Employment Multipliers
Over The Business Cycle

06/18/2017

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Abstract

This paper estimates dynamic employment multipliers in a U.S. county during 1998-2015. On average, one exogenous tradable job gain creates 1.1 jobs in the rest of the county economy in the same year, but is offset by losses of 0.23 job one year later and 0.32 job two years later. The multiplier is modest during the 2002-2007 boom and is large during the Great Recession. It is smaller in the initial years of the Recovery but is larger in the latter years. Uncertainty and credit constraints are two possible hindrances to the propagation of job gains during the Recovery.

Keywords: employment, multipliers, business cycles
JEL code: E24, E62

[1] We thank Brian Kovak, Aart Kraay, Valerie Ramey, Luis Serven and Trang Tran, seminar participants at the World Bank for useful comments and feedback. This paper reflects the authors' views and not necessarily those of the World Bank and Central Bank of Malaysia (BNM). All errors are ours. Contact address: Ha Nguyen, Developing Research Group, Sasana Kijang, No. 2, Jalan Dato' Onn, 50480 Kuala Lumpur, Malaysia. Email: hanguyen@worldbank.org

1. Introduction

Economists and policy makers are interested in how employment gains or losses propagate through different sectors or regions. In recessions, job losses could form a vicious downward spiral, that is, initial job losses could cause further job losses and hence worsen the downturn. This concern was shared by many economists. Paul Krugman, for example, at the start of the Great Recession, 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*" (New York Times, November 14, 2008). By the same token, the creation of new jobs could also generate demand for additional jobs. The argument for stimulus packages enacted during the Great Recession is partly based on this premise: new job creations and investment by the government could lead to new job gains and investment by the private sector. Since the Great Recession, many studies have been conducted to estimate fiscal multipliers, with wide-ranging results.

This paper presents estimates of dynamic short-run employment multipliers within a U.S. county during 1998-2015. It also provides estimates for employment multipliers over the business cycle, in particular, during the boom time of 2002-2007, during the Great Recession of 2008-2010 and during the Recovery of 2011-2015. The plausibly exogenous source of employment changes is *a county's tradable*[2] *employment changes that are only driven by aggregate shocks.* Since there are more than 3000 counties in the U.S, the national aggregate

[2] Tradable industries refer to those industries that can sell their product across county lines. Since data on counties' import and export are not available, we follow Mian and Sufi (2014) to define tradable industries as those that have international imports plus exports equal to at least $10,000 per worker, or if total exports plus imports exceed $500 million. Please see section 3 for more information.

shocks to tradable sectors, such as a collapse of aggregate demand, are largely exogenous to a county. That is, they are little affected by any county's fundamentals. This implies that reverse causality and county-specific omitted variable problems, such as county productivity shocks, are not likely to impact the results. This identification idea was first formulated by Bartik (1991). Hence, we refer to these job changes as the Bartik job changes.

A county's Bartik job changes are determined by (1) how exposed the county was to tradable industries and (2) how those tradable industries' *national employment* changes. Bartik job changes in this paper are calculated as follows: $\sum_{i\in Tradable}\left[l_{c,t-1}^{i} \times (\log l_{USA-c,t}^{i} - \log l_{USA-c,t-1}^{i})\right]$, where $l_{c,t-1}^{i}$ is the level of employment of tradable industry *i* in county *c* in the previous year (i.e. the pre-existing exposure), and $\log l_{USA-c,t}^{i} - \log l_{USA-c,t-1}^{i}$ is the national change in tradable industry *i's* employment excluding county *c*'s employment in industry *i*. We interpret $\log l_{USA-c,t}^{i} - \log l_{USA-c,t-1}^{i}$ as the aggregate shock to industry i's employment in the rest of the country. The product of the two terms gives us a prediction of county *c*-industry *i*'s tradable job changes driven by exogenous aggregate shocks in year *t*.

The Bartik job changes are then used to estimate dynamic local employment multipliers within a county during 1998-2015 in an empirical framework with county-level panel data and county fixed effects. In other words, we estimate employment multipliers within a county. County-fixed effects help control for county-level characteristics such as county size, location and demographics that might affect the estimated multiplier. Overall, we find that every Bartik tradable job gain (loss) generates (kills) 1.09 jobs in the rest of the county economy in the same year, and is offset by 0.23 job loss (gain) one year later, and 0.32 job loss (gain) two years later. We break down the employment spillover to three different sectors: local retail and restaurants, construction, and other services (consisting of wholesales, finance, IT, hospitals…). On average, among the 1.09 jobs destroyed (created) contemporaneously by a Bartik tradable job loss (gain), 0.23 jobs are in retail and restaurants, 0.26 in construction, and 0.60 in other services.

One particularly interesting result is the asymmetric employment multipliers during the boom time of 2002-2007, the Great Recession (2008-2010), and the Recovery (2011-2015). During the 2002-2007 boom, the multiplier is relatively modest, around 0.98. During the Great Recession between 2008 and 2010, the job loss multiplier is much larger than average: within a county, every Bartik tradable job loss kills another 1.61 jobs in other sectors. However, during the Recovery, there is limited evidence of spillover from tradable job gains to jobs in other sectors. Between 2011 and 2014, the job gain multiplier ranges from 0 to 2.8. We only observe robust positive spillover from tradable job gains when 2015 is included, with the job gain multiplier ranges from 1.3 to 3.0. In section 6.2, we find evidence to support the hypothesis that uncertainty and credit constraints are two possible factors that hinder the propagation of job gains during the Recovery.

Note that these multipliers encompass all propagation mechanisms of job gains or losses from tradable sectors to other sectors. In other words, the estimates are the LATE (*local average treatment effects*) of Bartik job changes on a county's employment, via all the general equilibrium responses in the county's economy. The first mechanism is aggregate demand-driven. In recessions, laid-off tradable workers could cut consumption and cause further job losses in local businesses such as restaurants or retails. The second mechanism operates via input-output linkages. In particular, tradable firms in trouble could cut demand for local inputs and services, leading to further job losses in these supporting sectors. In addition, the spillover could operate via other mechanisms not related to labor markets, such as a local credit crunch or a local housing market decline caused by tradable job losses.

Since this is a local multiplier, this does not capture inter-county linkages and the effects on federal government. For example, this does not capture induced declines in inter-county tourism from laid-off tradable workers. Neither does it capture job losses due to inter-county input-output linkages in production and services. Finally, the local multiplier ignores the effect on the federal government's tax revenue, which could affect federal employment. Therefore, the estimates are likely to underestimate the true cascading impacts of job gains or losses.

The rest of the paper is organized as follows: section 2 reviews the literature; section 3 discusses the identification strategy; section 4 reports data; section 5 presents the baseline results; section 6 provides the estimates during the Great Recession and the recovery; section 7 concludes.

2. Literature review

This paper is most related to Moretti (2010, 2012). Moretti (2010) uses three years of data (1980, 1990 and 2000) and a Bartik-typed instrument to estimate the *long-term* employment multiplier across U.S. cities. Although using a similar approach to Moretti (2010, 2012), this paper's focus is different. While Moretti's focus in on the long-run "geography of jobs" (i.e. how jobs are allocated across the country), we are interested in estimating the dynamic short-run multiplying effect of job creations or job losses within a small area, in this case, a county. This is a topic of great interest, particularly since the Great Recession. Having this short-run focus allows us to estimate time-varying multipliers, such as those during the Great Recession and the Recovery. Finally, we could also estimate the dynamics of employment multipliers.

Moretti (2010) finds that if a city has one more additional job in manufacturing, it has 1.6 more jobs in the non-tradable sectors. This number is larger than our short-run estimate. The difference in the estimates could be due to at least two reasons. First, Moretti (2010) considers a cross-city estimate while our estimate is based on a within-county regression framework with county fixed effects. The use of county-fixed effects helps control potential time-invariant county-level characteristics such as location and demographics that might affect the estimated multiplier. Second, our definition of tradable sector is broader than that of Moretti (2010), who defined manufacturing sector as tradable sector. We followed the definition in Mian and Sufi (2014), which will be described further in the data section. This categorization provides us with 82 four-digit tradable sectors, and consist of all manufacturing, oil and gas extraction, and mining sectors.

Blanchard and Katz (1991) is another influential paper that utilizes the Bartik instrument. However, their focus is not on employment multipliers. Rather, they examine how an employment shock affects a state's employment rate over time. They find that a state typically returns to having a normal employment rate after an adverse shock not because employment picks up, but because workers leave the state.

Other papers measure local spillovers of exogenous job gains or losses using specific case studies. Most notably, Carrington (1996) examines the impact of the construction of the Trans-Alaskan Pipeline System on the Alaskan economy from 1974 to 1977. Carrington finds significant spillovers to most sectors, except government and manufacturing. Relatedly, Black et al (2005) examine the local impacts of the coal boom in the 1970s and the subsequent coal bust in the 1980s. They find modest employment spillover into sectors with locally traded goods but not into sectors with nationally traded goods.

This paper is a part of the authors' research agenda on employment propagation. Nguyen (2015) examines the *demand-driven* propagation of job losses within a U.S. county during the Great Recession. Nguyen (2015) focuses on the job losses of the retail and restaurants sector, and finds that job losses in the rest of the county's economy kill jobs in local retailers and restaurants. The spillover is stronger for more demand-elastic retail and restaurants sectors, which is argued to be evidence for demand-driven propagation of job losses. Nguyen and Rezaei (2016) examine local job loss propagation that operates via input-output linkages. They find that tradable job losses in a county hurt the county's employment in the supporting service sectors (most clearly the logistics sectors). This paper has a different focus to that in Nguyen (2015) and Nguyen and Rezaei (2016). While the two aforementioned papers aim to examine specific channels via which job losses could propagate, this paper is interested in the dynamics of short-run employment multipliers and in understanding how these multipliers change over the business cycle.

This paper is related to a large body of literature on fiscal multipliers because it also examines the multiplying impacts of exogenous inflows or outflows of income (which come with the exogenous creations or losses of jobs). Ramey (2011b) offers a review of the literature on fiscal multipliers. Many researchers have found multipliers that are smaller than one, and potentially close to zero, while others have found substantially larger multipliers. For the United States, 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. Ramey (2011a) 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 Shoag (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. Wilson (2012) considers the job creation of fiscal spending. Using exogenous variation in the American Recovery and Reinvestment Act (ARRA) spending across states, he finds that ARRA in its first year yielded about eight jobs per million dollars spent. Chodorwo-Reich et al (2012), using a different approach, find that $100,000 of ARRA spending yields 3.8 jobs.

3. Identification strategy

3.1. Bartik job changes

Bartik job changes are tradable job changes driven by aggregate shocks and not by county specific issues. Therefore, reverse causality and county specific omitted variable problems, such productivity shocks or higher minimum wages, are not likely to taint Bartik. To see the relationship between change in a county's total employment and the Bartik job changes, consider the change in total employment of county *c*,

$$l_{c,t} - l_{c,t-1} = \sum_{i \in All} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right)$$

where $l_{c,t}$ is employment in county *c* at time *t;* $l_{c,t}^{i}$ is industry *i*'s employment in county *c* at time *t*. I split the change in total employment to those in tradable industries (T), and those in the remaining economy (Others), as follows:

$$\Delta l_{c,t} = \sum_{i \in T} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right) + \sum_{i \in Others} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right)$$

where $\sum_{i \in T} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right)$ is the change in the number of jobs of all tradable industries in county *c*.

The change in tradable jobs $\sum_{i \in T} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right)$ might not be exogenous to a county's fundamentals. For example, labor supply issues (such as an increase in minimum wages) or changes in regulations in the county could affect tradable employment in that county. The Bartik job changes capture only tradable job changes driven by changes in aggregate shocks. To see this, rewrite tradable job changes as:

$$\sum_{i \in T} \left(l_{c,t}^{i} - l_{c,t-1}^{i} \right) \sum_{i \in T} \left(l_{c,t-1}^{i} \times \Delta \log l_{USA-c,t}^{i} \right) + \left\{ \sum_{i \in T} \left(l_{c,t-1}^{i} \times (\Delta \log l_{c,t}^{i} - \Delta \log l_{USA-c,t}^{i}) \right) \right\}$$

The first term, $\sum_{i \in T} \left(l_{c,t-1}^{i} \times \Delta \log l_{USA-c,t}^{i} \right)$ is the Bartik job changes. It is interpreted as *the predicted job gains or losses driven by external shocks*. It is the sum of all individual Bartik job changes of all tradable industries. For each industry *i*, the Bartik job change is the product of the county's pre-existing exposure to the sector, $l_{c,t-1}^{i}$, and the national change in industry *i*'s employment excluding the current county employment in industry *i*, $\Delta \log l_{USA-c,t}^{i}$, between *t* and *t-1*. This is the leave-one-out approach to mitigate the concern that an industry employment could be overly concentrated in a county. We interpret $\Delta \log l_{USA-c,t}^{i}$ as the change in industry *i's* aggregate shocks in the rest of the country at year *t*. Bartik job changes, $\sum_{i \in T} \left(l_{c,t-1}^{i} \times \Delta \log l_{USA-c,t}^{i} \right)$, could be interpreted as the predicted tradable gains or losses due to aggregate shocks. Note that a positive $\sum_{i \in T} \left(l_{c,t-1}^{i} \times \Delta \log l_{USA-c,t}^{i} \right)$ implies a Bartik job gain for county *c*, and a negative number implies a Bartik job loss.

The second term, $\sum_{i \in T} \left(l_{c,t-1}^{i} \times (\Delta \log l_{c,t}^{i} - \Delta \log l_{USA-c,t}^{i}) \right)$, can be interpreted as tradable job changes driven by county-specific issues. It is the difference between actual tradable job changes and those that are driven by the aggregate shocks.

Hence, we can write total job changes as follows:

$$\Delta l_{c,t} = \text{Bartik} + \sum_{i\in T}\left(l^{i}_{c,t-1} \times \left(\Delta\log l^{i}_{c,t} - \Delta\log l^{i}_{USA-c,t}\right)\right) + \Delta l^{Others}_{c,t}$$

Since we are interested in the employment multiplier, we are interested in a relationship between change in other sectors' employment, $\Delta l^{Others}_{c,t}$, and the Bartik job changes.

3.2 Econometric specifications

The econometric model is therefore as follows:

$$\boldsymbol{l^{Others}_{c,t} - l^{Others}_{c,t-1} = \beta_1 + \beta_2 Bartik_{c,t} + fe_c + fe_t + \varepsilon_{c,t}} \qquad \textbf{(3.1)}$$

where $l^{Others}_{c,t}$ is employment at time *t* in the rest of the county economy (which consists of retail and restaurants, construction and other services). fe_c is a set of county fixed effects, and fe_t is a set of time fixed effects. fe_c control for time-invariant county characteristics, and fe_t control for aggregate (national) sources of fluctuation. An advantage of investigating the employment multiplier within a county is that we could rule out the possibility that time-invariant county characteristics could contaminate the regression results. Examples of such characteristics are county location, county size (i.e. population) and demographics. In other words, utilizing county fixed effects implies that we are looking for the short-run employment multiplier *within* a county. In addition, as Goldsmith-Pinkham et al (2017) argue, a concern with cross-sectional analyses using Bartik instruments is that industry shares are correlated with education and other characteristics. The use of county fixed effects helps mitigate this concern. Note that all standard errors in this paper are robust.

We will also examine an instrumental variable (IV) version of the regression:

$$\boldsymbol{l^{Others}_{c,t} - l^{Others}_{c,t-1} = \beta_1 + \beta_2 Instr\, \Delta\, tradable\ jobs_{c,t} + fe_c + fe_t + \varepsilon_{c,t}} \qquad \textbf{(3.2)}$$

where $Instr\ \Delta\ tradable\ jobs_{c,t}$ is the log change in tradable jobs instrumented by $\text{Bartik}_{c,t}$.

4. Data

County employment data by industry are from the County Business Patterns (CBP) dataset. Data are from 1998 to 2015, where the NAICS classification is available. CBP data are recorded in March each year. CBP employment data at the four-digit industry level are used. 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), we take the mean of this range as a proxy for the missing employment number in such cases.

Following Mian and Sufi (2014), a 4-digit NAICS industry is defined as *tradable* if it has international imports plus exports equal to at least $10,000 per worker, or if total exports plus imports exceed $500 million. There are 82 four-digit tradable sectors. They consist of all manufacturing, oil and gas extraction, and mining. Tradable industries on average account for about 15% of a county's total employment. *Construction* industries are those that are related to construction, real estate, or land development. On average, they account for 12% of a county's workforce. *Retail and restaurants* include local retailers and restaurants. On average, they account for 21% of the county's employment. The remaining industries are classified as *other services*. They consist of wholesales, transportation, finance, schools, hospitals etc. They do not include government services. On average, they account for about 52% of a county's workforce.[3]

[3]Please see http://faculty.chicagobooth.edu/amir.sufi/data-and-appendices/unemployment_miansufi_EMTRA_final_APPENDIX.pdf for a complete industry classification.

Table 4.1: Average employment shares of sectors in a county

Year	Tradable	Retails and Restaurants	Construction	Other Services
1998	18.0	20.6	12.9	48.6
1999	17.5	20.5	13.1	49.0
2000	17.0	20.5	13.2	49.4
2001	16.4	20.6	12.9	50.2
2002	15.4	20.8	12.8	51.1
2003	15.1	20.8	12.4	51.8
2004	14.7	21.0	12.6	51.8
2005	14.6	20.9	12.7	51.9
2006	14.3	20.9	13.0	51.9
2007	14.2	20.7	12.9	52.3
2008	14.0	20.9	12.7	52.5
2009	13.3	21.2	11.9	53.8
2010	13.0	21.2	11.5	54.5
2011	13.2	21.1	11.2	54.5
2012	13.4	20.8	11.1	54.7
2013	13.4	20.9	11.2	54.6
2014	13.4	20.9	11.3	54.5
2015	13.7	21.1	11.4	53.9
Total	14.7	20.9	12.3	52.3

Table 4.2: Average Bartik job changes over time

Year	Log change in tradable employment	Bartik job changes, number	△ Bartik jobs, % of total employment
1999	-0.03	-125.69	-0.53
2000	-0.01	-59.97	-0.28
2001	-0.04	-176.21	-0.71
2002	-0.08	-522.82	-1.50
2003	-0.02	-77.95	-0.30
2004	-0.01	-89.47	-0.20
2005	0.00	-68.24	-0.20
2006	0.01	-5.73	-0.04
2007	0.00	-77.50	-0.20
2008	-0.02	-75.14	-0.37
2009	-0.10	-411.31	-1.42
2010	-0.04	-219.16	-0.75
2011	0.03	53.44	0.25
2012	0.03	70.50	0.31
2013	0.00	23.83	0.10
2014	0.02	50.44	0.14
2015	0.00	0.06	0.00
Average	-0.01	-100.64	-0.33

While the shares of construction, retail and restaurants are steady, tradable employment share has been declining, from 18% of a county's work force in 1998 to 14% in 2015. This is accompanied by an increasing share in other services. Many have discussed the declines of U.S. manufacturing. For example, according to Autor et al (2013), import competition from China is one of the main explanations for the aggregate decline in U.S. manufacturing employment.

Table 4.2 reports the average year-over-year log change in tradable employment (first column), the Bartik job changes (second column), and the Bartik job changes as a percentage of total county employment in the previous year (third column). Every year from 1999 to 2010, on average, U.S. counties lose tradable jobs due to exogenous shocks. For example, in 1999, a U.S. county on average lost 125.7 jobs due to aggregate shocks, accounting for -0.53 percent of the county's total employment. The decline accelerated and peaked in 2002, when on average a county lost 523 tradable jobs due to exogenous shocks. This is explained by U.S. trade policy that eliminated potential tariff increases on Chinese imports (see Autor et al, 2013 and Pierce and Schott, 2016). The Great Recession hit and brought another wave of declines. In 2009 on average a county lost about 411 tradable workers due to aggregate shocks, which accounts for 1.42 percent of the county's total employment. Another 4% of tradable jobs were dissipated in 2010. Since 2011, tradable employment has recovered at a slow pace.

5. Baseline results

This section presents the baseline results for the paper. Section 5.1 shows the OLS regressions between the changes in the number of non-tradable jobs (consisting of jobs in retails and restaurants, construction and other services) and the changes in tradable jobs. Section 5.2 show the reduced form regressions where the Bartik job change is used as the main explanatory variable. Section 5.3 shows the IV regressions where the Bartik job change is used as an instrument for the change in tradable job. In addition, we also trimmed the top and bottom 1st percentile of all the main variables[4] we used in regressions to remove outliers from our dataset.

[4] The variables are change in the number of non-tradable jobs, tradable jobs, retail and restaurants jobs, construction jobs, services jobs and Bartik.

5.1 OLS

This section shows the OLS regressions between the changes in non-tradable jobs and the change in tradable jobs. Column (1) of Table 5.1 contains the bare-bones regression with county fixed effects, and in columns (2) we add the lags of changes in tradable jobs into the regression. We find a significant association between changes in tradable jobs and changes in non-tradable jobs. Changes in tradable jobs also affected non-tradable jobs in the subsequent one year. Note that without an instrument, it is difficult to derive any causal relationship between changes in tradable jobs and changes in employment in the rest of a county's economy.

Table 5.1: OLS regressions

	Change in number of non-tradable jobs	
	[1]	[2]
△ tradable jobs	0.099***	0.138***
	[0.021]	[0.021]
△ tradable jobs (t-1)		0.045**
		[0.020]
△ tradable jobs (t-2)		0.015
		[0.020]
Constant	Y	Y
Time fixed effect	Y	Y
County fixed effect	Y	Y
Observations	50,916	42,850
R-squared	0.044	0.045
Number of county	3,155	3,086

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

5.2 Reduced form regressions

Table 5.2 presents the reduced form regressions where the Bartik job changes are the main explanatory variables. Note that we include the contemporaneous Bartik job changes, as well as the first and second lags. This is to see if Bartik job changes affect jobs of other sectors one or two years later, as the spillover could take time. We also include county fixed effects. County fixed effects help mitigate the concern that county characteristics, such as county size, location, demographics or education, could affect the estimate of the spillovers. Essentially, we only consider the impact of Bartik job changes within a county. Within a county, a Bartik job loss (gain) causes other sectors to lose (add) another 0.95 jobs.

Table 5.2: Bartik and change in the number of non-tradable jobs

	Change in number of non-tradable jobs	
	[1]	[2]
Bartik	0.950***	0.940***
	[0.069]	[0.069]
Bartik (t-1)		-0.121
		[0.074]
Bartik (t-2)		-0.241***
		[0.071]
Constant	Y	Y
Time fixed effect	Y	Y
County fixed effect	Y	Y
Observations	50,916	42,850
R-squared	0.058	0.061
Number of county	3,155	3,086

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

The estimate remains stable after lags of Bartik job changes are added. We focus on interpreting the results in the final column (column [2]). Every Bartik tradable job loss (gain) destroys (creates) another 0.94 jobs in the non-tradable sector (i.e. in rest of the county economy) in the same year. Interestingly, the job loss (gain) is partially offset by 0.24 jobs in other sectors two years later. This is likely because of the equilibrium effects through price and wage adjustments. The adjustments could operate in the following way: tradable job losses over time depress local wages, allowing other sectors to absorb more labor. This process, however, takes time. That is clearly shown in our results. The offsetting equilibrium effects only start to show two years later.

5.3 IV regressions

Table 5.3: Instrumented change in tradable jobs and change in non-tradable jobs

	Change in number of non-tradable jobs	
	[1]	[2]
△ tradable jobs	1.138***	1.091***
	[0.044]	[0.046]
△ tradable jobs (t-1)		-0.230***
		[0.046]
△ tradable jobs (t-2)		-0.322***
		[0.044]
Constant	Y	Y
Time fixed effect	Y	Y
County fixed effect	Y	Y
Observations	50,916	42,850
R-squared		
Number of county	3,155	3,086

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

Table 5.3 presents results with IV regressions, where tradable job changes are instrumented by the Bartik job changes. Overall, the results are quite similar to those obtained in the reduced-form regressions. Coefficients in column [2] present the baseline results of the paper. Every instrumented tradable job loss (gain) destroys (creates) another 1.09 jobs in the rest of the county economy in the same year. Our IV estimate is slightly smaller than that in Moretti (2010) in which his IV estimate implies a multiplier of 1.59. In addition, in this specification, the offsetting equilibrium effects kick in one year later, with the job loss (gain) is partially offset by 0.23 jobs in other sectors one year later, and by 0.32 jobs two years later.

The coefficient for the IV regression (1.09) is larger than that in the OLS regression (0.14, see column (2), table 5.1). This is possible, as the IV regressions estimate the local average treatment effect - capturing only the effect of tradable job losses caused by exogenous shocks; whereas the OLS regressions estimate the average association over the entire population.

As discussed briefly in the introduction, at least three direct local spillover mechanisms could be at play via the labor market. First, it could be demand-driven. For example, laid-off tradable workers could stop going to restaurants, theaters and local shops, hurting jobs in these businesses (Nguyen, 2015). Second, the spillover mechanism could operate via input-output linkages. For example, shut-down factories could stop hiring local private security or packaging firms as suppliers (Nguyen and Rezaei, 2016). Third, tradable job losses could hurt the local tax base, which could affect the jobs of local public employees. The spillover could operate via other mechanisms, such as a local credit crunch or a local housing market decline. The local credit crunch channel refers to the possibility that underwater tradable firms are late in their payments to local banks, who then could not extend credit to the rest of the county economy, resulting in further job losses. The local housing market declines refer to the possibility that tradable job losses and possible subsequent foreclosures depress the local housing market. Bearing a negative wealth shock, local home-owners could further cut their consumption, again leading to job losses. For example, Mian, Sufi and Trebbi (2015) show that foreclosures led to a large decline in consumer demand during the Great Recession.

5.4. Breakdown by sectors

We examine how the spillover of tradable job gains or losses are distributed among different sectors of a county's economy. The four broad sectors in a county's economy are tradable sector, construction, retails and restaurants, and other services.

Table 5.4 shows the breakdown of employment multipliers from tradable to three sectors: retail and restaurants, construction and other services. The table shows the results with reduced form regressions on the left hand side and the IV regressions on the right hand side. Both sides yield similar results on the contemporaneous as well as the dynamic multiplying effects. Results from reduced form regressions reveal that for each Bartik job loss (gain), about 0.19 job is destroyed (created) in retail and restaurants, 0.22 job in construction, and 0.53 job in other services. Since other services account for about 52% of a county's total employment, it is not a surprise that the spillover to other services is strongest. Results from the IV regressions are remarkably similar. The coefficients of the instrumented change in tradable jobs are almost identical to those of Bartik from the OLS regressions.

One-year lag of Bartik and the instrumented change in tradable jobs have similar impacts on employment of the individual sectors. Columns [4] to [6] reveals one tradable job loss (gain) kills (creates) 0.04 job in retail and restaurants sectors and 0.06 job in construction sectors one year later. Interestingly, one tradable job loss was offset by 0.3 job gains in services sector one year later. This suggests the offsetting equilibrium effects took effect much earlier in the services sector by absorbing laid-off workers in the tradable sector. Two-year lags of Bartik and the instrumented change in tradable jobs also have similar impacts on retail and restaurants and services sector. Columns [4] to [6] reveals that one tradable job loss is offset by 0.1 new job in retail and restaurants, 0.03 job in construction and 0.18 job in services sector two years later.

Table 5.4: Breakdown by sector

	Change in number of non-tradable jobs					
	Reduced form			IV		
VARIABLES	R & R	Construction	Services	R & R	Construction	Services
	[1]	[2]	[3]	[4]	[5]	[6]
Bartik	0.189***	0.217***	0.534***			
	[0.019]	[0.020]	[0.059]			
Bartik (t-1)	0.052***	0.069***	-0.242***			
	[0.018]	[0.020]	[0.066]			
Bartik (t-2)	-0.083***	-0.006	-0.152**			
	[0.018]	[0.017]	[0.065]			
∆ tradable jobs				0.227***	0.261***	0.603***
				[0.012]	[0.013]	[0.039]
∆ tradable jobs (t-1)				0.036***	0.060***	-0.33***
				[0.012]	[0.013]	[0.039]
∆ tradable jobs (t-2)				-0.109***	-0.030**	-0.18***
				[0.012]	[0.013]	[0.037]
Constant	Y	Y	Y	Y	Y	Y
Time fixed effect	Y	Y	Y	Y	Y	Y
County fixed effect	Y	Y	Y	Y	Y	Y
Observations	42,850	42,850	42,850	42,850	42,850	42,850
R-squared	0.042	0.065	0.026			
Number of county	3,086	3,086	3,086	3,086	3,086	3,086

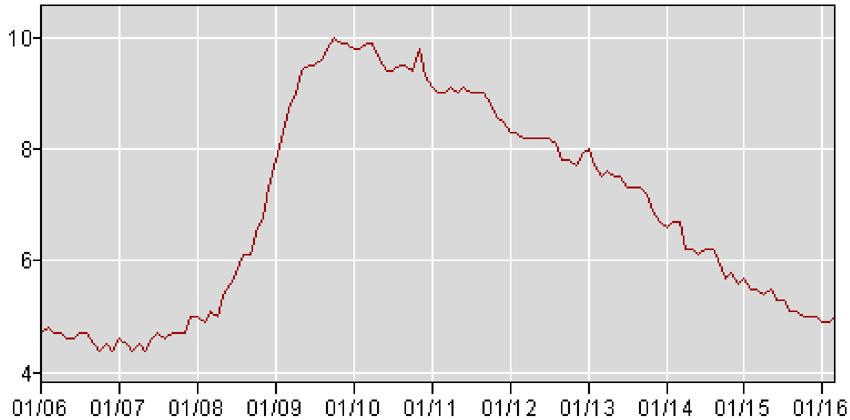
Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1

6 Employment multipliers over the business cycle

This extension examines employment multipliers during the 2002-2007 boom, the Great Recession (2008-2010) and the Recovery period (2011-2015). This is a topic of great interest. Economists and policy makers are interested in the quantitative spillover effects of job creations and more broadly, stimulus policies, over the business cycle. Some argue that when the economy is slack, stimulus programs have stronger multiplying effects. Auerbach and Gorodnichenko (2012, 2013) test this hypothesis and find larger fiscal multipliers during recessions in both quarterly post-World War II US data and in annual cross-country panel data since 1985. Their findings suggest fiscal multipliers near zero during expansions but between 1.5 and 2 during recessions. However, Owyang et al (2013) do not find this to be the case with U.S. historical data.

Since exogenous job creations bring exogenous additional income in a local area, they could be considered a form of exogenous stimulus. Estimating employment multipliers over the business cycle thus provides insights into the debate about the effects of stimulus over the business cycle. Fortunately, with the identification approach employed in this paper, estimating employment multipliers over the business cycle is relatively straight-forward. We just have to break the time series into periods corresponding to booms and busts in the U.S. economy. In particular, we break the time series into three periods: boom (2002-2007), the Great Recession (2008-2010), and recovery (2011-2015).

Figure 6.1: National unemployment rate
Source: BLS



The reason why 2010 is chosen as the end year of the Great Recession is that during the Great Recession, unemployment started to climb significantly from the beginning of 2008 and peaked around the beginning of 2010 (see Figure 6.1). This roughly coincides with CBP data in 2008 and 2010 because the CBP data are recorded in March each year. For that reason, we chose the Great Recession period as 2008 to 2010 (i.e. 3 years which are 2008, 2009 and 2010[5]).

Table 6.1 presents the employment multiplier during the boom of 2002 and 2007. The first column shows the reduced form estimate, while the second column shows the IV estimate. Note that we consider only a few years, lags are not included. The IV column shows that the estimated job gain multiplier during this boom time is modestly small.

[5] Note that to calculate Bartik job changes for the three years 2008, 2009, 2010 we use employment data in 2007, 2008, 2009 and 2010.

Table 6.1: Employment multiplier during the 2002-2007 boom

2002-2007	Change in number of non-tradable jobs	
	[Reduced form]	[IV]
Bartik	0.774***	
	[0.117]	
△ tradable jobs		0.978***
		[0.086]
Constant	Y	Y
Time fixed effect	Y	Y
County fixed effect	Y	Y
Observations	17,934	17,934
R-squared	0.028	
Number of county	3,128	3,128

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

To examine whether the multiplier is different in recessions, we look into the period of 2008-2010. Table 6.2 reveals that during the Great Recession, the employment multiplier is large and robust in magnitude. The coefficients capture the spillover of job losses between 2008 and 2010 with county fixed effects. It ranges from 1.53 (column 1) to 1.61 (column 2). These numbers are larger than the average multiplier of 1.09, as well as the multiplier during the boom period of 2002-2007. This is consistent with Auerbach and Gorodnichenko (2012, 2013) where larger multipliers are found during recessions. There are many reasons to believe this is the case. The first reason is the magnitude of the tradable employment losses. The Great Recession is a particularly severe downturn. Many tradable sectors witnessed 30 to 40% of job losses between 2007 and 2010 (Nguyen, 2015). In addition, the natural stabilizing mechanisms might not have operated. For example, Mian and Sufi (2014) and Nguyen (2015) find that local wages were sticky. The swift and dramatic employment collapse during the Great

Recession might have prevented local labor markets from adjusting and potentially absorbing laid-off workers. Even if local businesses wanted to expand, the paralyzed banking sector during the early period of the Great Recession could not supply sufficient credit to businesses (Chodorow-Reich, 2014).

Table 6.2: Employment loss multiplier during the Great Recession

2008-2010	Change in number of non-tradable jobs	
	[Reduced form]	[IV]
Bartik	1.532***	
	[0.148]	
∆ tradable jobs		1.606***
		[0.098]
Constant	Y	Y
Time fixed effect	Y	Y
County fixed effect	Y	Y
Observations	8,848	8,848
R-squared	0.138	
Number of county	3,077	3,077

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

Note that this multiplier could nest the effect of fiscal stimulus. During the Great Recession, the U.S. government signed two major stimulus acts: the Economic Stimulus Act in 2008 of about 152 billion dollars and the American Recovery Reinvestment Act in 2009 of about 787 billion dollars. To the extent that the stimulus could flow to areas more exposed to tradable sectors, the job loss multiplier here could include the positive effect of the fiscal stimulus programs. In other words, the job loss multiplier estimated here may have underestimated the true multiplying effect of job losses. The fact that we still find a large and significant job loss multiplier suggests that the negative job loss spillover outweighs potentially positive effects of the fiscal stimulus programs.

Table 6.3: Employment gain multiplier during the Recovery

	Change in number of non-tradable jobs					
	[1]	[2]	[3]	[4]	[5]	[6]
Bartik	0.681		0.783		1.264***	
	[0.619]		[0.485]		[0.356]	
△ tradable jobs		1.682**		2.833**		3.011***
		[0.846]		[1.199]		[0.618]
Constant	Y	Y	Y	Y	Y	Y
Time fixed effect	Y	Y	Y	Y	Y	Y
County fixed effect	Y	Y	Y	Y	Y	Y
Observations	9,018	9,018	12,013	12,013	15,029	15,029
R-squared	0.008		0.008		0.020	
Number of county	3,106	3,106	3,111	3,111	3,123	3,123
Years	2011-2013		2011-2014		2011-2015	

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

Table 6.3 reveals that during the initial four years of the Recovery, 2011 to 2014, there is mixed evidence on the spillover from tradable job gains to other sectors. The employment multiplier ranges from 0 (column 1) to 1.68 (column 2) in 2011-2013, and from 0 (column 3) to 2.83 (column 4) in 2011-2014. When year 2015 is included, there is stronger evidence on the positive spillover from tradable job gains, with the employment multiplier ranges from 1.3 (column 5) to 3.0 (column 6). This suggests that the non-tradable labor market became tighter in 2015 and non-tradable firms started to make new hires.

6.2 On the role of uncertainty and credit constraints

There are at least two prominent factors that could hinder the propagation of job gains during the Recovery. The first is uncertainty. Uncertainty can be rooted in the overall economy (Bloom, 2009) or in economic policies (Baker, Bloom and Davis, 2016). Uncertainty has been touted as one of the main drivers for the sharp downturn of the Great Recession (see Shoag and Veuger, 2016). Uncertainty could affect both consumers and producers' behavior. Uncertainty about the economy could cause newly-employed tradable workers to refrain from spending, effectively shutting down the demand-driven channel of job gain spillovers. Even if the newly employed workers do spend, uncertainty about future demand could make worried non-tradable firm owners hesitate to make new hires. If this is the case, job gains in tradable sectors do not necessarily lead to job gains in other sectors. The second reason is a credit crunch. If credit is tight, non-tradable firm owners would face difficulty expanding, even if they are willing to hire and make investment.

We test for the effects of uncertainty using the Global Economic Policy Uncertainty (GEPU) index constructed by Davis (2016), building upon the work in Baker, Bloom and Davis (2016). The GEPU index is a GDP-weighted average of national Economic Policy Uncertainty (EPU) indices for 18 countries[6]. The 18 countries that entered the Global EPU index accounts for two-thirds of global output on a PPP-adjusted basis. Each national EPU index reflects the count of articles that contains a triple of terms about the economy (E), policy (P), and uncertainty (U). In other words, each country EPU index is proportional to the share of own-country newspaper articles that discuss economic policy uncertainty

[6] Australia, Brazil, Canada, Chile, China, France, Germany, India, Ireland, Italy, Japan, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States.

in that period[7]. Once the national EPU index is constructed for the 18 countries, a Global EPU index is computed using the PPP-adjusted GDP-weighted average of the 18 national EPU index values. Of note, in the period between July 2011 and August 2016, the average value of the GEPU index is 60% higher than in the previous fourteen and one half years. The mean GEPU index value since July 2011 is also 22% greater than the index value during the Great Recession of 2008 (Davis, 2016). This indicates policy-related concerns have become a great source of uncertainty in the Recovery period. Hence, we interact the GEPU index with the county-level exogenous job gains or losses to check if the magnitude of the job gain multiplier changes with the time-varying level of uncertainty[8].

Table 6.4 Job gain multiplier with Global Economic Policy Uncertainty Index

	Change in number of non-tradable jobs					
	[1]	[2]	[3]	[4]	[5]	[6]
△ tradable jobs	1.682**	6.762***	2.833**	9.944***	3.011***	8.617***
	[0.846]	[2.054]	[1.199]	[3.222]	[0.618]	[1.772]
△ tradable jobs* Global uncertainty		-0.035***		-0.044***		-0.039***
		[0.011]		[0.014]		[0.010]
Constant	Y	Y	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y	Y	Y
County fixed effects	Y	Y	Y	Y	Y	Y
Observations	9,018	9,018	12,013	12,013	15,029	15,029
Number of county	3,106	3,106	3,111	3,111	3,123	3,123
Year	2011-2013		2011-2014		2011-2015	

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

[7] For a detailed discussion on the construction of cross-country EPU indices see Baker, Bloom and Davis (2016).

[8] Since our data is in annual frequency, we use the December GEPU index from 2011-2015 as the proxy for yearly GEPU uncertainty index.

We use the 2011-2015 GEPU uncertainty index to interact with the instrumented tradable job gains or losses in each county. We expect the job gain multiplier in the years with high level of economic policy uncertainty to be smaller. Table 6.4 reveals that the interactions between the exogenous job gains and GEPU uncertainty is negative and significant at 1% level. Specifically, a 1-point increase in the global uncertainty index (for example, increasing from 100 to 101) will reduce the job gain multiplier by about 0.04 in all the recovery periods (2011-2013; 2011-2014; 2011-2015).

In addition to uncertainty, we test for the presence of credit constraints during the job recovery period. Following Mian and Sufi (2014) we splits the counties into two groups, one primarily served by national banks before the Great Recession (National=1), and one primarily served by local banks (Local=1)[9]. Mian and Sufi (2014) define a national banking county as a county that has banks with a very low fraction of their deposits in that county. They therefore should not be as sensitive to local credit supply conditions. If credit were to play a key role in the transmission, the multiplier would be smaller in counties with more local banks, as local banks would be less likely to get deposits and funding beyond their respective counties.

Table 6.5 presents the employment multipliers by two types of counties: those that were dominated by national banks compared to those that were dominated by local banks before crisis. We find that the job gain multipliers for counties primarily served by national banks are consistently statistically significant in all recovery periods, whereas the job gain multipliers for counties primarily served by local banks are consistently statistically insignificant. This finding is consistent with the notion that credit constraints existed during the recovery – counties with national banks have larger job gain multipliers during the recovery

[9] Data on national banks and local banks are from Mian and Sufi (2014)

periods than counties with local banks, which are more sensitive to local credit supply conditions.

Table 6.5 Evidence for credit constraints

	Change in number of non-tradable jobs								
VARIABLES	All	National	Local	All	National	Local	All	National	Local
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
△ tradable jobs	1.682**	1.477*	3.031	2.833**	3.929**	0.303	3.011***	3.148***	2.646
	[0.846]	[0.895]	[2.837]	[1.199]	[1.655]	[1.795]	[0.618]	[0.681]	[1.794]
Constant	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y
County fixed effect	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	9,018	4,280	4,729	12,013	5,692	6,309	15,029	7,131	7,883
Number of county	3,106	1,494	1,609	3,111	1,498	1,610	3,123	1,507	1,613
Year	2011-2013			2011-2014			2011-2015		

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

The findings in this section have significant policy implications. Since job losses propagate greatly during the Great Recession, the quantitative finding suggests an argument for government interventions, in particular, job-stabilizing and job-stimulating policies. Without such policies in place to assist the hardest hit population and sectors, negative shocks would spread through other healthier sectors of the economy, worsening the impacts of a recession.

On the other hand, the relatively small job gain multiplier during the first phase of the Recovery suggests that stimulus programs, while necessary, might not be sufficient. Complementary policies, such as those that alleviate uncertainty and credit constraint issues, might be needed to ensure the spillover channels of job creations are operating favorably.

7 Conclusion

Exploiting exogenous variation in tradable employment changes driven by aggregate shocks, this paper provides estimates for within-county employment multipliers. It finds that from 1998 to 2015, the average employment multiplier is 1.09: each tradable job gain (or loss) creates (destroys) another 1.09 jobs in the rest of the county economy. This paper also discovers interesting dynamics of the multiplier: exogenous job gains (losses) continue to propagate in the following year, but are partly offset by job changes in the rest of the county economy as early as one year later. These aspects of the employment multiplier are arguably due to the general equilibrium effects operating via wage and price adjustments.

Focusing on the multiplier over the business cycle, this paper finds that the multiplier is modest (0.98) during the boom time (2002-2007) and large during the Great Recession (1.61). However, during the initial four years of recovery, the presence of job gain multiplier is arguably indistinct. We only find consistently significant positive spillover from tradable job gains to other sectors when year 2015 is included. We further find supporting evidence suggesting uncertainty and credit constraints are two potential factors that obstruct the propagation of job gains during the recovery period. The findings imply that complementary policies, such as those that alleviate uncertainty, boost consumer confidence, and increase availability of credit might be needed to ensure the spillover channels of job creations are operating favorably.

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