Investing in lagging regions is efficient: a local multipliers analysis of U.S. cities

Jasper J. van Dijk

University of Oxford, jasper.vandijk@economics.ox.ac.uk

Abstract

This paper shows that attracting tradable jobs to a city has a bigger positive impact on employment in the non-tradable sector in the same city when the unemployment rate is higher. Therefore it is efficient to stimulate firms in the tradable sector to locate and/or expand in cities with relatively high unemployment rate. This policy would also reduce disparity between cities. Finally the jobs created in the non-tradable sector due to this local multiplier effect from the tradable sector will employ relatively more current inhabitants in cities with a high unemployment rate, thus making this policy more attractive for local policy makers as well.

A simple model illustrates the effect of a demand shock on employment in the non-tradable sector of a city. Empirically I consider the effect of demand from workers in the tradable sector on employment in the non-tradable sector in the same city using U.S. census data from 1980 to 2000. I find that 100 additional jobs in the tradable sector will increase employment in the non-tradable sector in the same city by employing 81 current residents and employing 28 workers that move to the city from other regions. I find that the size of this local employment multiplier depends on the local unemployment rate. Specifically, the multiplier for current residents increases, which drives the overall effect, but the multiplier for migrants decreases.

Keywords: Local labour market, multiplier, tradable, non-tradable, unemployment, migration
JEL: F16, R15, R23

1 Introduction

Employment in the tradable sector[1] of a city has a great impact on the local economy. Extra jobs in the tradable sector create additional jobs in the non-tradable sector[2], both by employing current residents of the city and by employing workers that moved to the city from other regions. The size of this local employment multiplier depends on the unemployment rate in the city. The local employment multiplier for current residents increases with the unemployment rate, but fewer migrants will be attracted when the unemployment rate is high. As a result, policies, that try to increase growth in less favoured regions by stimulating tradable firms to locate in areas with high unemployment, will both reduce disparities between cities *and* efficiently reduce unemployment across the board.

Recently the local employment multiplier between the tradable and the non-tradable sector, or the public and the private sector, has been estimated for the United States (Moretti, 2010; van Dijk, 2014), Sweden (Moretti and Thulin, 2013) and the United Kingdom (Faggio and Overman, 2014). These studies already impact public policies, where national or local governments try to attract tradable jobs to a specific regions to boost the local economy (Greenstone and Moretti, 2003; Greenstone et al., 2008).

In the current literature no paper discusses how the size of the multiplier differs between cities within a country. I will fill this gap by showing that cities with a high unemployment rate have a bigger local employment multiplier than cities with a low unemployment rate. This allows governments to select the cities in which attracting tradable workers is most effective. Additionally, the local employment multiplier will provide relatively more jobs for current inhabitants in cities with a high unemployment rate.

I substantiate this argument by building a simple model that shows how demand shocks, for example from employment in the tradable sector, affect the non-tradable sector and I explain how this interaction is affected by the unemployment rate. To do so I model a single city with a static tradable sector and a non-tradable sector that experiences migration from the surrounding hinterlands. I assume that cities are large enough to be their own commuting areas, therefore I won't consider workers that live outside the city they work in. I support this model by demonstrating that the predicted multiplier effects are consistent with observations across cities in the United States.

I show that, for United States Metropolitan Statistical Areas, the average multiplier is given by 1.09.[3] An additional 100 jobs in the tradable sector will increase employment in the non-tradable sector by employing 81 additional current residents and employing 28 workers from

[1] Jobs at firms that produce goods and/or services that can be traded with other cities and/or countries. For example someone working at a high-tech firm in Silicon valley or someone working in the financial sector at Wall street.

[2] Jobs at firms that produce goods and/or services that are (mostly) consumed within the city they are produced in. For example someone working at a bakery or in construction.

[3] So an increase of 100 jobs in the tradable sector causes an increase of 109 jobs in the non-tradable sector. The total increase is therefore 209. Alternatively, in the input-output literature this would be a multiplier of 2.09.

other regions. The average local employment multiplier for current inhabitants increases from 0.47 at 4.2% unemployment to 1.82 at 8.3% unemployment where the average multiplier for migrants decreases from 0.45 at 4.2% unemployment to 0.22 at 8.3% unemployment.

2 Theoretical model

I will build a simple model that illustrates the effect of a demand shock in a city on the employment of workers in the non-tradable sector, where I allow for migration from the hinterlands to the city. There are many events that can cause demand shocks to a city, for example the establishment of a new tradable industry, the expansion of an existing tradable firm or the inflow of rich pensioners.

This model will show that the size of the effect of such a shock on employment in the non-tradable sector increases with the local unemployment rate, but the effect on migration into the non-tradable sector from the hinterland decreases with the unemployment rate. This makes sense if we explain the size of the multiplier with the underlying elasticity of labour supply and accept that this elasticity increases with the unemployment rate. This assumption seems reasonable as a city with a higher unemployment rate is likely to have: (a) more workers that are voluntarily unemployed; (b) unemployed workers with more diverse skills; and (c) more labour market frictions. Assumption (a) and (b) imply a greater elasticity of labour supply for the workers already living in the city, whilst they do not affect workers that move from the hinterlands. Therefore the multiplier increases for locals with the unemployment rate. Finally assumption (c) does affect all workers, but will probably only dominate for current inhabitants at very high unemployment rates. Since migrants are only affected by (c) the multiplier will decrease with the unemployment rate for them.

The model is a combination of the Shapiro and Stiglitz (1984) "no-shirking" condition for the labour market and the Harris and Todaro (1970) migration model. I combine these models in a way very similar to Moene (1988) and subsequently add the non-tradable sector as a competitive market with a constant returns to scale production function to close the model.

2.1 Workers

Consider a country with a large number of cities that contain all industries. Outside of the city everyone is employed in some rural sector. Each city produces a homogeneous non-tradable good that can only be consumed within the city and a mixture of tradable goods that can be traded with all other cities. For simplicity I assume the skills of workers in the tradable sector are different from the skills of workers in the non-tradable sector and that therefore these two labour markets are completely separate. For now I will put aside the tradable sector and focus on the non-tradable sector within the city and the rural sector outside the city.

I assume that all workers outside the city have the right skills to work in the non-tradable sector inside the city and that this group is completely homogeneous. Therefore each worker makes a choice, whether to live within or outside of the city. There are L_{S} persons in the city that are able to work in the non-tradable sector, of those all employed worker L_{NT} receives a wage w_{NT} and the unemployed workers $(L_{\text{S}}-L_{\text{NT}})$ receives no wage or benefits. There is a probability b that an employed worker will become unemployed due to some exogenous circumstance and a is the job acquisition rate.

In the Shapiro and Stiglitz model, each worker can choose between two discrete levels of effort, minimal effort $(e=0)$ and some positive effort $(e=\bar{e})$. This choice will not effect their wage, but if a worker does not put in effort there is a probability q that he/she will be detected and fired. Therefore the probability that a shirkers loses his or her job is $(b+q)$. All workers derive utility from their wage and experience an additional increase if they do not put in effort. In the hinterland a worker does not have to put in any effort and has a guaranteed utility w_{R}. Workers maximize the expected present discounted value of utility with a discount rate $r>0$.

I use the Shapiro and Stiglitz (1984) definition of expected lifetime utility, with V_E^S for an employed shirker, V_E^N for an employment non-shirker, V_R for a worker in the hinterlands and V_U for an unemployed worker in the city. The fundamental asset equations are given by

$$\begin{aligned} rV_E^S &= w_{\text{NT}}+\bar{e}+(b+q)\left(V_U-V_E^S\right), && (1)\\ rV_E^N &= w_{\text{NT}}+b\left(V_U-V_E^N\right), && (2)\\ rV_U &= a\left(V_E-V_U\right), && (3)\\ rV_R &= w_{\text{R}}, && (4)\end{aligned}$$

where V_E is the expected utility of an employed worker (which equals V_E^N in equilibrium). In the steady state the flow *into* the unemployment pool bL_{NT} and the flow *out* $a(L_{\text{S}}-L_{\text{NT}})$ must be equal, so

$$a=bL_{\text{NT}}/\left(L_{\text{S}}-L_{\text{NT}}\right). \tag{5}$$

Workers will move from the hinterlands to the city as long as this increases their expected lifetime utility, or $rV_U>rV_R$, therefore in equilibrium

$$rV_U=rV_R. \tag{6}$$

Equations 2, 3 and 4 can be solved, using conditions 5 and 6, to obtain

$$L_{\text{S}}=\frac{w_{\text{NT}}b+w_{\text{R}}r}{w_{\text{R}}\left(b+r\right)}L_{\text{NT}}. \tag{7}$$

A worker will choose not to shirk if and only if $V_E^N\geq V_E^S$. This is the *no-shirking condition*

(NSC), which using (1), (2), (4) and (6), can be written as

$$w_{\mathrm{NT}} \geqq w_{\mathrm{R}} + e\frac{b+r}{q}. \tag{8}$$

If there is no unemployment a worker has no incentive to put in effort, because he will immediately find a new jobs when he is fired. Therefore firms need to pay a premium above the wage in the hinterlands, this incentives more workers to move to the city and creates involuntary unemployment which incentivises employed workers to put in effort. The non-shirking wage is greater: the higher the wage in the hinterlands w_{R}; the larger the effort e; the higher the interest rate r; the higher the quit rate b; and the smaller the detection probability q. This is all consistent with the original Shapiro and Stiglitz (1984) model.

2.2 Employers

To close the model I need to specify a labour demand curve, which I will derive from the goods market. I will keep production as simple as possible. I assume there is some fixed demand for non-tradable goods from people living inside the city, that are not employed in the non-tradable sector. This is everyone with an income (or savings) that does not compete for the jobs in the non-tradable sector, their aggregate demand is given by D_{T}.

To allow me to solve the model analytically I assume all firms in the non-tradable sector are in a competitive equilibrium and produce a homogeneous good with a constant returns to scale technology and only one factor, labour $y_{\mathrm{NT}} = L_{\mathrm{NT}}$. I assume that all workers in the non-tradable sector are paid the marginal product of their labour, so $w_{\mathrm{NT}} = p_{\mathrm{NT}}$, where p_{NT} is the price of the non-tradable good.

Again for simplicity I will assume all workers in both sectors in the city have the same Cobb-Douglas preferences over tradable and non-tradable goods, therefore total demand for the non-tradable good is given by

$$x_{\mathrm{NT}} = \lambda\frac{D_{\mathrm{T}} + w_{\mathrm{NT}}L_{\mathrm{NT}}}{p_{\mathrm{NT}}} = \lambda\left(\frac{D_{\mathrm{T}}}{w_{\mathrm{NT}}} + L_{\mathrm{NT}}\right). \tag{9}$$

The goods market clears when $y_{\mathrm{NT}} = x_{\mathrm{NT}}$, which gives us the labour demand function

$$L_{\mathrm{NT}} = \eta\frac{D_{\mathrm{T}}}{w_{\mathrm{NT}}}, \tag{10}$$

where $\eta \equiv \lambda/(1-\lambda)$.

2.3 Comparative Statics

Since the firms in the non-tradable sector are in a competitive equilibrium the firms will pay the minimal wage required to prevent shirking. The number of employed workers L_{NT} in the non-tradable sector of the city in equilibrium can be obtained by inserting (8) as an equality into (10), which yields

$$L_{\mathrm{NT}} = \frac{\eta q D_{\mathrm{T}}}{e\,(b+r) + q w_{\mathrm{R}}}. \tag{11}$$

Employment is greater : the lower the wage in the non-tradable sector w_{NT}; the greater the preferences for the non-tradable good η; and the higher the demand from outside the non-tradable sector D_{T}. The detection probability, quit rate, interest rate, wage in the hinterlands and effort only affect employment through the wage.

The total number of (employed and unemployed) workers L_{S} in the non-tradable sector of the city in equilibrium can be obtained by inserting (8) and (11) into (7), resulting into

$$L_{\mathrm{S}} = \eta \frac{be + q w_{\mathrm{R}}}{e\,(b+r) + q w_{\mathrm{R}}} \frac{D_{\mathrm{T}}}{w_{\mathrm{R}}}. \tag{12}$$

The total number of workers is greater: the greater the preferences for the non-tradable good η; the higher the quit rate b; the smaller the effort e; the greater the detection probability q; the lower the wage in the hinterlands w_{R}; the lower the interest rate r; and the higher the demand outside the non-tradable sector D_{T}.

2.4 Local Multiplier

This model can be used to predict the local multiplier effect of demand shocks on the non-tradable sector. The local multiplier is given by

$$\Delta L_{\mathrm{NT}} = \frac{\eta q \Delta D_{\mathrm{T}}}{e\,(b+r) + q w_{\mathrm{R}}}. \tag{13}$$

This multiplier can be split into two parts, the extra jobs in the non-tradable sector that are fulfilled by migrants and the extra jobs in the non-tradable sector that are fulfilled by previously unemployed inhabitants. The number of jobs fulfilled by migrants is equal to the number of workers that move to the city multiplied with the probability that each migrant finds a jobs

$$\begin{aligned} \Delta L_{\mathrm{M}} &= a \Delta L_{\mathrm{S}} \\ &= \eta q \left(\frac{1}{e} - \frac{r}{e\,(b+r) + q w_{\mathrm{R}}} \right) \Delta D_{\mathrm{T}}, \end{aligned} \tag{14}$$

and the remainder is the effect on current inhabitants

$$\begin{aligned} \Delta L_{\mathrm{C}} &= \Delta L_{\mathrm{NT}} - a \Delta L_{\mathrm{S}} \\ &= \eta q \left(-\frac{1}{e} + \frac{1+r}{e\,(b+r) + q w_{\mathrm{R}}} \right) \Delta D_{\mathrm{T}}. \end{aligned} \tag{15}$$

The multiplier for migrants is greater: the greater the preferences for the non-tradable good η; the greater the detection probability q; the smaller the effort e; the lower the interest rate r; the higher the quit rate b; and the higher the wage in the hinterlands w_{R}.

I assume $w_{\mathrm{R}} < e(1-b)/q$ such that the multiplier for locals is positive. The multiplier for locals is greater: the greater the preferences for the non-tradable good η; the lower the interest rate r; the lower the quit rate b; and the lower the wage in the hinterlands w_{R}. The multiplier increases with the detection probability q and decreases with the effort e when $qw_{\mathrm{R}} < e\left(\sqrt{(1+r)(b+r)}-(b+r)\right)$ and the inverse holds otherwise.

I am specifically interested in the effect of the unemployment rate on the size of this multiplier. In this model the unemployment rate in the non-tradable sector of the city is given by

$$u \equiv 1-\frac{L_{\mathrm{NT}}}{L_{\mathrm{S}}}=\frac{be}{be+qw_{\mathrm{R}}} \tag{16}$$

The unemployment rate is independent of any demand shocks, just like the wage. I can re-express (13), (14) and (15) as

$$\Delta L_{\mathrm{NT}} = \frac{\eta qu\Delta D_{\mathrm{T}}}{e(b+ur)}, \tag{17}$$

$$\Delta L_{\mathrm{M}} = \frac{\eta bq\Delta D_{\mathrm{T}}}{e(b+ur)}, \tag{18}$$

$$\Delta L_{\mathrm{C}} = \frac{\eta q(u-b)\Delta D_{\mathrm{T}}}{e(b+ur)}. \tag{19}$$

2.5 Predictions

From Equation (17) we can see that there is a positive local multiplier, we can also see that the size of this multiplier increases with u. Equation (18) shows that the multiplier for migrants is also positive, but decreases in size with the unemployment rate. In contrast Equation (19) shows that the multiplier for local can actually be negative for very low unemployment rates, but the multiplier increases with the unemployment rate and becomes positive when $u > b$. Finally the multiplier for current inhabitants depends more strongly on the unemployment rate than the multiplier for migrants:

$$\frac{|\partial\Delta L_{\mathrm{C}}/\partial u|}{|\partial\Delta L_{\mathrm{M}}/\partial u|}=\frac{1+r}{r}.$$

In the empirical section I will focus on the multiplier effect of employment in the tradable sector on the non-tradable sector. This can be captured with this model by splitting the demand shock into two parts $\Delta D_{\mathrm{T}} = w_{\mathrm{T}}\Delta L_{\mathrm{T}}$, where w_{T} is the average wage in the tradable sector and ΔL_{T} is the change in employment in the tradable sector. I will focus on the non-parametric relationship between the size of this multiplier and the unemployment rate, for current inhabitants and migrants. I will try to fit a first order Taylor approximation of my model to the data, this approximation is given by

$$\frac{\Delta L_{\mathrm{M}}}{\Delta L_{\mathrm{T}}} \approx \kappa_0 - \kappa_{\mathrm{M}} u, \quad (20)$$

$$\frac{\Delta L_{\mathrm{C}}}{\Delta L_{\mathrm{T}}} \approx -\kappa_0 + \kappa_{\mathrm{C}} u, \quad (21)$$

where $\kappa_0 \equiv \eta w_{\mathrm{T}} q/e$, $\kappa_{\mathrm{M}} \equiv \kappa_0 r/b$ and $\kappa_{\mathrm{C}} \equiv \kappa_0/b + \kappa_{\mathrm{M}}$.

3 Data

I estimate the local employment multiplier in United States Metropolitan Areas (MSA's) based upon U.S. census data. I retrieved these data from the Integrated Public Use Microdata Series (Ruggles et al., 2010). Moretti (2010) also used this dataset to estimate the local employment multiplier. The census provides a 1-in-20 national random sample of the population for 1980, 1990 and 2000. I only use data on the individuals living within one of the MSA's.

I am interested in the change of employment over time. To analyse this I 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. All industries are coded according to the three-digit industries codes of 1990. I classify manufacturing as a tradable industry and I classify all other industries except for agriculture, mining, public administration and the military as non-tradable.[4] I observe 74 tradable industries and 119 non-tradable industries over all periods.

Table 1 shows there is plenty of variation in the growth of both the tradable and the non-tradable sector between these observations. I define *Total employment* as the sum of employment in the tradable and the non-tradable sector. The 6.9% of the population that is employed outside of these sectors is not considered in this paper.

In Table 1 *Contribution tradable* is defined as the change in employment in the tradable sector divided by initial total employment. Similarly *Contribution non-tradable* is defined as the change in employment in the non-tradable sector divided by initial total employment. These two variables will be the main regressor and the dependent variable respectively in most of my analysis. Because I am only interested in the effect of employment in the tradable on employment in the non-tradable sector I will control for other variations between cities that might drive employment in the non-tradable sector, such as population size, the level of education and the unemployment rate.

[4] In this I follow Moretti (2010)

Tab. 1: Descriptive Statistics

	1980-1990		1990-2000		Both periods	
	Mean	Std. dv.	Mean	Std. dv.	Mean	Std. dv.
Total employment (initially, $\times$1000)	270	579	314	675	293	630
Tradable employment (initially, $\times$1000)	62	138	55	119	58	129
Share tradable (initially)	23%	10%	18%	7%	21%	9%
Non-tradable employment (initially, $\times$1000)	208	445	259	561	234	508
Share non-tradable (initially)	77%	10%	82%	7%	79%	9%
Total employment growth	20%	24%	28%	33%	24%	29%
Tradable sector employment growth	0%	29%	14%	37%	7%	34%
Contribution tradable	-1%	6%	2%	7%	1%	7%
Non-tradable sector employment growth	27%	24%	32%	33%	30%	29%
Contribution non-tradable	21%	19%	26%	27%	24%	24%
Control Variables						
Population Size (initially, $\times$1000)	668	1,389	722	1,499	696	1,444
Share 'grade 12 - 2 years of college'	37%	4%	47%	4%	42%	6%
Share '3+ years of college'	13%	4%	14%	4%	13%	4%
Unemployment rate (initially)	7%	2%	6%	2%	6%	2%

Tab. 2: Migration to U.S. cities

	Original data			Adjusted data	
	1980	1990	2000	1980	1990
N/A	50%	0%	0%		
Same house	25%	51%	53%	49%	51%
Moved within state, within county/PUMA	14%	0%	26%	27%	27%
Moved within state, between counties/PUMAs	5%	0%	9%	11%	10%
Moved within state, unknown	0%	37%	0%		
Moved from out of state	6%	12%	11%	13%	12%

3.1 Migration

To distinguish between current inhabitants of a city and migrants I use the migration statistic from the census. This variable indicates where the household lived five years earlier, this does not cover the complete ten year interval over which I measure the multiplier, but it should be a good indicator. It does not specifically indicate whether a person moved from outside the MSA, but only from outside their county (in 1980) or PUMA (in 2000). I assume that everyone who remained within the same county or PUMA is a current inhabitant and everyone else is a migrant. I also do not observe the place of work, but I assume all workers commute within the MSA they live in.

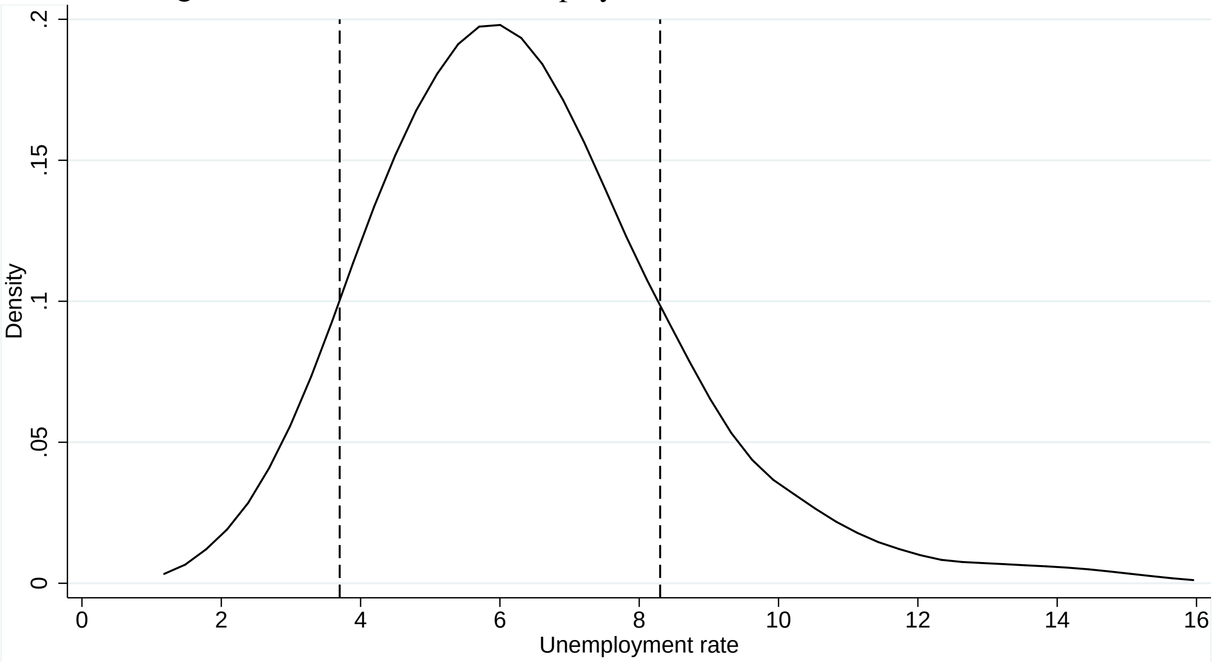
In every period we observe whether the household remained in the same house, moved within the state or moved from out of state. In 1980 we also observe, for those who moved within the state, whether they moved within the county or between counties. In 2000 we observe, for those who moved within the state, whether they moved within the PUMA or between PUMAs. But in 1990 we don't have any extra information on the persons that moved within the state. Furthermore there is a significant number of missing observations in 1980. The proportion of each type of migration can be found in Table 2.

There is a lot of unknown data on migration in both 1980 and 1990, but in both cases we have enough information to define a group that definitely consists of current inhabitants and a group that consists of migrants. Therefore these data on observed migration can be used for analysis.

Alternatively we can estimate the distribution of the missing observations. If we assume that it is random within each city whether a worker's migration status is observed by the census, then for each city migration within the unobserved group is distributed the same as the observed group. For example, if we observe a city where 44% of the workers in a city is a current inhabitant and 11% is a migrant, this implies 1-in-5 workers is a migrant. If we apply this to the 45% of the workers for whom the migration status is unknown this implies that in total 77.25% of the workers is a current inhabitant and 22.25% is a migrant. This provides us with an adjusted number of current inhabitants and migrants that adds up to the total number of workers in a city.

For those that moved within the state we can see a stable share moved within county/PUMA

Fig. 1: Distribution of the unemployment rate across all observed cities



in both 1980 and 2000. It is reasonable to assume that for each city in 1990 this share will lie between the shares found in 1980 and 2000. Therefore we can split the "Moved within state, unknown" group observed in 1990 into two parts based upon the relative sizes of "Moved within state, within county/PUMA" and "Moved within state, between county/PUMA" in 1980 and 2000 for the same city. The resulting adjusted data for both 1980 and 1990 is summarized as well in Table 2.

3.2 Unemployment

I derive the unemployment rate in each city directly from the census data. I will use this measure to do a non-parametric analysis of the size of the local multiplier. As shown in Figure 1 the unemployment rate lies between 3.7% and 8.3% for most cities[5]. Therefore I will focus my non-parametric estimation on this range.

4 Empirical method

The empirical strategy used to determine the causal effect of employment in the tradable industry on employment in the non-tradable industry relies on the shift-share instrument as suggested by Bartik (1991). This paper is based upon an adaptation of this method used by Faggio and Overman (2014).

[5] The estimated probability density function is greater than 0.1 in this interval.

The central equation that is estimated for every city, c, is

$$\frac{E^{NT}_{c,t+s}-E^{NT}_{c,t}}{E^{T}_{c,t}+E^{NT}_{c,t}}=\alpha+\beta\frac{E^{T}_{c,t+s}-E^{T}_{c,t}}{E^{T}_{c,t}+E^{NT}_{c,t}}+\gamma X_{c,t}+\delta D_t+\varepsilon_{c,t}, \tag{22}$$

where $\left(E^{NT}_{c,t+s}-E^{NT}_{c,t}\right)/\left(E^{T}_{c,t}+E^{NT}_{c,t}\right)$ is the contribution of employment in the non-tradable sector to total employment growth between period t and $t+s$; and $\left(E^{T}_{c,t+s}-E^{T}_{c,t}\right)/\left(E^{T}_{c,t}+E^{NT}_{c,t}\right)$ is the contribution of employment in the tradable sector. The vector $X_{c,t}$ is a set of city specific characteristics that affect employment growth in the non-tradable sector, D_t is a time dummy and $\varepsilon_{c,t}$ is the error term.

The parameter β indicates the effect of employment in the tradable sector on employment in the non-tradable sector. If $\beta=0$ they are not related, otherwise β indicates the number of additional jobs that are created in the non-tradable sector for each new job in the tradable sector.

The parameter β can capture three types of co-movement: the causal effect of extra jobs in the tradable sector on employment in the non-tradable sector; the effect of employment in the non-tradable sector on the tradable sector; and effects due to omitted variables, for example effective local government can increase employment in both sectors.

Since I am only interested in the causal effect of a change in the number of jobs in the tradable sector on the number of jobs in the non-tradable sector I need a way to filter out the other two unwanted co-movements captured by β. To achieve this I will use an instrumental variable derived from the well-established shift-share approach introduced by Bartik (1991).

This instrument uses the initial share of each tradable sub-sector within the city and the national growth of these sectors to predict the growth of the tradable sector in city c. The instrument for each city is given by

$$\sum_{j\in\text{Trad.}}\frac{E^{j}_{c,t}}{E^{T}_{c,t}+E^{NT}_{c,t}}\times\frac{T^{j}_{\neg c,t+s}-T^{j}_{\neg c,t}}{T^{j}_{\neg c,t}}, \tag{23}$$

where $E^{j}_{c,t}/\left(E^{T}_{c,t}+E^{NT}_{c,t}\right)$is the initial share of a three-digit tradable industry j in city c and $\left(T^{j}_{\neg c,t+s}-T^{j}_{\neg c,t}\right)/T^{j}_{\neg c,t}$ captures the overall growth in industry j based upon all cities in the U.S. except for city c itself. See Faggio and Overman (2014) or Moretti (2010) for more details on this method.

4.1 Unemployment

As can be seen from Equation (17) the size of the multiplier depends on the unemployment rate

$$\beta(u)=\frac{\gamma q u w_{\mathrm{T}}}{e(b+ur)}.$$

I will not impose this structural relation on the data, but instead I will estimate the non-parametric relationship between the unemployment rate and the local employment multiplier. I start out by estimating the linear effect of all the control variables on the contribution of the non-tradable sector to total growth, which results in the predicted value

$$\frac{\widehat{E^{NT}_{c,t+s}-E^{NT}_{c,t}}}{E^{T}_{c,t}+E^{NT}_{c,t}}=\hat{\theta}_{NT}+\hat{\rho}_{NT}X_{c,t}+\hat{\pi}_{NT}D_{t}, \tag{24}$$

and I do the same for the tradable sector

$$\frac{\widehat{E^{T}_{c,t+s}-E^{T}_{c,t}}}{E^{T}_{c,t}+E^{NT}_{c,t}}=\hat{\theta}_{T}+\hat{\rho}_{T}X_{c,t}+\hat{\pi}_{T}D_{t}. \tag{25}$$

Subsequently I do the first stage estimation with my instrumental variable to find the predicted value

$$\frac{\widehat{E^{T}_{c,t+s}-E^{T}_{c,t}}}{E^{T}_{c,t}+E^{T}_{c,t}}_{IV}=\hat{\theta}_{I}+\hat{\tau}_{I}\mathrm{IV}_{\mathrm{c,t}}+\hat{\rho}_{I}X_{c,t}+\hat{\pi}_{I}D_{t}. \tag{26}$$

The effect of employment in the tradable sector on employment in the non-tradable sector is given by a regression of the residuals

$$R^{NT}_{c,t}=\alpha+\beta R^{T}_{c,t}+\varepsilon_{c,t}, \tag{27}$$

where

$$\begin{aligned}
R^{NT}_{c,t} &\equiv \frac{E^{NT}_{c,t+s}-E^{NT}_{c,t}}{E^{T}_{c,t}+E^{NT}_{c,t}}-\frac{\widehat{E^{NT}_{c,t+s}-E^{NT}_{c,t}}}{E^{T}_{c,t}+E^{NT}_{c,t}},\\
R^{T}_{c,t} &\equiv \frac{\widehat{E^{T}_{c,t+s}-E^{T}_{c,t}}}{E^{T}_{c,t}+E^{T}_{c,t}}_{IV}-\frac{\widehat{E^{T}_{c,t+s}-E^{T}_{c,t}}}{E^{T}_{c,t}+E^{NT}_{c,t}}.
\end{aligned}$$

I use the Nadaraya-Watson kernel regression (Nadaraya, 1965; Watson, 1964) to estimate β as a function of the unemployment rate

$$\hat{\beta}(u) = \arg\min_{\alpha,\beta}\sum_{t=1}^{T}\sum_{c=1}^{C}\left\{\left(R^{NT}_{c,t}-\alpha-\beta R^{T}_{c,t}\right)K\left(\frac{u_{c,t}-u}{h}\right)\right\}, \tag{28}$$

with the Epanechnikov kernel

$$K\left(\frac{u_{c,t}-u}{h}\right)=\begin{cases}\frac{3}{4}\left[1-\left(\frac{u_{c,t}-u}{h}\right)^{2}\right] & \text{if } \left|\frac{u_{c,t}-u}{h}\right|\leq 1\\ 0 & \text{otherwise}\end{cases}, \tag{29}$$

and half-bandwidth $h = 1.5$. A wider bandwidth will reduce the variance, but increases the bias of the estimation.

5 Results

I will start with the estimation results of Eq. (22). My dependent variable is the change in employment in the non-tradable sector divided by total employment at the start of the interval. My main independent variable is the change in employment in the tradable sector, again divided by total employment. Column (1) in Table 3 reports OLS estimates with only a time dummy. Column (2) reports estimates when I add controls for education and population size at the start of the interval. The result in Column (3) also includes the unemployment rate at the start of the period as a control. As can be seen from the table the OLS estimate of β is stable and about 2.5.

The table also reports the instrumental variable estimates for the same three specifications, where I use the shift-share instrument as given by Eq. (23). As discussed in the empirical section the OLS estimate of β would likely be biased. From the table we can see that this is an upwards bias. The point estimate of 1.09 in column IV(3) implies that each additional 100 jobs in the tradable sector in a city increases employment in the non-tradable sector by 109. This effect is significant for all specifications.

5.1 Migration

It is possible to split the non-tradable sector into two parts, current inhabitants and recent migrants. I will name these two sectors the local non-tradable sector and the migrant non-tradable sector. This way I can estimate separate values for β, again using Eq. (22).

I modify Eq. (22) by only including current inhabitants or only migrants as workers in the non-tradable sector. In this case my dependent variable is the change in employment of current inhabitants in the non-tradable sector divided by total employment at the start of the interval. Or a similar definition in case of migrant workers. In both cases the main independent variable is the same as the one described above. All estimates in Table 4 are for a specification with a time dummy and controls for education, population size and the unemployment rate. The columns marked (1) report the Instrumental Variable estimates when workers with missing migration are not considered. The estimate of β for current inhabitants is not significantly different from zero. The estimate for migrants is significant and implies that each additional 100 jobs in the tradable sector in a city creates 26 jobs for migrants in the non-tradable sector.

The columns marked (2) report the estimates when I use the adjusted migration data, including those workers without an observed migration status. The way these values are adjusted is described in the data section. In this case the estimate of β differs significantly from zero for both current inhabitants and migrants. This suggest that the result in Current inhabitants (1) might be biased downwards because of the missing observations. Therefore I will only consider

Tab. 3: Impact of tradable sector on non-tradable sector employment, IPUMS data 1980-2000.

	OLS			IV		
	(1)	(2)	(3)	(1)	(2)	(3)
Contribution tradable	2.48***	2.50***	2.52***	1.24***	1.07***	1.09***
	(0.31)	(0.31)	(0.30)	(0.28)	(0.35)	(0.35)
ln(initial population)		0.010	0.010		-0.0064	-0.0062
		(0.0091)	(0.0091)		(0.013)	(0.013)
Share 'grade 12 - 2 years of college'		0.021	0.050		0.022	0.032
		(0.25)	(0.25)		(0.28)	(0.27)
Share '3+ years of college'		-0.037	0.10		0.40	0.45
		(0.33)	(0.36)		(0.41)	(0.41)
Initial unemployment rate			0.0064			0.0023
			(0.0044)			(0.0045)
Period 1990-2000	-0.038***	-0.041	-0.043	0.0062	0.0085	0.0074
	(0.015)	(0.029)	(0.028)	(0.022)	(0.040)	(0.039)
Constant	0.2***	0.11	0.038	0.23***	0.25	0.22
	(0.010)	(0.16)	(0.16)	(0.011)	(0.19)	(0.19)
Adjusted R^2	0.514	0.512	0.514	0.386	0.351	0.353
First-stage statistic[a]				62.8	53.1	51.1

Note: Robust standard errors clustered by MSA reported in parentheses. There are 464 observation in the United States. The dependent variable is the contribution of service sector employment to total employment growth. Contribution tradable denotes the contribution of tradable sector employment to total employment growth. The instrumental variable is equal to the initial share in tradable sector employment for a given region multiplied by the increase in tradable sector employment for the country as a whole (excluding own region).

[a] The Kleibergen-Paap rk Wald F statistic

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

Tab. 4: Impact of tradable sector on non-tradable sector migration, IPUMS data 1980-2000.

	Total	Current inhabitants		Migrants	
		(1)	(2)	(1)	(2)
Contribution tradable	1.09***	-0.16	0.81***	0.26*	0.28**
	(0.35)	(0.34)	(0.26)	(0.14)	(0.12)
Adjusted R^2	0.35	0.39	0.37	0.47	0.23

Note: Robust standard errors clustered by MSA reported in parentheses. There are 464 observation in the United States. The dependent variable is the contribution of all/local/migrant service sector employment to total employment growth. Contribution tradable denotes the contribution of tradable sector employment to total employment growth. The instrumental variable is equal to the initial share in tradable sector employment for a given region multiplied by the increase in tradable sector employment for the country as a whole (excluding own region). The Kleibergen-Paap rk Wald F statistic for all regressions is 51.1.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

the adjusted data from this point onwards. The estimates of 0.81 and 0.28 respectively imply that each additional 100 jobs in the tradable sector in a city creates jobs for 81 current inhabitant and 28 migrants, both in the non-tradable sector.

5.2 Unemployment

The simplest way to test the effect of the unemployment rate on the size of the local multiplier is to add an interaction term between employment in the tradable sector and the unemployment rate to Eq. (22). As can be seen in Table 5 the sign of these estimations is consistent with my model, but because the effect is non-linear the estimates are not significant. Both the total multiplier and the multiplier for current inhabitants increases with the unemployment rate as shown by the estimate of 0.14 and 0.15 respectively for the interaction term. The effect of the unemployment rate on the multiplier for migrants is very small.

The non-parametric estimation results[6] of Eq. (27) are shown in Figure 2. The solid line shows that the local employment multiplier increases with the unemployment rate, the dotted line shows the relationship predicted by the regression with an interaction term for unemployment and the dashed line is the estimate of the local multiplier when I assume it is independent of the unemployment rate. When I split the non-tradable sector into current inhabitants and recent migrants as I did above I can estimate Eq. (27) for both groups. Figure 3 shows the positive effect of the unemployment rate on the local employment multiplier for current inhabitants. Finally Figure 4 shows the effect of the unemployment rate on the local employment multiplier for migrants, which appears to be negative but is more ambiguous.

[6] I estimate the local multiplier for unemployment between 3.7% and 8.3%

Tab. 5: Impact of tradable sector on non-tradable sector migration interacted with unemployment for cities with an unemployment rate between 3.7% and 8.3%, IPUMS data 1980-2000.

	Total	Current inhabitants	Migrants
Contribution tradable	0.18	-0.12	0.31
	(1.52)	(1.10)	(0.50)
Unemployment rate (initially)	-0.0089	-0.0035	-0.0054*
	(0.0083)	(0.0059)	(0.0031)
Interaction	0.14	0.15	-0.0093
	(0.23)	(0.17)	(0.071)
Adjusted R^2	0.30	0.31	0.18

Note: Robust standard errors clustered by MSA reported in parentheses. There are 370 observation in the United States. The dependent variable is the contribution of all/local/migrant service sector employment to total employment growth. Contribution tradable denotes the contribution of tradable sector employment to total employment growth. The instrumental variable is equal to the initial share in tradable sector employment for a given region multiplied by the increase in tradable sector employment for the country as a whole (excluding own region). The interaction term is the product of contribution tradable and the percentage of unemployed workers. A second instrument has been added to accomodate for this interaction term. The Kleibergen-Paap rk Wald F statistic for all regressions is 38.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

Fig. 2: Non-parametric effect of unemployment on the local employment multiplier

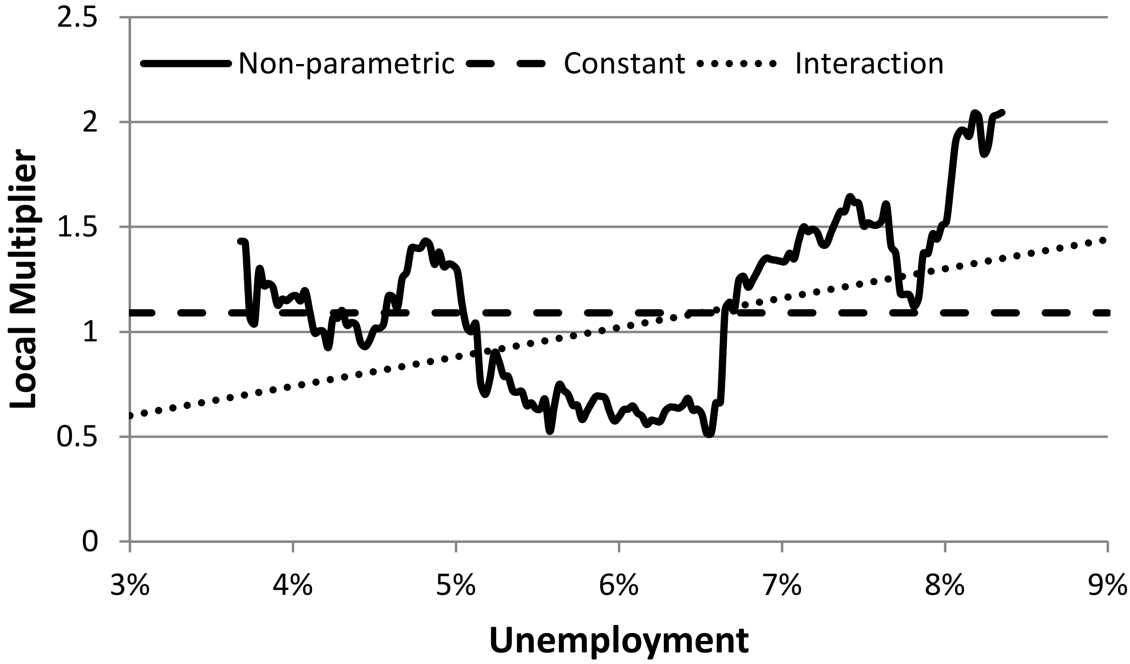


Fig. 3: Non-parametric effect of unemployment on the local employment multiplier for current inhabitants

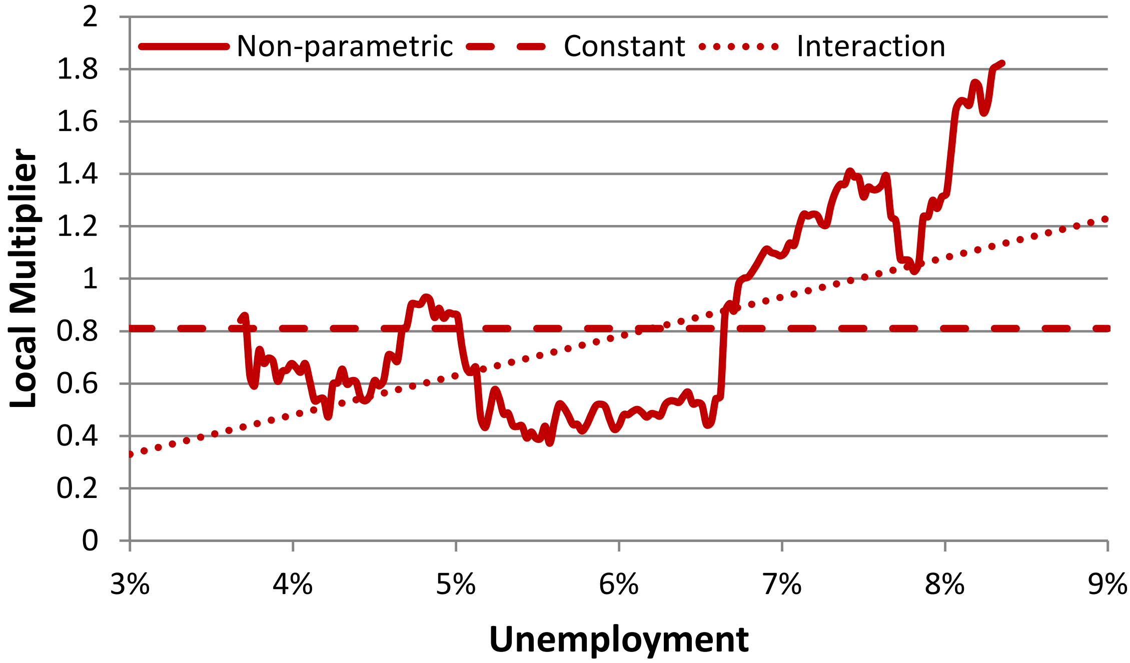


Fig. 4: Non-parametric effect of unemployment on the local employment multiplier for migrants

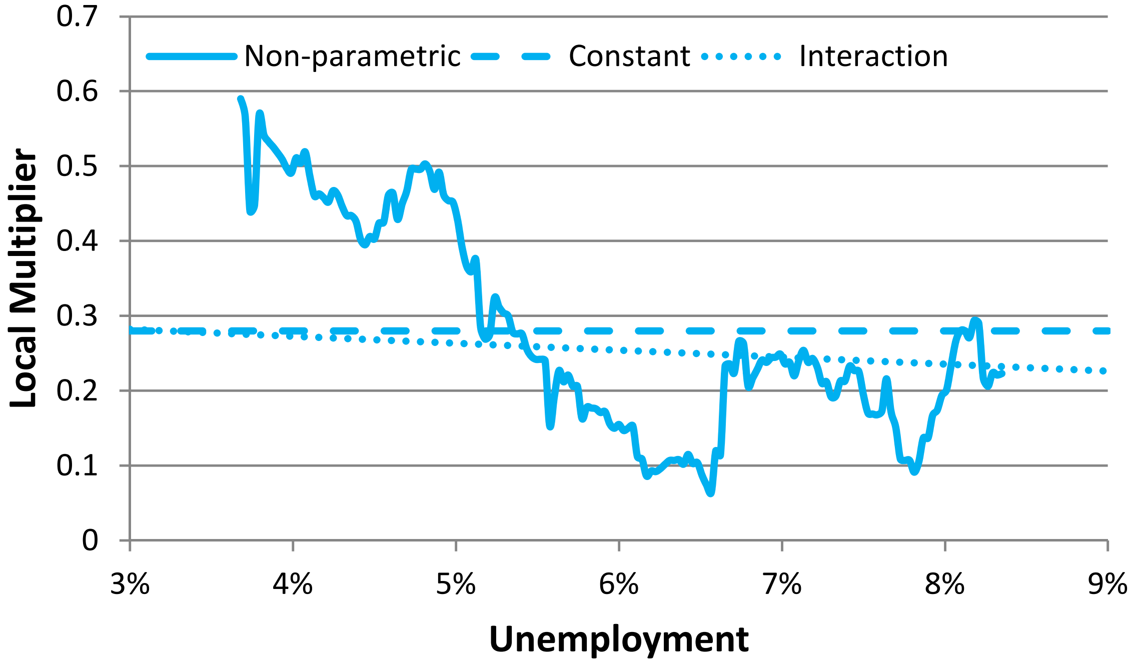
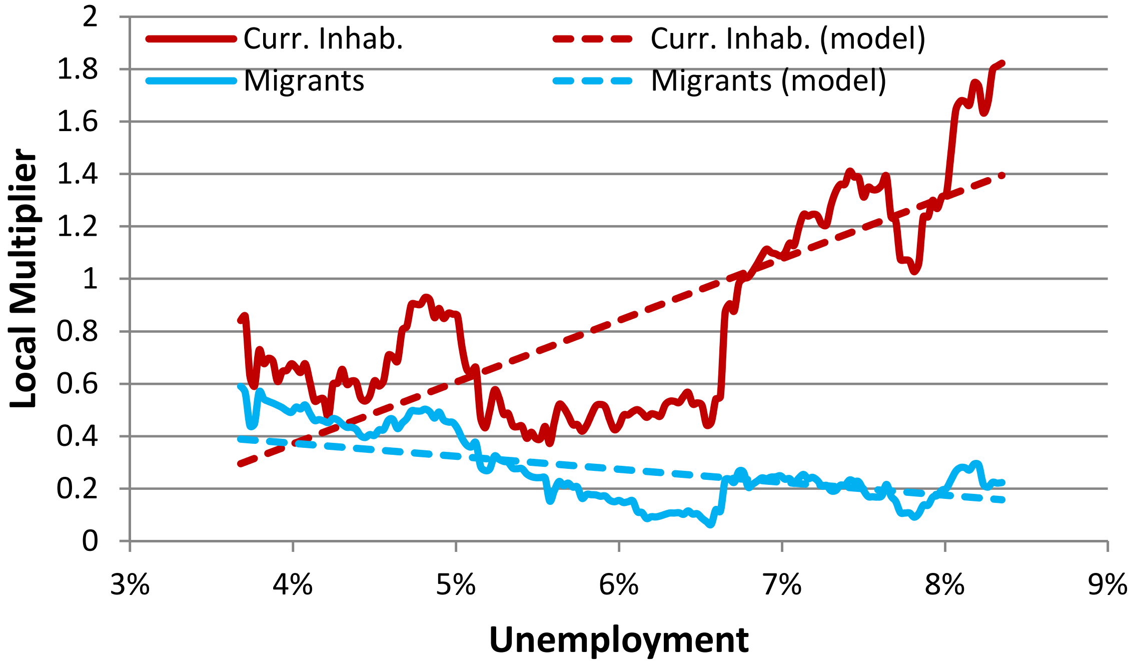


Fig. 5: Local employment multiplier for current inhabitants and migrants as a function of the unemployment rate predict by the model.



6 Discussion

We can now relate the empirical results to the predictions made by the model. First of all I indeed find that there is a significant positive effect of employment in the tradable sector on employment in the non-tradable sector as predicted by Equation (13) of the model. When I split all workers in the non-tradable sector into current inhabitants and migrants I find a multiplier for both subsets, this is consistent with the two channels predicted by the model.

When I fit (20) and (21) to the data I find $\hat{\kappa}_0 = 0.57$, $\hat{\kappa}_M = 4.95$ and $\hat{\kappa}_C = 23.54$. From this I can back out the quit rate $\hat{b} = 0.03$ and the interest rate $\hat{r} = 0.27$. The interest rate seems very high, but these estimates are hard to interpret since the time frame in the Shapiro-Stiglitz model is not clearly defined. I can, however, feed these parameter values back into the model and predict the relation between the size of the local employment multiplier and the unemployment rate. This prediction is shown alongside the actual estimates in Figure 5. The model predicts that the size of the local employment multiplier for current inhabitants increases with the unemployment rate; and that the size of the local employment multiplier for migrants decreases with the unemployment rate. Both are reflected in the data.

It is unlikely that the predicted increase in the local employment multiplier will sustain for much higher unemployment rates, because friction in the local labour market are likely to become dominant. It would be interesting to observe what happens when the unemployment rate becomes very small, but this lies outside of the scope of this paper, because there is only sufficient data available to discuss cities with an unemployment rate between 3.7% and 8.3%.

7 Conclusion

The model and empirical results in this paper support a large local employment multiplier between the tradable sector and the non-tradable sector. This is consistent with the existing literature. Policy makers in (local) governments use this multiplier as an argument to attract tradable firms to their cities, for example by giving tax cuts or investing in certain industries.

This paper extends the existing literature by showing that the impact of attracting jobs in the tradable sector depends on the unemployment rate. An increase in employment in the tradable sector in a city with a higher unemployment rate will have a greater multiplier effect on the non-tradable sector than the same increase in a city with a lower unemployment rate. Therefore policy makers can increase the regional impact of tradable employment and decrease the disparity between regions by stimulating tradable firms to expand in regions or cities with more unemployment.

The unemployment rate influences the local employment multiplier for current inhabitants differently than for migrants. As a result the share of jobs created in the non-tradable sector that is fulfilled by current inhabitants increases with the unemployment rate. In other words, in cities where the policy of attracting tradable jobs is most effective, the policy maker's constituents will relatively benefit the most. This could make attracting tradable jobs even more desirable for these policy makers.

This is good news: the bigger the problem is, the more effective the solution. The incentives for local officials; policy makers who want to reduce disparities between regions; and policy makers who want to increase overall employment are aligned. Policy makers should stimulate the tradable sector in regions with a high unemployment rate.

References

Bartik, T. J., 1991. Who benefits from state and local economic development policies? W.E. Upjohn Institute for Employment Research.

Faggio, G., Overman, H., 2014. The effect of public sector employment on local labour markets. Journal of urban economics 79, 91–107.

Greenstone, M., Hornbeck, R., Moretti, E., 2008. Identifying agglomeration spillovers: evidence from million dollar plants. National Bureau of Economic Research.

Greenstone, M., Moretti, E., 2003. Bidding for industrial plants: Does winning a 'million dollar plant' increase welfare? National Bureau of Economic Research.

Harris, J. R., Todaro, M. P., 1970. Migration, unemployment and development: A two-sector analysis. The American Economic Review 60 (1), pp. 126–142.
URL http://www.jstor.org/stable/1807860

Moene, K. O., Jan 1988. A reformulation of the harris-todaro mechanism with endogenous wages. Economics Letters 27 (4), 387–390.
URL http://dx.doi.org/10.1016/0165-1765(88)90168-1

Moretti, E., 2010. Local multipliers. The American Economic Review 100 (2), 373–377.

Moretti, E., Thulin, P., 2013. Local multipliers and human capital in the united states and sweden. Industrial and Corporate Change 22 (1), 339–362.

Nadaraya, E., 1965. On non-parametric estimates of density functions and regression curves. Theory of Probability & Its Applications 10 (1), 186–190.

Ruggles, S., Alexander, J. T., Genadek, K., Goeken, R., Schroeder, M. B., Sobek, M., 2010. Integrated public use microdata series: Version 5.0 [machine-readable database].

Shapiro, C., Stiglitz, J. E., 1984. Equilibrium unemployment as a worker discipline device. The American Economic Review, 433–444.

van Dijk, J. J., 2014. Local employment multipliers in us cities. Discussion Paper Series, Department of Economics, Oxford.

Watson, G. S., 1964. Smooth regression analysis. Sankhyā: The Indian Journal of Statistics, Series A, 359–372.