

ISSN 1471-0498



**DEPARTMENT OF ECONOMICS
DISCUSSION PAPER SERIES**

**Local Multipliers In United States Cities: A
Replication of Moretti (2010)**

Jasper Jacob van Dijk

Number 771
December 2015

Manor Road Building, Oxford OX1 3UQ

Local multipliers in United States cities: a replication of Moretti (2010)

Jasper Jacob van Dijk*
University of Oxford

December 9, 2015

Abstract

This paper replicates Moretti (AER, 2010). I estimate the local employment multiplier between the tradable and the nontradable sector in MSAs in the United States using two methods. The first replicates Moretti's results, based on the description he gives in his paper and part of his estimation files. I am able to reverse engineer the specification he uses, but identify some discrepancies with his results. The second method is an alternative to his specification that produces more robust estimates of the local multiplier effect with more policy relevance. Using an alternative instrument which, I argue is more plausibly exogenous, I find that for each 100 new jobs in the tradable sector, there are 84 additional jobs created in the nontradable sector of the same city. This is 75 fewer jobs than predicted by Moretti.

Keywords Local labor market, multiplier, tradable, nontradable

JEL Classification F16, R15, R23

*Department of Economics, University of Oxford, Manor Road Building, Oxford, OX1 3UQ, U.K.; e-mail: jasper.vandijk@economics.ox.ac.uk.

1 Introduction

This paper sets out to estimate the size of the local employment multiplier effect for metropolitan statistical areas (MSAs) in the United States as part of a replication study of Moretti (2010). The local employment multiplier is the number of additional jobs that are created in the nontradable sector of a city for each new worker in the tradable sector of that city. The tradable sector consists of all industries that provide goods or services that are sold outside the city and perhaps internationally, the nontradable sector consists of those industries that mainly sell goods or services within the city they are produced in. Car manufacturing would be an example of a tradable industry and a bakery is part of the nontradable sector.

Moretti (2010) estimates that the local multiplier in the U.S. is 1.59 using a Bartik (1991) shift-share instrument. With this highly cited paper he introduces a very interesting and useful way to estimate local multipliers and started a new strain of local multiplier literature. This study has been followed by similar analyses of Italy (de Blasio and Menon, 2011; Auricchio, 2015), Sweden (Moretti and Thulin, 2013), the United Kingdom (Faggio and Overman, 2014), Spain (Gerolimetto and Magrini, 2014; Bashford Fernández, 2014) and the entire European Union (van Dijk, Forthcoming). These estimates of local multipliers give insight in the possible impact of regional policy and already influence politicians. For example Moretti and Thulin (2013) has been cited by the Swedish government.

Moretti's estimations cannot be replicated based just on his paper, because he does not provide all the details of his estimation approach. When I contacted him about this he was kind enough to provide me with the Stata files he used to produce his first result in his paper¹, an estimate of the local multiplier between the tradable and nontradable sector. From these files I could complete reverse engineer his empirical approach and exactly replicate this estimate.

Based on this detailed understanding of Moretti's method I suggest several

¹Model 1 in Table 1 of his paper.

changes to his specification that allow for a more robust estimate of the local multiplier effect. For example, I study the service sector in more detail and include both tradable and nontradable services. I give equal weight to all observation, regardless of whether the city was observed between 1980 and 1990 or between 1990 and 2000. And I use an alternative instrumental variable that excluded the own city in its construction which, I argue is more plausibly exogenous.

I will provide a theoretical justification for these changes. This makes it easier to interpret my multiplier estimate and gives it more policy relevance. I find a multiplier of 0.84 with this alternative specification; this suggests that Moretti's result is a significant overestimation.

Moretti did not provide me with details on his estimation of the multiplier between durable/nondurable manufacturing and nontradable; tradable and other tradable; or tradable skilled/unskilled and nontradable skilled/unskilled. But in most cases I am able to replicate his results by extending the method he used for his first result.

I find some discrepancies in Moretti's analysis of the impact of employment in the production of durable and nondurable goods. In fact, I find a result opposite to Moretti: the multiplier of employment in the production of tradable goods on jobs in the nontradable sector is significantly *larger* than the multiplier of nondurable goods.

I was able to replicate his analysis of the effect of skilled and unskilled tradable jobs on the nontradable sector, but when I use my alternative instrument all significance of these results disappears.

When I split the nontradable sector into skilled and unskilled workers I find another discrepancy that led Moretti to overestimate the multipliers by almost a factor two. When I use my alternative specification the multipliers become even smaller.

Finally the method I was able to reproduce Moretti's results with did not always correspond to the description Moretti gives in his paper, this implies that there already were some differences between Moretti's paper and the

approach he actually used. In this paper I will discuss the method that Moretti actually used to find the estimated multiplier of 1.59, but I will point out any disaccord with his paper.

2 The Moretti framework

This conceptual framework comes from Moretti (2010, 2011); Moretti and Thulin (2013). Each metropolitan area is a competitive economy that uses labor to produce different tradable and nontradable goods and services. The price of tradable goods and services is determined on the national or international market and is considered fixed from the perspective of a city. For the nontradable goods, the price is determined locally. We assume labor is perfectly mobile across sectors within a city; and worker's utility depends on the net local wage and idiosyncratic preferences for location. Therefore the local labor supply curve is upward sloping. We make the assumption that the local housing supply is also upward sloping.

When a city attracts a new firm or the labor productivity of an existing firm increases we can see a permanent increase in the local labor demand in a tradable industry. This has an obvious direct effect on the local economy: employment in the tradable sector increases. But also a, more interesting, indirect effect on the rest of the tradable sector and the nontradable sector. This includes general equilibrium effects on local prices: the wages of all workers will go up as well as the cost of housing.

The focus of this paper lies on the positive effect on the local nontradable sector. As a result of additional employment in a tradable industry the aggregate income of a city will increase. The aggregate income will increase more if the additional jobs in the tradable sector require high skilled workers, as these workers command higher wages. Part of this extra income will be spend on nontradable goods, the size of this share depends on the consumer preferences for nontradable goods. This increased demand in nontradable goods will increase the demand for labor in the nontradable sector, where the

magnitude of this demand depends on the technology of the nontradable goods. These new jobs in the nontradable sector will be fulfilled by existing residents and new residents, depending on geographical mobility.

This positive effect of a permanent increase in labor demand in the tradable sector on employment in the nontradable sector will be offset in *part* by general equilibrium effects on wages and prices. If the local housing market is constrained the cost of living will increase more when an industry in the tradable sector grows. And when labor mobility is higher, the wage increase as a result of the higher labor demand will be smaller, therefore we will see a larger local employment multiplier. Because of the nature of nontradable goods they can only be produced locally, and the local labor supply curve is upwards sloping, therefore the increase in aggregate income will always lead to a weak increase in employment in the nontradable sector.

Moretti defines the local employment multiplier as the number of additional jobs created in the nontradable, because of one new job in the tradable sector of the same city. This is equal to the base multiplier or I/O multiplier less one.

3 Data

Moretti and I estimate the local employment multiplier in United States Metropolitan Areas based on the United States census data. I retrieved these data from the Integrated Public Use Microdata Series (IPUMS) provided by Ruggles et al. (2010). The census provides a 1-in-20 national random sample of the population for 1980, 1990 and 2000. The sample of 1980 is unweighted and the sample of 1990 and 2000 are weighted. We only use data on the individuals living within one of the MSAs.

We are interested in the change of employment over time. To analyze this we need data on a city in at least two consecutive periods. This leaves 220 cities observed at the start and end of both intervals, 6 cities that are only observed between 1980 and 1990; and 18 cities that are only observed between 1990 and 2000. On average this covers 92% of the metropolitan population. Moretti

(2010) states “*the sample includes two observations per city, corresponding to the periods 1980–1990 and 1990–2000*”, but he also includes the cities that are observed in just one interval.

It is important to note that the population of many MSAs are only partially identified in the census data, and in many cases, the unidentified portion is considerably large. The reason for incomplete coverage is that the source data for these samples include no specific information about metro areas. The most detailed geographic information available is for 1980 county groups or for 1990 or 2000 PUMAs², areas which occasionally straddle official metro area boundaries. If any portion of a straddling area’s population resided outside a single metro area, IPUMS uses a conservative assignment strategy and identifies no metro area for all residents of the straddling area.

The census provides detailed information about the industry that employs each worker, but the industry codes change with each census. Fortunately IPUMS provides a mapping of the 1980 and 2000 census industry data to the three-digit industries codes of 1990, allowing for comparison across time. Moretti (2010) states that tradable sector growth “*is measured using changes in manufacturing employment, while [the nontradable sector] includes all other industries excluding agriculture, mining, government and the military*”, but in reality he does include agriculture and mining as nontradable industries.³ I will do this as well in my replication of Moretti, but I will include an alternative analysis were I exclude agriculture and mining. In this analysis I will also allow for tradable services, such as the financial sector in NY, to be included in the tradable sector. I do this following work by Jensen and Kletzer (2006). They measure the geographical dispersion of all three-digit services in the U.S. and express this with a gini-coefficient. Finally they split the services into

²Public Use Microdata Areas (PUMAs) are statistical geographic areas defined for the dissemination of Public Use Microdata Sample (PUMS) data.

³He also states he uses “*the weighted average of nationwide employment growth by 77 narrowly defined industries within manufacturing*”, but in fact he uses 82 industries within manufacturing in the 1980-1990 period and 74 industries within manufacturing in the 1990-2000 period.

three categories from least to most concentrated and argue that it is easier to concentrate an industry when it is tradable. Using this logic and these categories I consider the most concentrated services as tradable and the rest as nontradable.

Combining the 1980-1990 and the 1990-2000 interval in the same analysis results into 464 observations. The most workers in the tradable sector are employment in New York in 1980, at this time 9% of all tradable jobs where in New York. A very large city could invalidate the instrumental variable analysis I intend to do later on, but this should not pose a problem.

4 Replicating Moretti's method

Moretti (2010) tries to quantify the long-term change in the number of jobs in a city's tradable and nontradable sectors generated by an exogenous increase in the number of jobs in the tradable sector, allowing for the endogenous reallocation of factors and adjustment of prices. He estimates variants of the reduced form regression model

$$\ln E_{c,t+10}^{NT} - \ln E_{c,t}^{NT} = \alpha + \beta (\ln E_{c,t+10}^T - \ln E_{c,t}^T) + \delta \text{Time}_t + \varepsilon_{c,t} \quad (1)$$

for $c \in C_t$ and $t \in \{1980, 1990\}$. $\ln E_{c,t+10}^{NT} - \ln E_{c,t}^{NT}$ approximates the growth rate of employment in the nontradable sector in city c between time t and time $t+10$ and $\ln E_{c,t+10}^T - \ln E_{c,t}^T$ is a similar measure for tradable employment. Time_t is a dummy⁴ to control for national shocks in employment in the nontradable sector and $\varepsilon_{c,t}$ is an error term. In this specification the parameter β measures the elasticity between tradable employment and jobs in the nontradable sector. Finally C_t is the set of all MSAs observed in both t and $t + 10$.

⁴ $\text{Time}_{1980} = 0$ for measurements over interval 1980-1990 and $\text{Time}_{1990} = 1$ for 1990-2000.

4.1 Regression weights

Moretti weighs all observations, those over the interval 1980-1990 and those over the interval 1990-2000, by their total employment in 1990. This can be expressed as

$$w_{c,t} = N_{c,1990}^T + N_{c,1990}^{NT}. \quad (2)$$

This approach does not treat the two intervals equally. The weight of a city observed in the first interval is determined by the final size of the city, whilst the weight of a city in the second interval is determined by its initial size. Therefore the first interval is over-weighted, as most cities grow over time. A possible improvement can be made by treating both intervals in the same way. I would suggest using the initial size

$$w_{c,t} = N_{c,t}^T + N_{c,t}^{NT}, \quad (3)$$

because we express the growth rate with respect to this size as well.

4.2 Elasticity to Multiplier

Since both the dependent variable and the main regressor are a growth rate, the parameter β reflects the elasticity between the tradable and the nontradable sector. When the tradable sector grows by 1%, the nontradable sector grows by $\beta\%$. This elasticity can be converted into an estimate of the local employment multiplier by multiplying β with the relative size of the nontradable sector to the tradable sector

$$\beta \times \frac{\sum_{C_{1990}} N_{c,1990}^{NT}}{\sum_{C_{1990}} N_{c,1990}^T}. \quad (4)$$

In Eq. (4) Moretti relies solely on on the relative size between the tradable and the nontradable sector in 1990, which corresponds to the second interval (1990-2000), but ignores the first. Since employment in the tradable sector has decreased between 1980 and 2000, the nontradable sector is relatively larger compared to the tradable sector in 1990 than in 1980. So because Moretti

(2010) ignores the relative size in the first interval, he multiplies the elasticity with a bigger factor and therefore overestimates the size of the local multiplier. Therefore I would like to propose an alternative.

Since the estimated elasticity is based on employment data for two intervals, it is reasonable to include the relative size of the nontradable sector to the tradable sector in both periods when calculating the multiplier from this elasticity. For all 464 observation I know the growth rate of the tradable and the nontradable sector over a period of ten years and I know the initial size of both sectors at the start of this ten year period. I sum up the initial size of the tradable sector in all observations and I do the same for the nontradable sector, now I can use this ratio to convert the estimated elasticity into a multiplier

$$\beta \times \frac{\sum_{t \in \{1980, 1990\}} \sum_{C_t} E_{c,t}^{NT}}{\sum_{t \in \{1980, 1990\}} \sum_{C_t} E_{c,t}^T}, \quad (5)$$

which seems to be the most representative way to make this conversion.

4.3 Instrumental Variable

When estimating Eq. (1) using a weighted least-squares regression, the intercept and the time dummy variables will capture any general booms and recessions that occur in a specific year and all other co-movement between jobs in the tradable and the nontradable sector are captured by β .

There will be three types of co-movement captured by β , first of all the causal effect of extra jobs in the tradable sector on employment in the nontradable sector, this is the effect we want to measure. This result will be confounded due to endogeneity, an increase in jobs in the nontradable sector that effects employment in the tradable sector. And omitted variables, for example effective local government will increase jobs in both sectors.

To isolate the causal effect of employment in the tradable sector on employment in the nontradable sector we need to use an Instrumental Variable analysis. It is possible to isolate exogenous shifts in the demand for labor in

the tradable sector with a Bartik (1991) shift-share instrument. Moretti uses an instrument based on the lagged share of each industry in the region and the national growth of that industry

$$\sum_{j \in T} \left\{ \frac{N_{c,t}^j}{N_{c,t}^T} \left[\ln \left(\sum_{c' \in C_t} N_{c',t+10}^j \right) - \ln \left(\sum_{c' \in C_t} N_{c',t}^j \right) \right] \right\} \quad (6)$$

Consider for example the production of computer hardware. If there is a productivity shock in computer hardware in China, there will be more exports to the U.S. and the demand for in the U.S. produced computer hardware will decline. This decline will be measured by $\ln \left(\sum_{c' \in C_t} N_{c',t+10}^j \right) - \ln \left(\sum_{c' \in C_t} N_{c',t}^j \right)$ which approximates the percentage growth in industry j between period t and period $t + 10$.

It is likely that a region with a large share of employment in the production of computer hardware will be affected more by this shock than regions with a smaller share. The share of jobs in region c that is part of industry j at time t is given by $N_{c,t}^j/N_{c,t}^T$. Combining this results into to the instrument given in (6). The idea is that: under the assumption that the national changes in employment are exogenous to a specific region a weighted 2SLS regression with this instrument will identify the effect of an increase in jobs in the tradable sector on employment in the nontradable sector, avoiding the problems caused by endogeneity and omitted variables seen in the LS regression.

The complication with this approach is that the change in employment in the tradable sector of city c is included within the instrument as part of the difference of the summations $\sum_{c' \in C_t} N_{c',t+10}^j$ and $\sum_{c' \in C_t} N_{c',t}^j$. These changes might drive the national changes, which in turn means that the instrument might violate the exogeneity assumption. A possible improvement, as suggested by the Moretti and Thulin (2013) study of Sweden, is to exclude the own region

when calculating the instrument. I apply this idea to (6) and propose

$$\sum_{j \in T} \left\{ \frac{N_{c,t}^j}{N_{c,t}^T} \left[\ln \left(\sum_{c' \in C_t \setminus c} N_{c',t+10}^j \right) - \ln \left(\sum_{c' \in C_t \setminus c} N_{c',t}^j \right) \right] \right\}. \quad (7)$$

as an alternative instrumental variable.

5 Replicating Moretti's results

Estimates of the total effect of a change in employment in the tradable sector on employment in the nontradable sector of the same city are shown in Table 1. Columns OLS and IV (1) show the results reported by Moretti. Since Moretti provided me with the files he used for this estimation I can exactly replicate his result, a multiplier of 1.59, as shown in Column IV (2). As I discussed in Section 4, I take issue with some parts of the method Moretti uses.

If we allow for tradable services, if we do not consider agriculture and mining as nontradable, and if we base the relative size of the nontradable sector to the tradable sector on both intervals as shown in Eq. (5), then the estimated size of the multiplier reduces to 1.03. If we use regression weights based on the initial size of the city as suggested in Eq. (3), the multiplier reduces to 1.49. Finally if we use the alternative instrument, specified in Eq. (7), to make sure our instrumental analysis is valid, the multiplier is only 1.38.

The result of the combination all these changes is shown in Columns OLS and IV (3). The effect on the elasticity estimated with OLS is small, but the estimated local multiplier effect using IV is now reduced to 0.84. The estimated multiplier can be interpreted as follows: for each 100 new jobs in the tradable sector, there are 84 additional jobs created in the nontradable sector of the same city. This is 75 fewer jobs than predicted by Moretti (2010).

Moretti also estimates the multiplier of tradables on other tradables by randomly dividing all manufacturing industries into two groups. Since I don't know the division he used and each random division will lead to a different

Table 1: Estimate of the impact of employment growth in the tradable sector on employment growth in the nontradable sector for Metropolitan Areas in the United States between 1980 and 2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Multiplier		2.63*** (0.17)	2.07*** (0.13)	1.59*** (0.26)	1.59*** (0.26)	0.84*** (0.30)
Tradable employment (growth over ten years)	0.554*** (0.036)	0.554*** (0.036)	0.544*** (0.034)	0.335*** (0.055)	0.336*** (0.056)	0.221*** (0.078)
Time dummy (1990-2000)		-0.089*** (0.011)	-0.109*** (0.011)		-0.092*** (0.013)	-0.088*** (0.017)
Constant		0.297*** (0.010)	0.259*** (0.008)		0.291*** (0.010)	0.252*** (0.009)
Observations		464	464		464	464
Adj. R^2		0.71	0.68		0.61	0.46
First-stage statistic ^a					69	24

Note: Robust standard errors clustered by msa reported in parentheses. The dependent variable is the growth rate of nontradable sector employment. Multiplier denotes the estimate of the elasticity between the tradable and the nontradable sector multiplied by the relative size of the nontradable sector to the tradable sector. Tradable employment denotes the growth rate of tradable sector employment; the estimated parameter is the elasticity between the tradable and the nontradable sector. Column (1) shows the results reported by Moretti (2010), (2) shows my replication of this result and (3) shows the result of my alternative specification. ^a The Kleibergen-Paap rk Wald F statistic

* Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

Table 2: Estimate of the impact of employment growth in the durable and nondurable tradable sector on employment growth in the nontradable sector for Metropolitan Areas in the United States between 1980 and 2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Durable multiplier		2.21*** (0.19)	2.09*** (0.15)	0.72 (1.73)	2.14*** (0.45)	1.44*** (0.54)
Nondurable multiplier		3.57*** (0.49)	2.61*** (0.37)	1.89*** (0.54)	0.34 (1.53)	-1.52 (3.52)
Tradable durable employment (growth over ten years)	0.283*** (0.039)	0.291*** (0.024)	0.339*** (0.025)	0.006 (0.138)	0.281*** (0.060)	0.233*** (0.088)
Tradable nondurable employment (growth over ten years)	0.290*** (0.024)	0.283*** (0.039)	0.182*** (0.026)	0.250*** (0.072)	0.027 (0.122)	-0.106 (0.246)
Time dummy (1990-2000)		-0.078*** (0.0121)	-0.103*** (0.010)		-0.098*** (0.016)	-0.080*** (0.024)
Constant		0.287*** (0.011)	0.296*** (0.009)		0.293*** (0.011)	0.258*** (0.027)
Observations		464	464		464	464
Adj. R^2		0.71	0.68		0.59	0.34
First-stage statistic ^a					8	4

Note: Robust standard errors clustered by msa reported in parentheses. The dependent variable is the growth rate of nontradable sector employment. (Non)Durable multiplier denotes the estimate of the elasticity between the (non)durable tradable and the nontradable sector multiplied by the relative size of the nontradable sector to the (non)durable tradable sector. Tradable (non)durable employment denotes the growth rate of (non)durable tradable sector employment; the estimated parameter is the elasticity between the (non)durable tradable and the nontradable sector. Column (1) shows the results reported by Moretti (2010), (2) shows my replication of this result and (3) shows the result of my alternative specification. ^a The Kleibergen-Paap rk Wald F statistic * Significance at the 10% level.

** Significance at the 5% level. *** Significance at the 1% level.

estimate, I cannot replicate this result.

5.1 Durable and nondurable goods

It is possible to split the manufacturing sector into a durable and a nondurable part. Moretti does not state how he does this, so I assume he follows the definition given by the census industry data. The results Moretti presents in his paper are given in Columns OLS and IV (1) of Table 2. Moretti comments on these findings by stating: “when I split the manufacturing sector into durable and nondurable goods, I find a significantly larger elasticity for the latter”. This conclusion is counter-intuitive, in a sense durable goods should be more tradable than nondurable goods.

Nondurable goods includes perishable items that are therefore harder to produce far away from the city of consumption. On the other hand durable goods are long lasting, therefore generally easier to transport over long distances and as such more representative of the tradable sector. So if there is any difference between durable and nondurable goods, one would expect a larger multiplier for durable goods.

Columns OLS and IV (2) shows my replication of Moretti result.⁵ My replication suggest that Moretti accidentally switched the results for durable and nondurable goods. My OLS replication matches his results exactly when you switch his results around and my IV estimates come very close. So in fact, the multiplier for durable goods is significantly *larger* than the multiplier for nondurable goods. This makes a lot more intuitive sense. This result holds up when we apply my alternative method as shown in Column IV (3), although the multiplier size becomes smaller. These results do suffer from a weak instrument problem as indicated by the small First-stage F-statistic. The complete first-stage estimates are left out for brevity, but available on request.

Finally it seems like Moretti wrote 0.006 instead of 0.06 as the elasticity for tradable (now) nondurable, because the ratio between his estimate and the standard error should stay constant when he transforms the elasticity to a multiplier.

5.2 Skilled and unskilled workers in the tradable sector

In the same vain as durable and nondurable goods it is possible to estimate the difference in multiplier between skilled and unskilled workers in the tradable sector. Columns OLS and IV (1) of Table 3 show Moretti's results. My replication as shown in Columns OLS and IV (2) seems to be quite adequate. The local multiplier for skilled workers is significantly larger than the multiplier for unskilled workers.

⁵The replication is no longer exact as Moretti did not provide me the files he used for this estimation, but I can make a reasonable approximation by modifying the method he used to estimate the overall multiplier.

Table 3: Estimate of the impact of employment growth in the skilled and unskilled tradable sector on employment growth in the nontradable sector for Metropolitan Areas in the United States between 1980 and 2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Skilled multiplier		2.94*** (0.36)	2.47*** (0.33)	2.52 (1.54)	2.93** (1.40)	1.46 (1.65)
Unskilled multiplier		2.60*** (0.28)	2.08*** (0.19)	1.04 (0.99)	0.94 (0.80)	0.56 (0.75)
Skilled tradable employment (growth over ten years)	0.287*** (0.037)	0.300*** (0.037)	0.278*** (0.037)	0.257 (0.157)	0.298** (0.142)	0.164 (0.185)
Unskilled tradable employment (growth over ten years)	0.292*** (0.033)	0.283*** (0.031)	0.314*** (0.029)	0.115 (0.109)	0.103 (0.087)	0.085 (0.113)
Time dummy (1990-2000)		-0.045* (0.026)	-0.095*** (0.026)		0.012 (0.094)	-0.047 (0.109)
Constant		0.256*** (0.023)	0.245*** (0.024)		0.198** (0.080)	0.210* (0.112)
Observations		464	464		464	464
Adj. R^2		0.71	0.71		0.64	0.48
First-stage statistic ^a					13	7

Note: Robust standard errors clustered by msa reported in parentheses. The dependent variable is the growth rate of nontradable sector employment. (Un)Skilled multiplier denotes the estimate of the elasticity between the (un)skilled tradable and the nontradable sector multiplied by the relative size of the nontradable sector to the (un)skilled tradable sector. (Un)Skilled tradable employment denotes the growth rate of (un)skilled tradable sector employment; the estimated parameter is the elasticity between the (un)skilled tradable and the nontradable sector. Column (1) shows the results reported by Moretti (2010), (2) shows my replication of this result and (3) shows the result of my alternative specification. ^aThe Kleibergen-Paap rk Wald F statistic * Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

If we apply my alternative method this is no longer the case. Using this method it is not possible to say anything definitive about the multiplier of skilled or unskilled workers, possibly due to again a weak instrument problem as indicated by the F-statistic of the first-stage estimation, although the t-value for the instruments for (un)skilled workers is 2.43 (4.05). The instrument is most likely weaker because I no longer include the own city. But if this is what drives the Moretti result, we should be careful when drawing conclusions.

5.2.1 Skilled workers in the nontradable sector

It is also possible to estimate the effect of skilled and unskilled employment in the tradable sector on just the *skilled* jobs in the nontradable sector. Moretti's results are shown in Columns OLS and IV (1) of Table 4. The results of my replication are quite close for the elasticities, but off for the multipliers as shown in Columns OLS and IV (2). This can be explain by the relative size between sectors Moretti uses to convert his elasticities into multipliers. He uses the relative size of the (un)skilled tradable sector to the *entire* nontradable sector, whilst he only considers the *skilled* workers in the nontradable sector in this case. As a result he overestimates the multipliers by almost a factor two. These result are not significant and this stays the case using my alternative specification as shown in Columns OLS and IV (3).

5.2.2 Unskilled workers in the nontradable sector

Finally we can estimate the effect of skilled and unskilled employment in the tradable sector on just the *unskilled* jobs in the nontradable sector. Moretti's results are shown in Columns OLS and IV (1) of Table 5 and my replication is shown in Columns OLS and IV (2). Again, Moretti uses the entire nontradable sector to determine the relative size. His result that adding an unskilled job in the tradable sector generates 3.3 unskilled jobs in the nontradable sector is therefore an overestimate. Under Moretti's own assumptions this is only 1.58 and when I use my alternative specification the multiplier is 1.16 as shown in

Table 4: Estimate of the impact of employment growth in the skilled and unskilled tradable sector on employment growth in the skilled nontradable sector for Metropolitan Areas in the United States between 1980 and 2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Skilled multiplier		2.59*** (0.23)	1.90*** (0.22)	2.03 (1.72)	1.38 (0.94)	0.76 (1.01)
Unskilled multiplier		0.45 (0.18)	0.45*** (0.12)	-0.09 (1.21)	-0.26 (0.53)	-0.38 (0.41)
Skilled tradable employment (growth over ten years)	0.420*** (0.044)	0.457*** (0.041)	0.417*** (0.049)	0.208 (0.176)	0.243 (0.166)	0.167 (0.221)
Unskilled tradable employment (growth over ten years)	0.125*** (0.042)	0.084** (0.034)	0.133*** (0.036)	-0.010 (0.133)	-0.050 (0.099)	-0.111 (0.122)
Time dummy (1990-2000)		-0.262*** (0.030)	-0.336*** (0.032)		-0.320*** (0.109)	-0.332*** (0.123)
Constant		0.427*** (0.025)	0.419*** (0.030)		0.466*** (0.093)	0.437*** (0.128)
Observations		464	464		464	464
Adj. R^2		0.87	0.87		0.79	0.71
First-stage statistic ^a					13	7

Note: Robust standard errors clustered by msa reported in parentheses. The dependent variable is the growth rate of skilled nontradable sector employment. (Un)Skilled multiplier denotes the estimate of the elasticity between the (un)skilled tradable and the skilled nontradable sector multiplied by the relative size of the skilled nontradable sector to the (un)skilled tradable sector. (Un)Skilled tradable employment denotes the growth rate of (un)skilled tradable sector employment; the estimated parameter is the elasticity between the (un)skilled tradable and the skilled nontradable sector. Column (1) shows the results reported by Moretti (2010), (2) shows my replication of this result and (3) shows the result of my alternative specification. ^aThe Kleibergen-Paap rk Wald F statistic
* Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

Table 5: Estimate of the impact of employment growth in the skilled and unskilled tradable sector on employment growth in the unskilled nontradable sector for Metropolitan Areas in the United States between 1980 and 2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Skilled multiplier		0.38 (0.17)	0.39*** (0.15)	0.296 (1.68)	0.05 (0.63)	-0.33 (0.75)
Unskilled multiplier		2.07*** (0.14)	1.72*** (0.10)	3.34*** (1.06)	1.58*** (0.37)	1.16*** (0.37)
Skilled tradable employment (growth over ten years)	0.109*** (0.039)	0.091** (0.040)	0.089*** (0.034)	0.030 (0.172)	0.011 (0.152)	-0.076 (0.172)
Unskilled tradable employment (growth over ten years)	0.510*** (0.037)	0.534*** (0.035)	0.531*** (0.032)	0.367*** (0.117)	0.408*** (0.096)	0.358*** (0.113)
Time dummy (1990-2000)		0.152*** (0.030)	0.130*** (0.027)		0.154 (0.099)	0.137 (0.106)
Constant		0.116*** (0.026)	0.104*** (0.025)		0.106 (0.087)	0.111 (0.108)
Observations		464	464		464	464
Adj. R^2		0.82	0.84		0.78	0.73
First-stage statistic ^a					13	7

Note: Robust standard errors clustered by msa reported in parentheses. The dependent variable is the growth rate of unskilled nontradable sector employment. (Un)Skilled multiplier denotes the estimate of the elasticity between the (un)skilled tradable and the unskilled nontradable sector multiplied by the relative size of the unskilled nontradable sector to the (un)skilled tradable sector. (Un)Skilled tradable employment denotes the growth rate of (un)skilled tradable sector employment; the estimated parameter is the elasticity between the (un)skilled tradable and the unskilled nontradable sector. Column (1) shows the results reported by Moretti (2010), (2) shows my replication of this result and (3) shows the result of my alternative specification. ^a The Kleibergen-Paap rk Wald F statistic
* Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

Column IV (3).

6 Conclusion

Moretti (2010) is a seminal paper that estimates local employment multiplier in the United states with a reduced form regression model using a Bartik (1991) shift-share instrument. The paper started a prolific and exciting branch of literature.

This paper replicates Moretti's results and shows and goes into detail, beyond his own paper, on the choices he makes in his empirical method. I suggest alternatives for some of these choices and I try to underpin these

changes theoretically. The most important changes are the introduction of an alternative instrument which, I argue is more plausibly exogenous; and the introduction of tradable services such as the financial sector in New York.

I find that for each additional job in the tradable sector, 0.84 jobs are created in the nontradable sector in the same city. Therefore the estimated multiplier of 1.59 by Moretti could be considered an overestimate of the real effect. When I split the manufacturing sector into durable and nondurable goods, I find a significantly larger elasticity for the former; not the latter as stated by Moretti.

When I split the tradable sector into skilled and unskilled jobs, I have a weak instrument problem. Moretti (2010) seems to have a stronger instrument, because he included the own city in the instrument, but this could introduce an endogeneity problem into his estimation. I will still compare our results here, but one should be careful interpreting these. Adding one additional skilled job in the tradable sector generates 1.46 jobs in local goods and services and the corresponding figure for unskilled jobs is 0.56. This instead of the 2.52 and 1.04 respectively as reported by Moretti. So in contrast to Moretti I do not find that the elasticity is significantly larger for skilled labor.

Adding a skilled job in the tradable sector generates 0.76 skilled jobs and no unskilled job in the nontradable sector, while adding an unskilled job in the tradable sector generates 1.16 unskilled jobs and no skilled job in the nontradable sector. Only the effect of unskilled tradable jobs on unskilled nontradable jobs is significant. All these result are again much smaller than Moretti's estimates.

As noted in the introduction this branch of literature has already been quite influential with policy makers. And in light of my replications, they should perhaps be a bit more conservative in their expectations of the size of the local multiplier effect.

References

- Marta Auricchio. *Local Manufacturing Multiplier and Human Capital in Italian Local Labor Markets*. PhD thesis, Libera Università Internazionale degli Studi Sociali “Guido Carli”, 2015.
- Timothy J Bartik. *Who benefits from state and local economic development policies?* W.E. Upjohn Institute for Employment Research, 1991.
- Joanna María Bashford Fernández. *A new look at local employment multipliers: preliminary evidence from Spain*. PhD thesis, Universidad de Oviedo, 2014.
- Guido de Blasio and Carlo Menon. Local effects of manufacturing employment growth in Italy. *Giornale degli Economisti e Annali di Economia*, 70(3): 101–112, December 2011.
- Giulia Faggio and Henry Overman. The effect of public sector employment on local labour markets. *Journal of urban economics*, 79:91–107, January 2014.
- Margherita Gerolimetto and Stefano Magrini. Spatial analysis of employment multilpliers in Spanish labor markets. *Rivista Italiana di Economia Demografia e Statistica*, 68(3/4):87–94, July-December 2014.
- J Bradford Jensen and Lori G Kletzer. Tradable services: Understanding the scope and impact of services offshoring. In Susan M Collins and Lael Brainard, editors, *Brookings Trade Forum: Offshoring White-Collar Work*. Brookings Institution Press, 2006.
- Enrico Moretti. Local multipliers. *The American Economic Review*, 100(2): 373–377, 2010.
- Enrico Moretti. Local labor markets. In David Card and Orley Ashenfelter, editors, *Handbook of Labor Economics*, volume 4B, chapter 14, pages 1237–1313. Elsevier, 2011.

Enrico Moretti and Per Thulin. Local multipliers and human capital in the United States and Sweden. *Industrial and Corporate Change*, 22(1):339–362, 2013.

Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. Integrated public use microdata series: Version 5.0. [Machine-readable database], 2010.

Jasper van Dijk. Local effects of employment growth in the tradable sector in Europe. *OECD Regional Development Working Papers*, Forthcoming.