplier across US cities. Although we use a similar approach to Moretti (2010), our focus is different. While Moretti focuses on the long-run “geography of jobs” (i.e., how jobs are allocated across the country), we are interested in identifying the input–output linkage channel and estimating the short-run job loss spillover from tradable to supporting industries.

Our paper is also related to a growing amount of literature on labor market dynamics during the Great Recession. Ohanian (2011) argues that the decline in economic output and income during the Great Recession was due to severe distortions in the labor market and not due to declines in capital or productivity. Hoffman and Lemieux (2016) show that the collapse in construction employment was a major factor contributing to the fall in overall employment. Kroft et al. (2016) show that the massive 2008 employment collapse and the slow recovery in demand prevented employment from picking up quickly. Similarly, Foster et al. (2016) find that job destruction in the 2008–2009 period was accompanied by a very large drop in the job creation rate, which limited the scope for reallocation of jobs and pushed many laid-off workers into long-term unemployment.

3 Identification strategy

3.1 A simple model

Our empirical regressions can be better understood as the derivatives of simple production functions, illustrating the relationship between inputs and outputs. These functions are the following:

$$L_{s,c} = \theta T_c^\alpha \quad (1)$$

$$T_c = \omega L_{T,c}^\beta \quad (2)$$

where $L_{s,c}$ is supporting sector employment, $L_{T,c}$ is tradable employment, T_c is tradable output, the subscript c identifies a given county, and θ , ω , α , and β are parameters. The underlying assumption with these equations is that employment in the supporting service sector is determined by productivity (θ) and tradable output (T_c),

² See Goldsmith-Pinkham (2020) for a recent analysis of the Bartik instrument, in which they argue the instrument is equivalent to using local industry shares as instruments. See Sect. 6.1 for a detailed discussion in this paper’s context.

which in turn is produced by tradable employment. Note that the model does not consider capital. This assumption serves to simplify the model. One can think of this as unchanged capital stock during the three years of the analyses (2007–2010).³

We rearrange Eqs. (1) and (2) to derive our desired regression. We first combine the two equations by substituting T_c from Eq. (1) into Eq. (2) to get:

$$L_{s,c} = \theta \omega^\alpha L_{T,c}^{\alpha\beta} \quad (3)$$

Next, if we take the log of both sides, Eq. (3) becomes:

$$\log(L_{s,c}) = \log(\theta \omega^\alpha) + \alpha\beta \log(L_{T,c}) \quad (4)$$

We can then use Eq. (4) to derive the change in employment from 2007 to 2010:

$$\begin{aligned} \log(L_{s,c})_{2010} - \log(L_{s,c})_{2007} &= \alpha\beta [\log(L_{T,c})_{2010} - \log(L_{T,c})_{2007}] \\ &\quad + [\log(\theta \omega^\alpha)_{2010} - \log(\theta \omega^\alpha)_{2007}] \end{aligned} \quad (5)$$

From this, Eq. (5) provides a basis for our regression. Using Eq. (5), we arrive at an OLS regression:

$$\Delta \log(L_{s,c}) = \beta_0 + \beta_1 \Delta \log(L_{T,c}) + controls_c + \varepsilon_c \quad (6)$$

where $\Delta \log(L_{s,c})$ is the log change in supporting sector employment in county c from 2007 to 2010, $\Delta \log(L_{T,c})$ is the log change in tradable employment in county c during the same period, and $controls_c$ are all of the control variables. (We describe these in the next section.)

Equation (5) reveals two issues. First is the issue of omitted variable bias. For instance, county-specific changes, such as a change in productivity (i.e., $[\log(\theta \omega^\alpha)_{2010} - \log(\theta \omega^\alpha)_{2007}]$), could affect employment in both tradable and supporting sectors. Second, reversed causation also poses a threat to this identification strategy, as some might question whether a drop in supporting sector employment causes a decrease in tradable employment. For example, shutting down a warehouse would cause a manufacturing company to shut down factories if this were the case.

We overcome these challenges by instrumenting tradable job losses by their exogenous component. The exogenous component is the change in tradable employment driven by aggregate (national) shocks, namely Bartik job losses. We argue that county-specific factors do not drive this instrument. We explain this exogenous component in detail below.

³ Of course, our assumption is more valid during a relatively short period of time. Over the long run, there can be significant changes in the capital share. For example, Graetz and Michaels (2018) document a secular growth in robot use in the economy.

3.2 Bartik job losses

The concept of job loss spillover via production linkages has not been a subject of many empirical studies. One reason for this may be the difficulty distinguishing between job loss propagation pathways in data, which does not readily indicate causality. In other words, given that job losses in any industry may affect employment in other industries, it becomes exceedingly difficult to determine the direction in which a spillover travels. For example, unemployment in the automobile industry could reduce the need for freight, causing workers in the freight industry to lose their jobs. However, laid-off workers in the freight industry may be less inclined to purchase new cars, causing demand-driven unemployment in the automobile industry. As demonstrated by the above scenarios, job loss spillovers often occur simultaneously and in multiple directions, making determining causality within a particular spillover channel quite challenging.

We overcome this identification challenge by utilizing Bartik job losses to capture exogenous job losses. We argue that tradable job losses driven by aggregate shocks are exogenous to a county and are not driven by a county's fundamentals. Thus, reverse causality, and potentially county-specific omitted variable problems, such as productivity shocks or higher minimum wages, is not likely to affect Bartik job losses. To see the relationship between a county's tradable job losses and Bartik job losses, consider the log change in tradable job losses of county c :

$$\Delta \log(l_c^T) = \frac{l_{c,2010}^T - l_{c,2007}^T}{l_{c,2007}^T} = \sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_c^i \right)$$

where $l_{c,t}^T$ is total tradable employment in county c at time t and $l_{c,t}^i$ is tradable industry i 's employment in county c at time t .

Tradable job losses $\sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_c^i \right)$, however, might not be exogenous to a county's fundamentals. For example, labor supply issues (such as a raise in the minimum wage) or changes in regulations in the county could affect tradable employment in that county. Instead, Bartik job losses capture only tradable job losses driven by changes in aggregate shocks. To see this, we rewrite tradable job losses as:

$$\begin{aligned} \Delta \log(l_c^T) &= \sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_c^i \right) \\ &= \sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_{USA}^i \right) + \left\{ \sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times (\Delta \log l_c^i - \Delta \log l_{USA}^i) \right) \right\} \end{aligned} \quad (7)$$

The first term, $\sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_{USA}^i \right)$ represents Bartik job losses. It is the sum of all the individual Bartik job losses for all tradable industries. For each industry i , Bartik job losses are the product of the county's preexisting exposure to the industry (relative to total tradable employment), $\frac{l_{c,2007}^i}{l_{c,2007}^T}$, and the national change in the

industry's employment, $\Delta \log l_{USA}^i$. We interpret $\Delta \log l_{USA}^i$ as a change in industry i 's aggregate shocks (Bartik, 1991). Since there are more than 3000 counties in the USA, the aggregate changes should not be affected by changes in a county's fundamentals, such as productivity shocks or an increase in minimum wages during the Recession. Note that $\sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times \Delta \log l_{USA}^i \right) = \sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times (\log l_{USA,2010}^i - \log l_{USA,2007}^i) \right)$. Therefore, a negative result implies job losses.

The only situation in which an industry's Bartik job losses might not be exogenous is when production of that industry is heavily concentrated in one county. In that case, $\Delta \log l_{USA}^i$ could be influenced by county c -industry i specific supply issues. We examine such a possibility among 61,714 county-industry pairs in 2007 and do not find it problematic. The average concentration of an industry in a county in 2007 is very small, at 0.013%. The only two pairs with more than 20% of national employment concentrated in one county are *cut and sew apparel manufacturing* in Los Angeles, CA (33.9%), and *railroad rolling stock manufacturing* in Erie, Pennsylvania (23.2%). Therefore, generally, tradable Bartik job losses are exogenous to a county.

The second term, $\sum_{i \in T} \left(\frac{l_{c,2007}^i}{l_{c,2007}^T} \times (\Delta \log l_c^i - \Delta \log l_{USA}^i) \right)$, can be interpreted as tradable job losses driven by county-specific issues. It is the difference between actual tradable job losses and those driven by aggregate shocks.

Using Bartik job losses as an exogenous source of variation in tradable job losses, we can rewrite the regression as follows:

$$\Delta \log(L_{s,c}) = \beta_0 + \beta_1 \Delta \log \left(\widehat{L_{T,c}} \right) + controls_c + \varepsilon_c \quad (8)$$

$$\text{Where } \Delta \log \left(\widehat{L_{T,c}} \right) = \widehat{\delta_0} bartik_c + controls_c$$

Note that all regressions are weighted by the number of households in each county. In addition, unless otherwise stated, all of the standard errors in this paper are robust and clustered at the state level.

4 Data analysis

The primary source of our data is the Census Bureau. In addition, we use county-industry level employment data in March 2007 and March 2010 from the County Business Pattern (CBP) dataset, given that these dates represent the lowest and highest points of the US unemployment rate during the Great Recession. This data comes with flags representing employment ranges, which we replace with average employment values. We use the NAICS codes obtained from the CBP dataset at the six-digit level for supporting industries and the four-digit level for tradable employment. The data are then aggregated to the county level, which is the unit of our analyses (Table 1).

What classifies an industry as tradable or supporting? For this paper, we follow Mian and Sufi (2014)'s classification of the tradable sector based on global trade data: A four-digit NAICS industry is defined as *tradable* if it has imports

Table 1 Summary statistics. Source: County Business Pattern (CBP), Mian and Sufi (2014) and authors' calculations

Statistics	Number of counties	Mean	Standard deviation	p10	p90
Tradable employment/Population, 2007	3108	0.050	0.047	0.008	0.103
Supporting sector employment/Population, 2007	3093	0.012	0.017	0.004	0.023
Tradable employment/Employment, 2007	3102	0.145	0.107	0.030	0.288
Supporting sector employment/Employment, 2007	3146	0.035	0.037	0.012	0.064
Log change in tradable employment, 2007–2010	3013	−0.161	0.421	−0.580	0.186
Log change in supporting sector employment, 2007–2010	3131	−0.040	0.506	−0.600	0.505
Bartik job change	3128	−0.183	0.083	−0.282	−0.073
% White, 2007	3135	86.997	15.017	65.834	98.827
Median household income, 2007	3135	35,597.430	9147.112	26,312.470	46,608.320
Median home value, 2007	3135	82,862.160	45,629.080	45,377.850	127,120.500
% Owner occupied, 2007	3135	74.063	7.541	64.320	81.818
% With less than high school diploma, 2007	3135	22.565	8.705	12.584	34.965
% With only high school diploma, 2007	3135	34.706	6.571	26.398	42.903
% With college education, 2007	3135	10.994	4.961	5.924	17.494
Unemployment rate, 2007	3135	5.820	2.730	2.998	9.071
Poverty rate, 2007	3135	14.154	6.454	7.261	22.605
% Urban, 2007	3135	39.318	30.881	0.000	84.608

Table 2 List of supporting industries

NAICS	Industry name
484,110	General freight trucking, local
484,220	Specialized freight (except used goods) trucking, local
488,210	Support activities for rail transportation
488,510	Freight transportation arrangement
488,991	Packing and crating
493,110	General warehousing and storage
493,120	Refrigerated warehousing and storage
493,130	Farm product warehousing and storage
493,190	Other warehousing and storage
541,214	Payroll services
541,219	Other accounting services
541,511	Custom computer programming services
541,512	Computer systems design services
541,513	Computer facilities management services
541,519	Other computer-related services
541,611	Administrative management and general management consulting services
541,612	Human resources consulting services
541,613	Marketing consulting services
541,614	Process, physical distribution, and logistics consulting
561,110	Office administrative services
561,410	Document preparation services
561,499	All other business support services
561,910	Packaging and labeling services
562,112	Hazardous waste collection
562,211	Hazardous waste treatment and disposal
811,212	Computer and office machine repair and maintenance
811,213	Communication equipment repair and maintenance
811,219	Other electronic and precision equipment repair and maintenance
811,310	Commercial and industrial machinery and equipment (except automotive and electronic) repair

Authors' selection. See detail in Appendix A1

plus exports equal to at least \$10,000 per worker, or if total exports plus imports exceed \$500 M. Regarding the supporting industries, we base our categorization of a NAICS code on whether the industry aids the tradable sector, be it through local or regional support. To be identified as a supporting industry for our purposes, the given industry should support tradable industries, but it cannot also deal with the residential population. In determining the suitability of an industry, we examine each NAICS code provided on the NAICS Association's website (www.naics.com). Table 2 presents a full listing of supporting industries. A more detailed description of this methodology is provided in Appendix Table 12.

A factor prevents us from using the input–output table. We use six-digit NAICS codes to classify our industries. In contrast, the input–output table provided by the Bureau of Economic Analysis (BEA) mainly uses NAICS codes up to two or three digits. For example, the BEA input–output table includes code 562 (Waste management and remediation services). Note that this could mean residential or commercial waste management. Our focus only includes 562,112 (Hazardous Waste Collection) and 562,221 (Hazardous Waste Treatment and Disposal) from the broader 562 categories because we are more confident that Hazardous Waste Collection serves the tradable sectors rather than residents.

We also use Mian and Sufi (2014)’s data for several of our regressions. Most notably, we use several pre-crisis county characteristics in 2007 as controls: percentage white, the log of median household income, the log of median home value, percentage of homes occupied by owners, percentage of the population with less than high school diplomas, percentage with only high school diplomas, percentage with college degrees, unemployment rate, poverty rate, and percentage urban.

Summary statistics for the variables used in our regressions are provided in Table 1. Supporting sector employment made up 3.5% of the total employment in 2007, while tradable employment made up around 14.5%. On average, a given county lost a staggering 16.1% of tradable employment between 2007 and 2010. Tradable job losses driven by aggregate shocks (i.e., Bartik) for a county between 2007 and 2010 are 18.3% on average.

5 Main results

This section examines the causal impacts of a county’s tradable job losses on its supporting industries’ employment. Table 3 presents the baseline results underlying the job loss spillover effect from the tradable sector to supporting industries. It includes six regressions: The first two reveal the OLS relationship between supporting sector employment and tradable sector employment. The next two show the reduced form relationship between the Bartik instrument and supporting sector employment. The final two regressions show the instrumented variable results that capture the causal impact of tradable job losses on supporting sector employment.

The OLS results indicate a significant and positive relationship between the tradable job losses and supporting job losses. The relationship is robust when county characteristics are controlled. The coefficient of 0.068 implies that a 10 percent decline in tradable employment is associated with about 0.7 percent decline in supporting employment.

The reduced form results (columns [3] and [4] of Table 3) show that a 10 percent Bartik job loss on average caused a 3.35 percent decrease in supporting sector employment between 2007 and 2010. This relationship is significant at a 5% level. The relationship is stable when other county-level demographic and income characteristics are included.

The instrumented variable results (columns [5] and [6]) show a 10 percent decline in exogenous tradable employment (instrumented by Bartik job losses)

Table 3 Baseline results

Log change in supporting employment	OLS		Reduced form		IV	
	[1]	[2]	[3]	[4]	[5]	[6]
Log change in tradable employment	0.070** [0.031]	0.068** [0.029]			0.307** [0.145]	0.312** [0.128]
Bartik job change			0.337** [0.153]	0.348** [0.142]		
% White, 2007		0.001 [0.001]		0.001 [0.001]		0.001 [0.001]
Log of median household income, 2007		0.055 [0.123]		0.055 [0.123]		0.003 [0.116]
Log of median home value, 2007		-0.055 [0.036]		-0.058 [0.035]		-0.040 [0.034]
% Owner occupied, 2007		-0.004*** [0.001]		-0.005*** [0.001]		-0.004*** [0.001]
% With less than high school diploma, 2007		-0.000 [0.002]		0.000 [0.002]		0.000 [0.002]
% With only high school diploma, 2007		-0.001 [0.002]		-0.001 [0.002]		-0.001 [0.002]
Unemployment rate, 2007		0.014** [0.006]		0.014** [0.006]		0.013** [0.006]
Poverty rate, 2007		-0.005 [0.005]		-0.006 [0.005]		-0.006 [0.005]
% Urban, 2007		-0.001 [0.000]		-0.001 [0.000]		-0.000 [0.000]
Constant	-0.018* [0.009]	0.292 [1.079]	0.030 [0.027]	0.400 [1.091]	0.025 [0.025]	0.710 [1.079]
Observations	3012	3012	3035	3035	3012	3012
R-squared	0.002	0.015	0.004	0.016		

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level. The last two columns show the impact of log change in tradable employment on log change in supporting employment in a county, where log change in tradable employment is instrumented by Bartik job change

caused a 3.12 percent decrease in supporting sector employment between 2007 and 2010. This magnitude is much larger than the magnitude obtained by the OLS results. This discrepancy supports using an instrument to estimate the impact of tradable job losses on supporting job losses. Without the instrument, the OLS regressions may capture the reverse causality impacts of supporting job losses on tradable job losses or the impact of other county-specific shocks that might affect both tradable and supporting employment (see Eq. 7 and the discussion in Sect. 3.2).

Table 4 First-stage results

First stage	Log Change in Tradable employment	
Bartik job change	1.109*** [0.092]	1.127*** [0.089]
% White, 2007		0.001 [0.001]
Log of median household income, 2007		0.172* [0.099]
Log of median home value, 2007		-0.059* [0.030]
% Owner occupied, 2007		-0.001 [0.001]
% With less than high school diploma, 2007		0.000 [0.001]
% With only high school diploma, 2007		-0.000 [0.001]
Unemployment rate, 2007		0.003 [0.004]
Poverty rate, 2007		0.001 [0.003]
% Urban, 2007		-0.001*** [0.000]
Constant	0.019 [0.018]	-1.029 [0.865]
Observations	3012	3012
R-squared	0.089	0.099
F-stat	144.9	21.98

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level. The table shows the impact of Bartik job change on the log change in tradable employment in a county (the first-stage regressions)

The Bartik instrument is found to be highly correlated with tradable job losses. Table 4 shows the first-stage regression. The estimated coefficients are around 1.1. F-statistics is much larger than 10.

6 Extensions

This section will provide further evidence that the transmission mechanism for job loss spillovers takes place via input–output linkages. To do so, we conduct two exercises. In the first exercise, we argue that other county characteristics are not likely the driving force of the spillover. In the second exercise, we split a county's supporting sectors into those that serve a more local geographic area and those that serve a larger

Table 5 Bartik job losses and county characteristics

	Bartik Job Change
% White, 2007	0.000 [0.000]
Log of median household income, 2007	0.037 [0.037]
Log of median home value, 2007	−0.002 [0.008]
% Owner occupied, 2007	0.001 [0.001]
% With less than high school diploma, 2007	−0.002*** [0.001]
% With only high school diploma, 2007	−0.001 [0.001]
Unemployment rate, 2007	0.002 [0.002]
Poverty rate, 2007	0.003** [0.001]
% Urban, 2007	0.000 [0.000]
Constant	−0.607 [0.389]
Observations	3074
R-squared	0.058

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level

regional area. We show that those that serve locally are more affected by the county's Bartik job losses—further supporting the input–output linkage channel.

6.1 Other potential county characteristics

Goldsmith-Pinkham et al. (2020) argue that using the Bartik instrument is equivalent to using local industry shares as instruments and emphasize the need to argue for the exogeneity of the industry shares. To do so, we examine if Bartik job losses are correlated with pre-crisis county characteristics. Table 5 shows that Bartik job losses are correlated with a county's education and poverty. Nevertheless, when we control for these two factors and other county characteristics, the effects of tradable job losses on supporting service jobs remain robust (see Table 3). Therefore, we argue that the impact of tradable job losses on supporting services is not driven by other county characteristics associated with the preexisting exposure of tradable jobs.

Table 6 Summary statistics for local and regional industries

Statistics	Number of coun- ties	Mean	Standard deviation	p10	p90
Local supporting sector employment/Population, 2007	3074	0.08	0.011	0.002	0.015
Local sup/porting sector employment/Employment, 2007	3114	0.023	0.024	0.008	0.045
Regional supporting sector employment/Population, 2007	2710	0.005	0.014	0.001	0.009
Regional supporting sector employment/Employment, 2007	2761	0.013	0.031	0.003	0.025

The classification is based on the Modified Herfindahl index (see Table 7)

6.2 “Local” versus “regional” supporting sectors

This section divides the supporting industries into two separate subgroups. As shown in Table 2, the supporting industries are diverse, which may react differently to changes in tradable employment given that the nature of their workforces—the supply of workers available, the skillsets necessary, etc.—is inherently different. In addition, the scope of services might also be different across supporting sectors. Some industries serve more locally, while some others serve broader geographical areas. Therefore, we split the supporting sector into two subgroups, “local” and “regional” supporting services. The classification is based on two Herfindahl indices, which we refer to as the standard index, H_1^i and the modified index, H_2^i :

$$H_1^i = \sum_c \left(\frac{l_c^i}{l_{USA}^i} \right)^2$$

$$H_2^i = \sum_c \left(\frac{l_c^i}{l_{USA}^i} - \frac{l_c^T}{l_{USA}^T} \right)^2$$

The standard index is commonly used in the literature. It measures how spread out a supporting industry is across counties. H_1^i is the standard Herfindahl index of supporting industry i . $\frac{l_c^i}{l_{USA}^i}$ is the share of supporting industry i in county c , calculated as the ratio between employment of sector i in county c and total employment of sector i . The standard index for industry i , H_1^i , would take the smallest value if industry i is perfectly spread out across counties; this would indicate that industry i serves locally. Conversely, if industry i is all concentrated in a single county, H_1^i would take the value of 1, which is the largest possible value for H_1^i (Table 6).

In addition to the standard Herfindahl index, we also create a modified Herfindahl index by subtracting the share of tradable industries from the standard measure to measure market concentration while also considering the relative share of tradable industries. $\frac{l_c^i}{l_{USA}^i}$ is the share of the supporting industry i in county c . $\frac{l_c^T}{l_{USA}^T}$ is the share of tradable employment in county c . If a supporting sector i is located in perfect

proportion to the counties' shares of tradable industries, the value of the modified Herfindahl index would be zero. In other words, supporting industry i is located where tradable industries are—indicating that the supporting industry serves local tradable industries. Hence, those supporting industries with small modified Herfindahl index values are considered local. The standard and modified Herfindahl indices yield very similar results as the correlation between the two indices is 0.98. We present the results with the modified Herfindahl index here and leave those with the standard index in Appendix. The classification of each industry into local and regional supporting sectors is shown in Table 7. We classify the top 14 industries as local and the bottom 15 as regional.

Summary statistics for a county's local and regional industries are provided in Table 6. While the local portion of supporting services comprises a slightly larger portion of the workforce, employing a bit over 2.3% of the total employment in 2007, the regional portion makes up slightly over 1.3%.

Tables 8 and 9 depict the results of the two separate categories of regressions when the supporting sector is split into local and regional industries, respectively, based on the modified Herfindahl index. In each table, the first two columns depict the relationship between a county's Bartik job losses and the log change in the county's supporting sector employment without controls. The next two columns show the causal impact of tradable job losses on supporting employment job losses.

The positive coefficients of tradable employment in each regression indicate that greater tradable losses lead to a greater decrease in a county's supporting employment. Across counties and holding control variables constant, a 10 percent decline in tradable jobs causes a 3.8 percent decrease in a county's local supporting jobs. The relationship is significant at a 1% level. However, Bartik job losses do not seem to significantly affect a county's regional supporting jobs. In the regional regressions, the coefficients of the explanatory variable, while positive, are not statistically significant. In other words, exogenous tradable employment shocks in a county during the Great Recession did not possess a significant spillover effect for the county's regional supporting industries.

The results are robust if the standard Herfindahl index is used to classify supporting industries. Local supporting industries, classified by the standard Herfindahl index, are significantly affected while regional supporting industries are not (see Appendix Tables 13 and 14).

Evidence from county-industry level data also reinforces the findings. Table 10 presents the impact of county-level tradable job losses on county-industry level supporting job losses. To make the point that the negative impact on supporting job losses is more heavily concentrated on local supporting industries, we interact the instrumented tradable job losses with the modified Herfindahl index. The interaction has a negative and statistically significant coefficient, implying that the tradable job losses had stronger impacts on employment of more local supporting industries (i.e., those with lower Herfindahl indices).

The findings reinforce the argument for the input–output linkage channel. Since both local supporting industries and regional supporting industries are located in the same county, the different impacts of local tradable job losses on them indicate that transmission mechanisms relying on county-specific factors

Table 7 Supporting industries classified as local or regional

NAICS	Industry name	Modified Herfindahl	Local (l) regional (r)
484,220	Specialized freight (except used goods) trucking, local	0.001201	l
484,110	General freight trucking, local	0.00134	l
541,219	Other accounting services	0.001874	l
493,110	General warehousing and storage	0.002287	l
561,110	Office administrative services	0.003353	l
811,219	Other electronic and precision equipment repair and maintenance	0.003672	l
811,310	Commercial and industrial machinery and equipment (except automotive and electronic) repair	0.004667	l
561,410	Document preparation services	0.004911	l
493,130	Farm product warehousing and storage	0.005773	l
493,190	Other warehousing and storage	0.005910	l
561,499	All other business support services	0.006142	l
561,910	Packaging and labeling services	0.006186	l
541,614	Process, physical distribution, and logistics consulting	0.006207	l
493,120	Refrigerated warehousing and storage	0.006388	l
541,612	Human resources consulting services	0.006618	r
541,511	Custom computer programming services	0.006821	r
811,213	Communication equipment repair and maintenance	0.007847	r
541,613	Marketing consulting services	0.007908	r
488,510	Freight transportation arrangement	0.008280	r
541,512	Computer systems design services	0.008515	r
562,112	Hazardous waste collection	0.008640	r
488,991	Packing and crating	0.009334	r
488,210	Support activities for rail transportation	0.009852	r
541,611	Administrative management and general management consulting services	0.010226	r
541,519	Other computer-related services	0.010330	r
811,212	Computer and office machine repair and maintenance	0.011539	r
541,513	Computer facilities management services	0.019112	r
562,211	Hazardous waste treatment and disposal	0.023096	r
541,214	Payroll services	0.037047	r

The table classifies supporting industries to local supporting industries (l) and regional supporting industries (r), based on the modified Herfindahl index

did not play an important role. If a local county-specific factor, such as a credit crunch, played a dominant role, both types of supporting industries should have reacted similarly. The fact that a county's local supporting industries are more affected by its tradable industries than its regional supporting industries suggests that spillovers occur via the input–output linkage channel.

Table 8 Impacts on local supporting sector employment

Log change in local supporting employment, 2007–2010 (classified based on modified Herfindahl)	Reduced form		IV	
	[1]	[2]	[3]	[4]
Bartik job change	0.366** [0.139]	0.425*** [0.152]		
Instrumented log change in tradable employment			0.337*** [0.123]	0.383*** [0.127]
% White, 2007		0.001 [0.001]		0.000 [0.001]
Log of median household income, 2007		0.032 [0.152]		–0.034 [0.150]
Log of median home value, 2007		–0.153* [0.080]		–0.129 [0.080]
% Owner occupied, 2007		–0.004*** [0.001]		–0.003*** [0.001]
% With less than high school diploma, 2007		0.001 [0.003]		0.001 [0.003]
% With only high school diploma, 2007		–0.002 [0.004]		–0.002 [0.004]
Unemployment rate, 2007		0.017** [0.008]		0.017** [0.008]
Poverty rate, 2007		–0.013*** [0.005]		–0.014*** [0.005]
% Urban, 2007		–0.001 [0.001]		–0.000 [0.001]
Constant	–0.001 [0.034]	1.829 [1.144]	–0.006 [0.031]	2.215* [1.209]
Observations	3014	3014	2992	2992
R-squared	0.003	0.017		

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level. The last two columns show the impact of log change in tradable employment on log change in local supporting employment in a county, where log change in tradable employment is instrumented by Bartik job change

6.3 Impact on other services

As a robustness check, we examine the impact of tradable job losses on “other” services. They are defined as those with NAICS codes 48 and 49 (Transportation and Warehousing), 54 (Professional, Scientific and Technical Services), 56 (Administrative and Support and Waste Management and Remediation Services), and 81 (Other Services, except Public Administration), but *exclude* the supporting industries identified in Appendix Table 12. In other words, these “other” services are not

Table 9 Impacts on regional supporting sector employment

Log change in regional supporting employment, 2007–2010 (classified based on modified Herfindahl)	Reduced form		IV	
	[1]	[2]	[3]	[4]
Bartik job change	0.182 [0.250]	0.181 [0.238]		
Instrumented log change in tradable employment			0.161 [0.228]	0.157 [0.211]
% White, 2007		0.000 [0.002]		0.000 [0.002]
Log of median household income, 2007		0.024 [0.188]		−0.001 [0.187]
Log of median home value, 2007		0.015 [0.051]		0.024 [0.053]
% Owner occupied, 2007		−0.003 [0.002]		−0.002 [0.002]
% With less than high school diploma, 2007		−0.002 [0.003]		−0.002 [0.003]
% With only high school diploma, 2007		0.002 [0.003]		0.002 [0.003]
Unemployment rate, 2007		0.005 [0.008]		0.004 [0.008]
Poverty rate, 2007		0.002 [0.007]		0.002 [0.008]
% Urban, 2007		−0.001 [0.001]		−0.000 [0.001]
Constant	0.036 [0.043]	−0.268 [1.878]	0.033 [0.039]	−0.118 [1.873]
Observations	2582	2582	2575	2575
R-squared	0.000	0.004		

Robust standard errors in brackets

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

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level. The last two columns show the impact of log change in tradable employment on log change in regional supporting employment in a county, where log change in tradable employment is instrumented by Bartik job change

affected by the tradable job losses via the input–output channel, although they might be affected by other channels.

We find that the effects of tradable job losses on “other” services are weaker (Table 11). Column [5] reveals that instrumented tradable job losses do not significantly affect the employment of other services. However, when county controls are

Table 10 Impacts on regional supporting sector employment

Variables	Log change in supporting employment at county-industry level			
	Reduced form		IV	
Bartik job change	0.471*** [0.176]	0.571*** [0.159]		
Bartik job change*Modified Herfindahl	-20.868*** [7.871]	-22.762*** [7.974]		
Instrumented log change in tradable employment			0.419*** [0.156]	0.498*** [0.140]
Instrumented log change in tradable employment *Modified Herfindahl			-20.175*** [7.558]	-21.796*** [7.662]
% White, 2007		0.000 [0.001]		0.000 [0.001]
Log of median household income, 2007		0.058 [0.113]		0.002 [0.117]
Log of median home value, 2007		-0.103** [0.043]		-0.084* [0.046]
% Owner occupied, 2007		-0.003** [0.001]		-0.003* [0.001]
% With less than high school diploma, 2007		-0.002 [0.002]		-0.002 [0.002]
% With only high school diploma, 2007		-0.000 [0.002]		-0.000 [0.002]
Unemployment rate, 2007		0.009 [0.007]		0.008 [0.007]
Poverty rate, 2007		-0.005 [0.005]		-0.005 [0.006]
% Urban, 2007		-0.002*** [0.000]		-0.001*** [0.000]
Constant	0.011 [0.030]	0.970 [1.054]	0.004 [0.026]	1.277 [1.095]
Observations	30,570	30,570	30,534	30,534
R-squared	0.001	0.004		

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is the *county-industry* level. All regressions are weighted by the number of households in the county. Standard errors are clustered at the county level

included, the effects become statistically significant (column [6]). The magnitude is still much smaller than the effect on the supporting services (0.12 versus 0.31). This finding strengthens the argument for our selection of supporting services.

Table 11 Impact of tradable shocks on “other” service industries

Log change in supporting employment	OLS		Reduced form		IV	
	[1]	[2]	[3]	[4]	[5]	[6]
Log change in tradable employment	0.013 [0.015]	0.008 [0.013]			0.093 [0.061]	0.121** [0.055]
Bartik job change			0.102 [0.065]	0.136** [0.059]		
% White, 2007		0.000 [0.000]		0.000 [0.000]		0.000 [0.000]
Log of median household income, 2007		0.105*** [0.039]		0.102** [0.038]		0.080* [0.042]
Log of median home value, 2007		−0.036** [0.017]		−0.037** [0.016]		−0.029* [0.015]
% Owner occupied, 2007		−0.002*** [0.001]		−0.002*** [0.001]		−0.002** [0.001]
% With less than high school diploma, 2007		−0.001* [0.001]		−0.001 [0.001]		−0.001 [0.001]
% With only high school diploma, 2007		0.001 [0.001]		0.001 [0.001]		0.001 [0.001]
Unemployment rate, 2007		0.000 [0.003]		0.000 [0.003]		−0.000 [0.003]
Poverty rate, 2007		0.002 [0.002]		0.002 [0.002]		0.001 [0.002]
% Urban, 2007		−0.001*** [0.000]		−0.001*** [0.000]		−0.001*** [0.000]
Constant	−0.076*** [0.006]	−0.609 [0.415]	−0.060*** [0.012]	−0.544 [0.414]	−0.061*** [0.011]	−0.417 [0.464]
Observations	3050	3050	3075	3075	3050	3050
R-squared	0.000	0.022	0.002	0.026		

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. “Other” service industries are those with NAICS codes 48 and 49 (Transportation and Warehousing), 54 (Professional, Scientific, and Technical Services), 56 (Administrative and Support and Waste Management and Remediation Services), and 81 (Other Services, except Public Administration), but excluding the industries identified in Appendix Table 12. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level. The last two columns show the impact of log change in tradable employment on log change in other “excluded” service employment in a county, where log change in tradable employment is instrumented by Bartik job change

7 Conclusion

The Great Recession was a painful period in world economic history. Behind the dry numbers are actual people and communities that suffer from job losses and the resulting hardship. Thus, it is important to understand the impacts of the Great Recession, in particular, how shocks transmit across economic sectors.

This paper is an effort to better understand the transmission of job losses during the Great Recession. We focus only on the transmission via input linkages. We find that counties with higher tradable job losses driven by aggregate shocks experience greater declines in supporting service employment. The results reveal that across counties, a 10 percent decrease in tradable jobs, on average, caused a 3.1 percent decrease in supporting sector employment between 2007 and 2010. These results are statistically significant and are robust across numerous control variables.

Moreover, the impact of tradable job losses shock was much larger and more significant on the supporting services that serve local markets than on those that serve larger geographic areas. Across counties, a 10 percent decline in tradable jobs causes a 3.8 percent decline in a county's local supporting jobs. We argue that this is due to local industries' high dependence on local tradable employment. Hence, the results are argued to reflect the impact of cross-sectoral job loss spillovers during the Great Recession.

Appendix

In defining supporting industries, we rigorously examined all of the NAICS codes provided on the NAICS Association's website. We made our decisions based on the descriptions of each industry described under a given NAICS code. If the code potentially supported the tradable sectors, we then asked if any industries under the code a) deals with the residential population (such as 561,720, which includes housekeeping services) or b) functions far from the tradable industries (such as 484,121 and 484,122, which deal with long-distance freighting and trucking). If either was thought to be true, the code was removed. The following table includes descriptions of all the industry NAICS codes that we included in the supporting sector as well as the reason for inclusion :

Table 12, 13 and 14 shows the results of regressions when the supporting sector is split into local and regional industries based on the standard Herfindahl index. These results are similar to those obtained when the industries are divided based on the modified Herfindahl index. Across counties, a 10 percent decline in tradable jobs causes a 3.8 percent decrease in a county's local supporting jobs. However, tradable job losses do not seem to significantly affect a county's regional supporting jobs.

Table 12 Supporting industries descriptions and reasons for inclusion

NAICS	Industry name	Description	Reason for inclusion
484,110	General freight trucking, local	Provides local general freight trucking, generally with a one-day return Note: We exclude industries 484,121 (General Freight Trucking, Long-Distance, Truckload) and 484,122 (General Freight Trucking, Long-Distance, Less Than Truckload) because these industries are not stationed locally; thus inclusion of them would therefore contaminate our results	Helps fulfill the need for transportation to support tradable industries, as manufactured goods, etc., require freight trucks to move them from factories to warehouses, stores, etc
484,220	Specialized freight (except used goods) trucking, local	Provides local specialized trucking, generally with a one-day return	Same as aforementioned industry
488,210	Support activities for rail transportation	Provides specialized services for railroad transportation, including servicing, repair, maintenance, loading and unloading of rail cars, and operating terminals	Aids rail transport which is vital to support the transportation of tradable industries
488,510	Freight transportation arrangement	Arranges transportation of freight between shippers and carriers, includes freight forwarders, marine shipping agents, etc	Necessary for freight transportation industry which serves tradable industries as it provides services spanning transportation modes
488,991	Packing and crating	Deals with packing, crating, and otherwise preparing goods for transportation	Same as aforementioned industry
493,110	General warehousing and storage	Responsible for storing goods in warehouses	Considered supporting because this industry stores tradable goods
493,120	Refrigerated warehousing and storage	Responsible for storing goods that require refrigeration	This industry is included for the same reasons as the previous code except that this industry deals with tradable goods that require refrigeration
493,130	Farm product warehousing and storage	Responsible for the storage of farm products	Since farm products are tradable goods, this industry falls under the supporting category
493,190	Other warehousing and storage	Provides storage for specific industries, such as lumber, whiskey, etc	Considered supporting because this industry stores tradable goods
541,214	Payroll services	Deals with accounting, billing, and bookkeeping	Considered supporting given that the tradable industries require its service

Table 12 (continued)

NAICS	Industry name	Description	Reason for inclusion
541,219	Other accounting services	Provides accounting services, and other services like providing tax return preparation or payroll services	Same as aforementioned industry
541,511	Custom computer programming services	Engaged in writing, modifying, testing, and supporting software to meet the needs of a particular customer	Included because many tradable industries utilize software and computers for their businesses
541,512	Computer systems design services	Involved in planning and designing computer systems that integrate computer hardware, software, and communication technologies; also involved in system installation and training and supporting users of the system	Same as aforementioned industry
541,513	Computer facilities management services	Provides on-site management and operation of clients' computer systems and/or data processing facilities as well as support to these systems	Necessary to aid computer and software industries that serve tradable industries
541,519	Other computer-related services	Provides computer-related services, such as computer disaster recovery services and software installation	Necessary to aid computer and software industries that serve tradable industries
541,611	Administrative management and general management consulting services	Provides operating advice and assistance to businesses and other organizations on administrative management issues	Tradable companies require consulting services in order to deal with back-end challenges
541,612	Human resources consulting services	Provides advice and assistance to businesses and organizations in the areas of human resource and personnel policies, employee benefits planning, communication and administration, and compensation planning and administration	Same as aforementioned industry
541,613	Marketing consulting services	Provides operating advice and assistance to businesses and organizations on marketing issues, such as developing objectives and policies, sales forecasting, new product development, and marketing planning and strategy	Same as aforementioned industry

Table 12 (continued)

NAICS	Industry name	Description	Reason for inclusion
541,614	Process, physical distribution, and logistics consulting	Provides operating advice and assistance to businesses and organizations in the areas of manufacturing operations and production, productivity, transportation, warehousing, etc	Same as aforementioned industry
561,110	Office administrative services	Responsible for providing a range of day-to-day office administrative support services	It is included as it provides office support services which are important for the day-to-day functioning of tradable industries
561,410	Document preparation services	Deals with letter writing or resume writing, document editing, and other secretarial services	It is included as it provides office support services
561,499	All other business support services	Provides business support services	Included for aforementioned reasons
561,910	Packaging and labeling services	Deals with packaging client-owned materials	An integral part of the transportation of tradable goods
562,112	Hazardous waste collection	Deals with collecting and hauling hazardous waste within a local area and operating hazardous waste transfer stations	Tradable industries, such as manufacturing, create harmful by-products that require disposal
562,211	Hazardous waste treatment and disposal	Engaged in operating treatment and disposal facilities for hazardous waste	Same as previous industry
811,212	Computer and office machine repair and maintenance	Deals with repair and maintenance of computers and other office machines	Integral for the day-to-day functioning of tradable industries
811,213	Communication equipment repair and maintenance	Deals with repair and maintenance of communications	Same as aforementioned industry
811,219	Other electronic and precision equipment repair and maintenance	Responsible for repair and maintenance of electronic and precision equipment	Supports the functioning of certain tradable industries
811,310	Commercial and industrial machinery and equipment (except automotive and electronic) repair	Deals with repair and maintenance of commercial and industrial machinery and equipment	Same as aforementioned industry

Table 13 Supporting industries classified as local or regional according to a standard Herfindahl index

NAICS	Industry name	Standard Herfindahl	Local (l) Regional (r)
484,220	Specialized freight (except used goods) trucking, local	0.002071	l
493,110	General warehousing and storage	0.004657	l
484,110	General freight trucking, local	0.004907	l
493,130	Farm product warehousing and storage	0.005402	l
541,219	Other accounting services	0.006081	l
811,219	Other electronic and precision equipment repair and maintenance	0.006820	l
811,310	Commercial and industrial machinery and equipment (except automotive and electronic) repair	0.007959	l
561,499	All other business support services	0.008376	l
561,410	Document preparation services	0.008500	l
493,190	Other warehousing and storage	0.008593	l
561,110	Office administrative services	0.008822	l
493,120	Refrigerated warehousing and storage	0.008870	l
811,213	Communication equipment repair and maintenance	0.009771	l
541,614	Process, physical distribution, and logistics consulting	0.010042	l
561,910	Packaging and labeling services	0.010523	r
541,511	Custom computer programming services	0.012042	r
488,991	Packing and crating	0.012463	r
541,512	Computer systems design services	0.012938	r
541,612	Human resources consulting services	0.012972	r
541,613	Marketing consulting services	0.013493	r
541,519	Other computer-related services	0.014440	r
811,212	Computer and office machine repair and maintenance	0.014802	r
541,611	Administrative management and general management consulting services	0.015322	r
562,112	Hazardous waste collection	0.015403	r
488,210	Support activities for rail transportation	0.015538	r
488,510	Freight transportation arrangement	0.015745	r
541,513	Computer facilities management services	0.021722	r
562,211	Hazardous waste treatment and disposal	0.026548	r
541,214	Payroll services	0.049904	r

Table 14 Impacts on local and regional supporting sector employment using the standard Herfindahl index classification of supporting industries

Variables	Log change in local supporting employment, 2007–2010			
	Reduced form		IV	
	<i>Local</i>			
Bartik job change	0.356** [0.136]	0.418*** [0.151]		
Instrumented log change in tradable employment			0.327*** [0.120]	0.375*** [0.126]
Controls	No	Yes	No	Yes
Constant	0.004 [0.034]	1.179 [1.155]	-0.002 [0.032]	1.555 [1.237]
Observations	3012	3012	2990	2990
R-squared	0.003	0.017		
	<i>Regional</i>			
Bartik job change	0.237 [0.271]	0.223 [0.256]		
Instrumented log change in tradable employment			0.211 [0.247]	0.194 [0.228]
Controls	No	Yes	No	Yes
Constant	0.038 [0.046]	0.281 [1.941]	0.033 [0.042]	0.466 [1.932]
Observations	2583	2583	2576	2576
R-squared	0.001	0.005		

Robust standard errors in brackets (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The unit of analysis is a county. All regressions are weighted by the number of households in the county. Standard errors are clustered at the state level

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