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Local multipliers in OECD regions

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Local Multipliers in OECD regions

Jasper van Dijk*

27th February 2014

Abstract

I have shown that an exogenous increase in the number of jobs in the tradable sector of a region has a significant multiplier on the number of jobs in the non-tradable sector of that same region. This results holds for U.S. counties and European TL2 and TL3 regions. The size of the multiplier is significantly higher in the U.S. than in Europe and the size of the multiplier increases with the scale of the regions considered.

1 Introduction

A key aspect of understanding how regions grow is the interplay between jobs in the tradable and jobs in the non-tradable sector. Jobs in the tradable sector supply the world market and can therefore move from region to region, but every region has a local demand for non-tradable goods and the size of the non-tradable sector is directly dependent on the size of the tradable industries. An exogenous increase of one job in the tradable sector of a region has a local multiplier effect of 1.6 endogenously created extra jobs in the non-tradable sector in the same region[Moretti, 2010].

In short the increased employment in the tradable sector increases the total income in a region and therefore allows for more consumption by the local inhabitants. Depending on the preferences of the inhabitants this will increase demand for non-tradable goods and depending on the technology required to produce these goods, this will increase employment and wages in the non-tradable sector. Therefore the size of the local multiplier will depend on many factors, such as the type of new jobs in the tradable sector, the unemployment rate in a region and whether it is urban or rural.

Over the past decades there has been a shift from manufacturing to services in most OECD countries. As shown in figure 1 the average share of value added and employment for manufacturing has been steadily decreasing in OECD countries, whilst the opposite holds for services. With manufacturing and therefore tradables becoming more sparse, capturing this multiplier effect can be crucial for local development.

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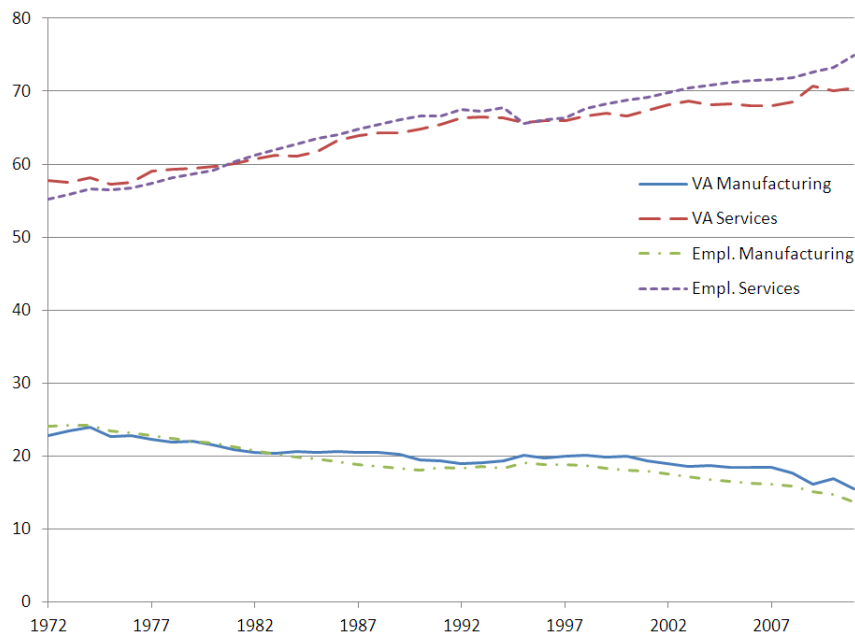


Figure 1: Trends in Manufacturing and Services in the OECD

An accurate estimate of the size of the local multiplier can be interesting academically, but policy makers need to know the multiplier in the region they are designing policy for and the multiplier of the jobs they would like to attract. For example when unemployment is low, the increased demand in the non-tradable sector due to an increase in the tradable sector will probably have a greater effect on wages and the multiplier on jobs will be smaller.

An urban area will likely have a higher multiplier than a rural area, because there is a greater likelihood of technological spillover and there are more diverse local services. A larger area will also catch a higher multiplier as the increase in jobs in the tradable sector will have an effect on the greater surrounding area. This can be shown by comparing the multiplier of cities to the multiplier of counties, or the multiplier of TL3-regions to the multiplier of TL2-regions¹.

The type of extra jobs matters as well. An increase in jobs in the tradable sector fulfilled by skilled workers has a local multiplier of 2.52 compared to a local multiplier of 1.04 for unskilled workers[Moretti, 2010]. The difference in size could partially be explained by the higher income of skilled workers. On the other hand for each extra (un)skilled tradable jobs the extra non-tradable jobs mostly are (un)skilled as well. So apart from the difference in wages there could also be a difference in preferences between skilled and unskilled workers or a technological spillover from skilled tradable jobs to skilled non-tradable jobs. In any case the type of tradable jobs policy makers would like to attract depends on the type of unemployment there is in the region.

Finally even if one can accurately determine the size of the multiplier for a specific industry in a specific region, the question of who fulfils these jobs remains. Do the new jobs, due to local multiplier effects, benefit the current inhabitants of a region and reduce unemployment, or are

¹TL2 and TL3 regions correspond to the second and third level NUTS regions respectively.

they mainly fulfilled by workers migrated from other regions?

In this paper I will focus on the effect of the region size and the location of the region. I will compare data on U.S. counties to existing results on U.S. cities; I will compare European TL2 and TL3 data to existing results on Swedish TL3 regions; and I will compare my U.S. and European findings to each other.

2 Literature review

Attracting a new manufacturing firm increases the number of jobs in a region directly and endogenously creates extra jobs through the local multiplier. Therefore many local authorities choose to offer tax cuts or new infrastructure to persuade firms to locate their new plant in their jurisdiction. They wish to attract big plants as they hope it will bring welfare to their region. When a county in the US successfully attracts a large plant, property values increase by 1.1-1.7% compared to similar counties when the plant is opened [Greenstone and Moretti, 2003]. The increase in welfare could be explained by heterogeneity amongst national subsidies to regions or structural underbidding.

The opening of a new plant has several effects on the incumbent firms in the same region. Demand for labour and land increases, which increases costs for incumbent firms. But the agglomeration spillover effect increases the total factor productivity (TFP) of incumbent firms. “Five years after the new plant opening, TFP of incumbent plants in winning counties is 12% higher than TFP of incumbent plants in losing counties” [Greenstone et al., 2008]. The resulting effect could be positive or negative and can differ per incumbent firm. The effect is strongly dependent on the distance between the incumbent and the new plant.

Let's assume regions keep increasing their bid for a new plant until they are indifferent between whether their bids get accepted by the firm or not. If regions are homogeneous in the effect of the agglomeration spillover effect and other multipliers this would result into a zero net gain for the winning region. Assuming the firm will always build their plant in some county and the only question is in which, all money spend on tax cuts is essentially wasted [Greenstone et al., 2008]. Not bidding at all would be a Pareto improvement for all regions. But if we consider regions to be heterogeneous, the region with the highest spillover will attract the new plant and this will yield a net improvement in welfare as shown in Greenstone and Moretti [2003]. Bidding will increase the spillover effect as (re)locating firm may only be concerned with maximizing profits, ignoring spillover to other firms in their locating decision. But we should also look into other ways policy can increase the spillover effect.

When there is an exogenous increase in the tradable sector the labour market will adapt endogenously allowing for an additional increase in jobs. One should consider attracting new firms as well as the expansion of existing plant and improving the multiplier of existing jobs. The multiplier on jobs in the non-tradable sector increases when the tradable jobs are higher paying, consumers prefer labour intensive services and the tradable labour market is highly

elastic.

This is confirmed by research on Sweden with a local multiplier of 0.49 additional non-tradable jobs per extra job tradable sector. “This multiplier effect is particularly large for jobs with high levels of human capital and for high-technology industries” [Moretti and Thulin, 2013]. This could be explained by the high average wage these jobs have. I wonder what is the impact of investing in education on the multiplier and what is the effect of combining a plant with a regional technology sector. High education and technology jobs show to have a greater multiplier, this could be enhanced by extra investments in these resources.

I would like to investigate multiplier of different sub-sectors within the tradable industry. I think this is key to policy making decision on what types of jobs to attract. Take Mexico for example where a lot of U.S. low wage jobs are outsourced. These jobs gave a positive impulse to the Mexican economy, but had little value added. When it was cheaper to outsource even further to China, the jobs disappeared and the positive effects in Mexico disappeared. Because of increasing wages in China and increasing transport cost companies are now moving their manufacturing back to Mexico, but this time Mexico is more prepared. By demanding the use of Mexican technology and investment in education the endogenous effect on the Mexican economy is much greater. By moving higher value added goods to Mexico, there is a greater benefit. This could be an example for developing economies as well. Therefore the effect of technology, human capital and the sub-sectors of manufacturing jobs are well worth investigating.

In this paper my focus will be on a spatial expansion of Moretti’s work. In his U.S. study he looked at the multiplier within cities and in his study with Thulin he looked at small clusters of municipalities, but this does not take the interaction between cities and their hinterlands into account. Factories will locate where land is cheaper and part of the workers could come from there as well. Alternatively the national level is too high, this clouds regional effects when location and transport factor into production and labour decisions at a smaller scale. Therefore I will look at U.S. counties and at TL2 and TL3 regions within Europe. The OECD [2011] has classified two levels of geographic units within each member country. The higher level (Territorial level 2 [TL2]) consists of 362 larger regions while the lower level (Territorial level 3 [TL3]) is composed of 1794 smaller regions. All the territorial units are defined within national borders and in most of the cases correspond to administrative regions. Regions at the lower level (TL3) are contained within the higher level (TL2).

I will use national data to control for endogenous shock to jobs in the tradable sector, but in the future I would also like to consider the spillover effect of exogenous shock the jobs in the tradable sector in neighbouring regions. Finally the link between services and tradables might be too strict and allowing for tradable services, such as financial intermediation, could improve on this [Jensen et al., 2005].

3 Theory

When a local economy attracts a new manufacturing firm or an existing manufacturing firm expands this increases the number of jobs in the tradable sector, and therefore the number of jobs in the region, directly. These extra workers will spend part of their income on local goods and services, or non-tradable goods. The size this spending increase depends on their wages and their preferences. This spending will increase demand for some non-tradable goods in the region, depending on which specific non-traded goods are demanded and their respective technologies there will be an increase in labour demand in the non-tradable sector.

This increased demand for labour in the non-tradable sector will increase employment and wages in the non-tradable sector. If mobility and/or unemployment are high the effect on employment will be greater and the effect on wages will be smaller. On the other hand low mobility and/or a low unemployment rate will have a dampening effect on the employment multiplier, but will increase the effect on wages. The increased wages in the non-tradable effect will also have an effect on people living in the region that are currently not participating in the labour market. Higher wages will convince some of them to join the labour market. This will dampen the positive effect on the unemployment rate, but the participation rate will increase. It is very hard to pinpoint the relative size of these effects.

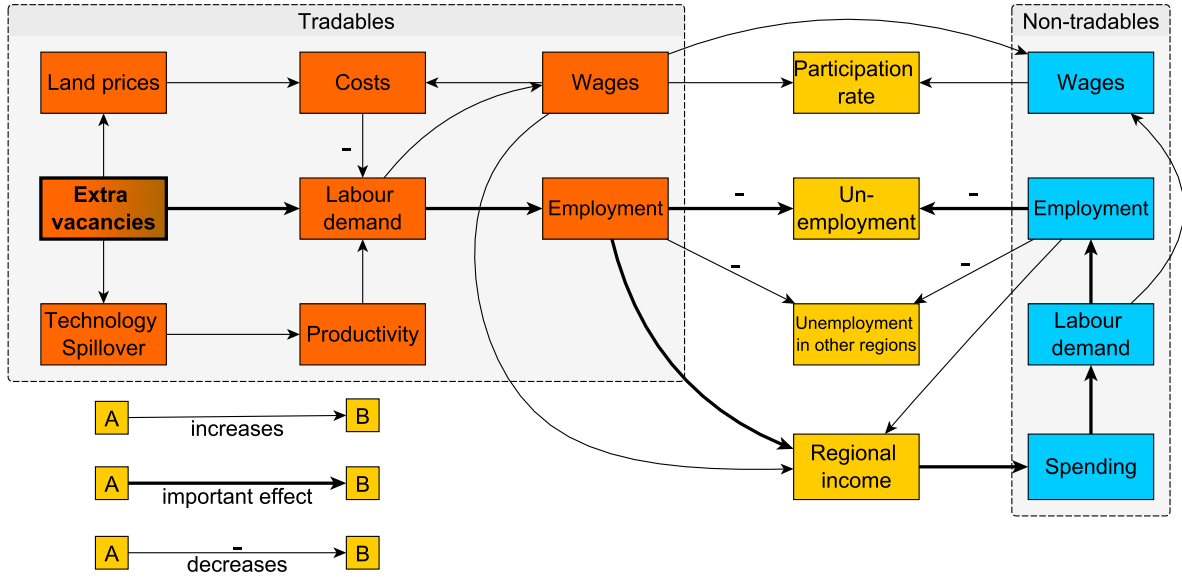
Finally the increased wages will make the region more attractive to workers from neighbouring regions. So part of the new jobs might be fulfilled by workers from other regions, once again dampening the effect on unemployment in the region. This effect is especially relevant for policy makers as they might want to attract firms because the multiplier effect is beneficial for their constituent and maybe don't want part (or all) of the benefits to be reaped by inhabitants of other regions.

Studies have shown a significant positive multiplier of extra jobs in the tradable sector on jobs in the non-tradable sector in the same region [Moretti, 2010, Moretti and Thulin, 2013] and I predict the magnitude of the multiplier depends on the wages in the tradable sector, consumer preferences, the unemployment rate, the technologies and labour mobility within the non-tradable sector, and labour mobility between regions.

The increase in labour demand in some tradable sub-sector also has an effect on the rest of the tradable sector. Demand for labour (and land) increases, which will increase factor prices. I assume prices for the tradable sector are set on the world market, so when the region is small a firm will not be able to adjust prices. When wages and other factor prices go up less efficient firms might close down and move to a cheaper region or hire fewer workers. Therefore the increase in jobs in a tradable sub-sector has a negative effect on the rest of the tradable sector.

When a new firm locates in a region there could also be agglomeration effects such as a positive spillover [Greenstone et al., 2008] to the incumbent firms in the region. Improved technologies can create efficiency benefits and therefore increase labour demand and wages. Depending on which effect is greater, the crowding out effect or the spillover effect, the multi-

Figure 2: Schematic for the multiplier of manufacturing on services



plier of extra jobs in one tradable sub-sector on other jobs in the tradable sector could go either way, but it is expected to be smaller than the multiplier on the non-tradable sector.

When the spillover effect improves technology and therefore wages in the tradable sector this can also directly affect the wages in the non-tradable sector. This far I have assumed little to no mobility between the tradable and the non-tradable sector, but when I assume there is a significant degree of mobility wages in the non-tradable sector will have to increase with the wages in the tradable sector, to keep the non-tradable sector competitive, the Balassa-Samuelson effect[Balassa, 1964, Samuelson, 1964]. The basic mechanisms are drawn out in figure 2.

4 Data Description

For this paper I have used three datasets. The first is Eurostat data on employment for different sectors on the national level, in TL2 regions and in TL3 regions. The second is an OECD dataset on employment in Sweden for TL3 regions and the last is a dataset from the U.S. Bureau of Labour Statistics with employment information for counties, states and the national level. For each dataset I have created a subset using just a selection off all available years, preventing short-term shocks to influence my analysis. I have cleaned all datasets myself to make them suitable for analysis, I describe this process in the Statistical Methods section. First I will discuss the datasets and subsets created after the cleaning.

4.1 Europe

I used the number of employed per TL2 region and country in 16 tradable and 6 non-tradable sub-sectors (see table 1 on the next page) from the Eurostat regional employment database.

For the estimation of the multiplier in TL2 region I used two subsets, the first consists of three intervals of three years from 1997 to 2006 based on a rolling average for each year. In this case I considered any TL2 region that employed more than 5% of all employees in the tradable sector in Europe as large, but none of these region were included in the final dataset because of a lack of data. There are 267 observations with sufficient data spread over 154 regions in 16 countries. More details can be found in table 12 on page 22. The second subset consists of all years from 1997 to 2006 without the use of a rolling average, this allows for short term effects. There are 912 observations with sufficient data spread over 182 regions in 18 countries. More details can be found in table 13 on page 23.

Table 1: Eurostat employment sub-sectors for TL2 regions and countries

Tradables	Non-tradables
mining and quarrying	electricity, gas and water supply
food products, beverages and tobacco	construction
publishing, printing and reproduction of..	wholesale and retail trade; repair of mo...
man. of textiles	hotels and restaurants
man. of wood and of products of wood and...	transport, storage and communications
man. of paper and paper products	real estate, renting and business activi...
man. of chemicals and chemical products	
man. of rubber and plastics products	
man. of other non-metallic mineral products	
man. of basic metals	
man. of fabricated metal products, excep...	
man. of machinery and equipment n.e.c...	
man. of electrical and optical equipment	
man. of motor vehicles, trailers and sem...	
man. of other transport equipment	
man. of furniture, manufacturing nec; re...	

For TL3 regions only the number of employed in agriculture, industry and services are available, therefore I used the TL2 data to create my instrument. For the estimation of the multiplier in TL3 regions I used four subsets, the sets differed by smoothing short-term shocks and/or removing large regions. I considered any TL3 region that employed more than 10% of all employees in the tradable sector in a country as large. I will discuss the sets with and without smoothing and denote the number of large regions in parentheses. The first set consists of two intervals of four years from 1997 to 2005 based on a rolling average for each year. There are 521 (50) observations, with sufficient data, spread over 440 (34) regions in 12 (1) countries. More details can be found in table 14 on page 24. The second subset consists of all years from 1997 to 2005, there are 2775 (248) observations with sufficient data spread over 596 (62) regions in 15 (1) countries. More details can be found in table 15 on page 25.

The OECD dataset on Sweden contained data on 27 tradable sub-sectors and 33 non-tradable sub-sectors (see table 2 on the following page). There are 21 TL3 regions in Sweden with data

from 1991 to 2006, the regions Stockholms Län, Skåne Län and Västra Götalands Län are considered large as they each employ more than 10% off all workers in the tradable sector in Sweden. In the subset to smooth out short-term effects I used a rolling average and only considered three year intervals.

Table 2: Employment sub-sectors for Swedish TL3 regions

Tradables	Non-tradables
Agriculture, hunting and forestry	Construction
Forestry, logging and related service ac...	Sale of motor vehicles
Fishing, operation of fish hatcheries an...	Maintenance and repair of motor vehicles
Mining and quarrying	Sale of motor vehicle, motorcycles and r...
Man. of food products and beverages	Wholesale trade and commission trade, ex...
Man. of tobacco products	Retail trade, except of motor vehicles a...
Man. of textiles, leather and leather pr...	Hotels and restaurants
Man. of veneer sheets; Man. of plywood...	Transport via railways
Saw-milling and planing of wood, impregna...	Other land transport, transport via pipe
Man. of pulp, paper and paper products...	Water transport
Man. of pulp	Air transport
Publishing, printing and reproduction of...	Supporting and auxiliary transport activ...
Man. of coke, refined petroleum products...	Post and courier activities
Man. of chemicals and chemical products...	Telecommunications
Man. of pharmaceuticals, medicinal chemi...	Financial intermediation, except insuran...
Man. of rubber and plastic products	Insurance and pension funding, except co...
Man. of other non-metallic mineral products	Real estate activities
Man. of basic metals	Renting of machinery and equipment witho...
Man. of fabricated metal products, excep...	Computer and related activities
Man. of machinery and equipment n.e.c...	Research and development
Man. of office machinery and computers	Other business activities
Man. of electrical machinery and apparat...	Defence activities
Man. of medical, precision and optical i...	Public administration and defence; compu...
Man. of motor vehicles, trailers, semi-t...	Education
Manufacturing n.e.c. + recycling	Human health activities and Veterinary a...
Electricity, gas, steam and hot water su...	Care in special forms of accommodation f...
Collection, purification and distributio...	Care in special forms of accommodation f...
	Social work activities without accommoda...
	Sewage and refuse disposal, sanitation a...
	Activities of membership organizations n...
	Recreational, cultural and sporting acti...
	Other service activities, Activities of...
	Extra-territorial organizations and bodi...

4.2 U.S.

The Bureau of Labour Statistics provided an extensive dataset on employment in counties, states and on the national level. I collected employment data for sectors based on the three-digit North

American Industry Classification System (NAICS). Since a lot of the data was incomplete I had to drop a lot of counties and some of the sub-sectors that had too few observations. The cleaned set I used describes employment in 14 tradable sub-sectors and 50 non-tradable sub-sectors. Within this cleaned set I used the same four sub-sectors as with the TL3 regions. I considered any county that employed more than 10% of all employees in the tradable sector in a state as large. I will once again discuss the sets with and without smoothing and denote the number of large regions in parentheses. The smoothed sets consist of five intervals of four years from 1991 to 2011 based on a rolling average for each year. There are 1013 (191) observations with sufficient data spread over 269 (36) regions in 40 (8) states. More details can be found in table 16 on page 26. The set allowing for shocks consists of all years from 1991 to 2011. There are 4393 (781) observations with sufficient data spread over 344 (35) regions in 41 (8) states. More details can be found in table 17 - 19 on page 27.

Table 3: Employment in the Tradable and Non-tradable sector

	% Tradables		% Non-tradables		Total Employment	
	2000	2005	2000	2005	2000	2005
AUT	28.1	26.5	71.9	73.5	2168430	2365790
BEL	25.7	25.7	74.3	74.3	2378554	2407324
CZE		39.7		60.3		3501596
DEU	38.1	32.1	61.9	67.9	16736723	18448130
ESP	24.2	19.7	75.8	80.3	10905487	13386822
FIN	36.4	38.0	63.6	62.0	1163138	1068558
FRA	28.7	25.7	71.3	74.3	13456414	14373989
GBR	24.8	17.5	75.2	82.5	21263032	18253272
GRC	11.6	16.1	88.4	83.9	1927914	2490392
HUN		31.6		68.4		2506447
ITA	35.7	31.0	64.3	69.0	13625574	14962238
NLD	21.0	16.6	79.0	83.4	4403131	4679504
NOR		22.8		77.2		1289971
POL	30.9	34.7	69.1	65.3	6981318	7538520
PRT	34.6	25.5	65.4	74.5	2752929	3215140
SVK	44.6	43.2	55.4	56.8	877421	903017
SWE	31.7	30.5	68.3	69.5	2591418	2639577
USA	14.7	12.2	85.3	87.8	129539528	131305488

Table 4: Description of all used data

Region	Unit	Tradables	Non-tradables	period	Δ (in years)	Rolling	Filtered	#clusters	#units	N
Europe	TL2	16	6	1997-2006	3	yes	yes	16	154	267
						no	16	154	267	
					1	no	yes	18	182	912
						no	18	182	912	
	TL3	2	1	1997-2005	4	yes	yes	11	406	471
						no	12	440	521	
					1	no	yes	14	534	2527
						no	15	596	2775	
Sweden	TL3	27	33	1991-2006	3	yes	yes	18	18	90
						no	21	21	105	
					1	no	yes	18	18	270
						no	21	21	315	
U.S.	County	14	50	1991-2011	4	yes	yes	32	233	822
						no	40	269	1013	
					1	no	yes	33	309	3612
						no	41	344	4393	

5 Statistical Methods

The goal of my research is to identify the effect of an exogenous increase in jobs in tradable industries in a region. In general I have data on the number of people employed in different sectors in different regions. For example in Europe I have data on employment in 25 different sectors for 243 TL2 regions in 22 countries. I also have the distribution of employment over these 25 sectors on a national level. To start I divide these sectors into two categories, sectors in tradable industries and sectors in non-tradable industries, where manufacturing is categorised as tradable and services as non-tradable. This could be further refined by considering tradable services, but I have chosen to keep it simple for now. For this dataset I have observations spanning from 1995 till 2007. I had to strike a balance between filtering out short term effect and keeping enough data point to do my analysis, so I chose to consider 1997, 2000, 2003 and 2006, leaving a three year gap between each set of observations. To filter out fluctuations that are specific to a year, I used a three year rolling average, for example by replacing the data for 2000 with the average over 1999, 2000 and 2001. In my results I present the outcome for this smoothed dataset that removed short-term shock effect as well as the results for the dataset when using data from every year and without averaging.

To prevent very large region from warping the results I marked all regions that had a tradable sector that employed more than 5% of all people in jobs in the tradable sector in Europe, I ran a regression with and without these regions. I calculated the growth for each sub-sector by looking at the difference in employment between two consecutive time periods. Since not all sectors are observed consistently over time I have to select entries with enough sectors observed. First I mark all entries for a specific region and period where the growth in employment is known in less than 50% of the tradable sub-sectors or less than 50% of the non-tradable sectors. Subsequently I remove all sub-sector that are observed in less than 50% of the unmarked entries, there is clearly not enough data on these sub-sectors. Now I aggregate the growth numbers for tradable and for non-tradables. I only included observations in my analysis that included at least 80% of the remaining tradable sub-sectors and at least 80% of the remaining non-tradable sub-sector.

In principle the resulting two variables could be used to estimate the multiplier between jobs in the tradable and non-tradable sector using the following relation

$$E_{c,t}^{NT} - E_{c,t-s}^{NT} = \beta'_0 + \beta'_1 (E_{c,t}^T - E_{c,t-s}^T) + \beta'_2 TDUM + \epsilon'_{c,t} - \epsilon'_{c,t-s}, \quad (1)$$

$$\epsilon'_{c,t} = \mu'_c + v'_{c,t}, \quad (2)$$

$$\Delta E_{c,t}^{NT} = \beta'_0 + \beta'_1 \Delta E_{c,t}^T + \beta'_2 TDUM + \Delta v'_{c,t}, \quad (3)$$

where $E_{c,t}^{NT}$ and $E_{c,t}^T$ denote employment in the non-tradable and tradable sector, respectively, in region c at time t . $TDUM$ is a time dummy included to control for shock to employment in the non-tradable sector in a specific year. The error term ϵ is the sum of unobservable region

specific properties μ and truly random errors v [Moretti and Thulin, 2013]. The multiplier of additional jobs in the tradable sector on jobs in the non-tradable sector is given by β_1 in this set-up. But an confounding factor, e.g. regional effect, that causes an increase in jobs in both sectors in a region would be captured in β_1 as well, when β_1 is estimated using OLS.

To prevent this endogeneity of the explanatory variables I use an instrumental variable analysis, with an instrument based on national data as described by Moretti. For each region I calculate the level of employment for all sub-sector in tradables for the rest of the country, simply by subtracting the level of employment in a region from the level of employment in the country for each sub-sector. Now I calculate the increase for each tradables sub-sector, but instead of just adding them all up I use a weighted sum based on the size of each sub-sector in the region considered. The resulting instrument is described as

$$\Delta \tilde{E}_{c,t}^T = \sum_j E_{c,j,t-s}^T (\ln(E_{j,t}^T - E_{c,j,t}^T) - \ln(E_{j,t-s}^T - E_{c,j,t-s}^T)). \quad (4)$$

This instrument can only be based on sub-sectors for which the level of employment is known in both periods for both the region and the nation the region is a part of. To provide a consistent analysis over different countries I require the instrument to contain data from at least 80% of all tradables sub-sectors. The instrument is justified by the difference in size between each region and the nation. Because TL3 regions are much smaller than a nation, changes on the national level can be considered exogenous for a specific region. This is less strict for TL2 regions, so I also do an regression without large regions. The procedure for the other dataset is slightly different, but the general method is consistent with everything I described in this section. Specific details for each dataset are given in section 4 on data description.

I applied instrumental variables by first estimating $\hat{\pi}'_1$ from

$$\Delta E_{c,t}^T = \pi'_0 + \pi'_1 \Delta \tilde{E}_{c,t}^T + \pi'_2 TDUM + \Delta \eta'_{c,t}, \quad (5)$$

and using the result to create the projection

$$\hat{\Delta E}_{c,t}^T = \hat{\pi}'_0 + \hat{\pi}'_1 \Delta \tilde{E}_{c,t}^T + \hat{\pi}'_2 TDUM. \quad (6)$$

Finally I estimate β_1 by plugging (6) into (3) to get

$$\Delta E_{c,t}^{NT} = \beta'_0 + \beta'_1 \hat{\Delta E}_{c,t}^T + \beta'_2 TDUM + \Delta v'_{c,t}, \quad (7)$$

To test the theory I will also estimate the effect of a part of the tradable sector on another part of the tradable sector by using

$$E_{c,t}^{T1} - E_{c,t-s}^{T1} = \beta'_0 + \beta'_1 (E_{c,t}^{T2} - E_{c,t-s}^{T2}) + \beta'_2 TDUM + \epsilon'_{c,t}, \quad (8)$$

$$\epsilon'_{c,t} = \mu'_c + v'_{c,t}, \quad (9)$$

where $E_{c,t}^{T1}$ and $E_{c,t}^{T2}$ reflect employment in two randomly selected parts of the tradable sector. This should result into smaller, no or even a negative multiplier.

To further test the instrument I will run a placebo regression, creating the instrument for non-tradables and looking at the effect of non-tradables on tradables, if the instrument is properly working there should be no significant effect.

$$E_{c,t}^T - E_{c,t-s}^T = \beta_0' + \beta_1' (E_{c,t}^{NT} - E_{c,t-s}^{NT}) + \beta_2' TDUM + \epsilon_{c,t}', \quad (10)$$

$$\epsilon_{c,t}' = \mu_c' + v_{c,t}'. \quad (11)$$

6 Results

I have estimated the local multiplier of additional jobs in the tradable sector on the non-tradables (β_1) for TL2 regions in Europe, TL3 regions in Europe, TL3 in Sweden and counties in the U.S. As shown in table 5 I have found a significant multiplier for each dataset using the instrument I defined in the 5 section. This multiplier is clearly influenced by removing large regions from the dataset or by smoothing the dataset to prevent short-term effect, but there was significant result in almost all cases. In most cases I could not reject under-determination, but this does not need to pose a problem. When all large regions are removed and the dataset is smoothed I find the instrument to be very strong, helping to find a reliable estimation. When these precautions are removed this weakens the instrument, therefore I prefer to consider the multipliers shown in the first column.

Significant results for a multiplier of tradables on non-tradables is not enough. As described in the literature section the multiplier of tradables on other tradables should be smaller or even negative according the theory. This is also found in the data shown in table 6, but the division of tradables into two sector weakened the instrument, thus giving a less reliable result. This analysis is not possible for TL3 regions in Europe, because of the lack of sub-sector data.

Finally we can check the instrument by doing a placebo regression. There should be no causal effect of an exogenous increase in jobs in the non-tradable sector on jobs in the tradable sector. Therefore I constructed an instrument for non-tradables in the same fashion as I did for tradables and did the same analysis. Due to endogeneity I expect to find a small multiplier when using ordinary least squares, but this should disappear when applying the instrument. Table 6 shows the multiplier is indeed not significant in most cases. For TL3 regions in Europe I do find a significant positive multiplier of 0.09, but it is a lot smaller than the multiplier of 0.27 found with OLS. So all in all the instrument seems to do its job pretty well.

Now that I have confirmed the validity of the instrument I will continue to interpret the results. The multiplier for TL3 regions in Sweden of 0.71 is larger than the multiplier found for smaller clusters of municipalities in Sweden of 0.49[Moretti and Thulin, 2013]. The multiplier for U.S. counties of 1.91 is also larger than the multiplier for cities in the U.S. of 1.59[Moretti,

Table 5: The local multiplier of additional jobs in the tradable sector on jobs in the non-tradable sector found by regression using instrumental values.

	Smoothed data		Short-term data	
	no large regions	all regions	no large regions	all regions
Europe TL2	1.115*** ^{††} (0.173)	1.115*** ^{††} (0.173)	2.491*** (0.692)	2.491*** (0.692)
N	267	267	912	912
Europe TL3	1.103*** ^{††} (0.118)	1.448*** (0.0737)	0.814*** (0.231)	1.245*** (0.367)
N	471	521	2,527	2,775
Sweden TL3	0.711*** ^{††} (0.241)	2.043*** ^{††} (0.771)	0.614*** ^{††} (0.253)	1.876*** ^{††} (0.529)
N	90	105	270	315
U.S. Counties	1.911** ^{††} (0.875)	2.422* ^{††} (1.271)	2.129*** ^{††} (0.557)	2.562*** ^{††} (0.550)
N	822	1,013	3,612	4,393

Two-way standard errors clustered by year and country or state in parentheses

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

^{††} F>16.38, [†] F>6.66, Kleibergen-Paap (2006) Wald rk statistic

Table 6: The local multiplier for smoothed dataset without large regions found by regression using instrumental values.

	EU TL2	EU TL3	Sweden TL3	U.S. Counties
Tradables on Non-tradables	1.115*** ^{††} (0.173)	1.103*** ^{††} (0.118)	0.711*** ^{††} (0.241)	1.911** ^{††} (0.875)
Tradables on other Tradables	0.880*** [†] (0.0735)		0.548*** (0.0706) ²	0.505*** [†] (0.0808)
Non-tradables on tradables	0.215 (0.161)	0.0915*** ^{††} (0.00473)	0.474 (0.289)	-0.0188 ^{††} (0.0124)
Observations	221-275	466-471	72-90	818-1,011

Robust standard errors in parentheses

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

Kleibergen-Paap (2006) Wald rk statistic: ^{††} F>16.38, [†] F>6.66

2010]. These results suggest that the local multiplier increases with scale. Comparing the U.S. results to Europe suggest that the multiplier is larger in the U.S. Finally the results for TL3 regions in Europe lie a lot closer to TL2 regions in Europe than to TL3 regions in just Sweden, this could be the effect of using the TL2 instruments for the TL3 data. Sub-sector data for TL3 region could prove very useful to generate further insight.

With further analysis I would like to investigate the effect of population density, level of technology, level of education of workers, unemployment. I expect a higher multiplier in densely populated regions and regions with high unemployment. In the U.S. and Sweden high technology jobs and high human capital jobs yield the greater multipliers [Moretti, 2010, Moretti and Thulin, 2013]. Currently differentiation to account for these effects would lead to weak instruments in the European dataset, but with a more extensive dataset this would be very interesting. It might already be possible to do this with the U.S. data, but information on for example unemployment and wages is currently unavailable due to the government shut-down.

The increase of jobs in the tradable sector could also increase wages as labour demand increases, this could be worth investigating as well. By using country data instrumental for TL2 and TL3 regions I have ignored the effects of neighbouring regions in other countries, whilst these might be very significant. It would be useful to expand on this thought and directly consider the effect of neighbouring regions on the multiplier on tradable jobs as has been done for i.e. unemployment [Garcilazo and Spiezia, 2007].

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Appendix

Table 7: Local multipliers for TL2 regions in Europe

	Ignore shocks		Allow shocks	
	OLS	IV	OLS	IV
Tradables on Non-tradables	0.876*** (0.104)	1.115*** (0.173)	1.365** (0.666)	2.491*** (0.692)
Tradables on other Tradables	1.792*** (0.108)	0.880*** (0.0735)	1.755*** (0.134)	0.849 (1.892)
Non-tradables on tradables	0.158* (0.0895)	0.215 (0.161)	0.174*** (0.0600)	0.196** (0.0899)
Observations	267/221/275	267/221/275	913 /747/957	912/747/957
Under identification	.	0.268/0.199/0.160	.	0.330/0.713/0.206
Instrument F-statistic	.	671.1/7.263/.	.	3.083 /0.109/12.37

Two-way standard errors clustered by year and country in parentheses

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

Table 8: Local multipliers for TL3 regions in Europe

	Ignore shocks				Allow shocks			
	filter large		no filter		filter large		no filter	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Tradables on Non-tradables	0.621*** (0.0798)	1.103*** (0.118)	0.994*** (0.218)	1.448*** (0.0737)	0.395*** (0.0480) ³	0.814*** (0.231)	0.645*** (0.204)	1.245*** (0.367)
Non-tradables on Tradables	0.268*** (0.00351)	0.0915*** (0.00473)	0.174*** (0.0142)	0.161*** (0.0143)	0.234*** (0.0622)	0.527 (0.347)	0.190*** (0.0424)	0.359** (0.167)
Observations	471 /466	471/466	526/533	521/533	2,527/2,671	2,527/2,671	2,780/2,963	2,775/2,963
Under identification	.	0.234/0.318	.	0.193/0.313	.	0.149/0.104	.	0.145/0.131
Instrument F-statistic	.	59.00/7022	.	4.692/985.9	.	4.704/14.22	.	3.400/7.077

Two-way standard errors clustered by year and country in parentheses

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

Table 9: Local multipliers for TL3 regions in Sweden

	Ignore shocks				Allow shocks			
	filter large		no filter		filter large		no filter	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Tradables on	0.228	0.711***	1.404	2.043***	0.120	0.614**	1.448***	1.876***
Non-tradables	(0.357)	(0.241)	(1.033)	(0.771)	(0.179)	(0.253)	(0.553)	(0.529)
Tradables on	0.479***	0.548***	0.442***	0.485***	0.474***	0.456***	0.444***	0.486***
other Tradables	(0.0975)	(0.0706) ⁴	(0.0481)	(0.0369)	(0.107)	(0.0591)	(0.0526)	(0.0328)
Non-tradables	0.0769	0.474	0.0585	0.176	0.0544	0.435**	0.114*	0.201**
on Tradables	(0.112)	(0.289)	(0.0698)	(0.107)	(0.0781)	(0.182)	(0.0642)	(0.0889)
Observations	90 /90/90	90 /90/72	105/105/105	105/105/84	270/270/270	270/270/198	315/315/315	315/315/227
Under-indentif.	.	0.201/0.369/0.370	.	0.267/0.272/0.279	.	0.127/0.359/0.183	.	0.165/0.268/0.197
Instrument F-st.	.	119.8/1.816/1.431	.	276.9/7.531/8.342	.	52.22/1.370/1.701	.	2514/4.028/8.125

Two-way standard errors clustered by year and tl3 region in parentheses

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

Table 10: Local multipliers for counties in the U.S.

U.S. Counties	Ignore shocks			
	filter large		no filter	
	OLS	IV	OLS	IV
Tradables on Non-tradables	1.101** (0.448)	1.911** (0.875)	1.251** (0.531)	2.422* (1.271)
Tradables on other Tradables	0.580*** (0.0652)	0.505*** (0.0808)	0.667*** (0.0397)	0.481** (0.196)
Non-tradables on Tradables	0.0439*** (0.0169)	-0.0188 (0.0124)	0.0541*** (0.0121)	-0.0300 (0.0500)
Observations	822/1,011/823	822/1,011/818	1,031/1,235/1,042	1,013/1,221/1,009
Under identification	.	0.0969/0.110/0.109	.	0.131/0.289/0.120
Instrument F-statistic	.	50.76/11.89/83.64	.	32.67/2.101/37.12

Two-way standard errors clustered by year and state in parentheses

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

Table 11: Local multipliers for counties in the U.S.

U.S. Counties	Allow shocks			
	filter large		no filter	
	OLS	IV	OLS	IV
Tradables on Non-tradables	1.003** (0.429)	2.129*** (0.557)	1.381*** (0.461)	2.562*** (0.550)
Tradables on other Tradables	0.587*** (0.0760)	0.508*** (0.0937)	0.664*** (0.0454)	0.485*** (0.151)
Non-tradables on Tradables	0.0323** (0.0132)	0.0325 (0.0220)	0.0549*** (0.0149)	0.0408 (0.0373)
Observations	3,614/4,422/3,619	3,612/4,420/3,599	4,476/5,325/4,509	4,393/5,252/4,377
Under identification	.	0.0723/0.0384/0.0665	.	0.0499/0.169/0.0400
Instrument F-statistic	.	86.97/13.72/40.77	.	230.6/4.731/59.67
Two-way standard errors clustered by year and state in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Table 12: TL2 regions observed per country and time period within Europe

	Δ '97-'00	Δ '00-'03	Δ '03-'06	Total
AUT	1	1	5	7
BEL	0	3	3	6
DEU	0	10	11	21
ESP	0	14	13	27
FIN	1	0	3	4
FRA	0	20	22	42
GBR	0	12	12	24
GRC	0	1	4	5
HUN	0	0	7	7
ITA	19	17	21	57
NLD	0	4	4	8
NOR	0	0	7	7
POL	0	6	16	22
PRT	1	1	2	4
SVK	2	4	4	10
TUR	0	0	16	16
Total	24	93	150	267

Table 13: TL2 regions observed per country and time period within Europe

	Δ '97-'98	Δ '98-'99	Δ '99-'00	Δ '00-'01	Δ '01-'02	Δ '02-'03	Δ '03-'04	Δ '04-'05	Δ '05-'06	Total
AUT	2	2	1	2	3	5	4	7	8	34
BEL	0	0	3	2	0	0	3	3	3	14
CZE	0	0	0	0	0	0	0	8	8	16
DEU	0	0	0	0	3	10	10	11	13	47
ESP	0	0	10	14	14	16	15	14	16	99
FIN	1	1	1	0	0	2	2	2	3	12
FRA	0	19	17	20	22	22	22	22	22	166
GBR	0	12	12	0	0	12	12	12	12	72
GRC	0	0	0	1	3	4	4	4	4	20
HUN	0	0	0	0	7	7	7	7	7	35
ITA	18	19	19	17	19	21	21	21	20	175
NLD	0	0	3	4	4	4	4	4	4	27
NOR	0	0	0	0	0	0	7	7	7	21
POL	0	0	1	0	0	5	16	16	16	54
PRT	1	1	1	1	1	5	3	2	0	15
SVK	2	1	2	4	3	3	2	2	4	23
SWE	0	8	8	8	8	0	0	8	7	47
TUR	0	0	0	0	0	16	19	0	0	35
Total	24	63	78	73	87	132	151	150	154	912

Table 14: TL3 regions observed per country and time period within Europe. The number of regions that is considered large is denoted in parentheses.

	Δ '97-'01	Δ '01-'05	Total
AUT	10 (1)	16 (1)	26 (2)
BEL	0 (0)	6 (2)	6 (2)
DEU	0 (0)	78 (0)	78 (0)
ESP	45 (2)	40 (2)	85 (4)
FRA	0 (0)	96 (0)	96 (0)
GRC	0 (0)	8 (6)	8 (6)
HUN	0 (0)	20 (6)	20 (6)
ITA	0 (0)	103 (1)	103 (1)
POL	0 (0)	28 (0)	28 (0)
PRT	8 (5)	8 (5)	16 (10)
SVK	5 (5)	8 (8)	13 (13)
SWE	21 (3)	21 (3)	42 (6)
Total	89 (16)	432 (34)	521 (50)

Table 15: TL3 regions observed per country and time period within Europe. The number of regions that is considered large is denoted in parentheses.

	Δ '97-'98	Δ '98-'99	Δ '99-'00	Δ '00-'01	Δ '01-'02	Δ '02-'03	Δ '03-'04	Δ '04-'05	Total
AUT	12 (1)	12 (1)	5 (1)	8 (1)	14 (1)	23 (1)	17 (1)	31 (1)	122 (8)
BEL	0 (0)	0 (0)	11 (7)	6 (2)	0 (0)	0 (0)	11 (7)	11 (7)	39 (23)
CZE	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	14 (7)	14 (7)
DEU	0 (0)	79 (0)	83 (0)	78 (0)	60 (0)	65 (0)	82 (0)	87 (0)	534 (0)
ESP	46 (2)	37 (1)	36 (2)	48 (2)	48 (2)	56 (3)	55 (3)	47 (3)	373 (18)
FIN	4 (0)	4 (0)	4 (0)	0 (0)	0 (0)	12 (4)	12 (4)	12 (3)	48 (11)
FRA	0 (0)	84 (0)	71 (0)	86 (0)	96 (0)	96 (0)	96 (0)	96 (0)	625 (0)
GRC	0 (0)	0 (0)	0 (0)	1 (1)	8 (6)	13 (10)	13 (10)	13 (10)	48 (37)
HUN	0 (0)	0 (0)	0 (0)	0 (0)	20 (6)	20 (3)	20 (4)	20 (5)	80 (18)
ITA	0 (0)	0 (0)	0 (0)	0 (0)	105 (1)	107 (1)	107 (1)	107 (1)	426 (4)
NOR	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	16 (8)	19 (7)	19 (7)	54 (22)
POL	0 (0)	0 (0)	8 (0)	0 (0)	0 (0)	21 (0)	66 (0)	66 (0)	161 (0)
PRT	0 (0)	0 (0)	8 (5)	8 (5)	8 (5)	28 (9)	22 (11)	10 (6)	84 (41)
SVK	5 (5)	2 (2)	4 (4)	8 (8)	7 (7)	7 (7)	4 (4)	4 (4)	41 (41)
SWE	21 (3)	21 (3)	21 (3)	21 (3)	21 (3)	0 (0)	0 (0)	21 (3)	126 (18)
Total	88 (11)	239 (7)	251 (22)	264 (22)	387 (31)	464 (46)	524 (52)	558 (57)	2775 (248)

Table 16: Counties observed per state and time-period within the U.S. The number of regions that is considered large is denoted in parentheses.

	Δ '91-'95	Δ '95-'99	Δ '99-'03	Δ '03-'07	Δ '07-'11	total
12	15 (1)	15 (1)	15 (0)	18 (0)	19 (0)	82 (2)
13	3 (0)	4 (0)	4 (0)	4 (0)	4 (0)	19 (0)
16	1 (1)	2 (1)	2 (2)	3 (2)	3 (2)	11 (8)
17	7 (1)	7 (1)	7 (1)	11 (1)	11 (1)	43 (5)
18	5 (1)	5 (1)	5 (1)	8 (2)	7 (1)	30 (6)
19	2 (0)	2 (0)	2 (0)	3 (0)	2 (0)	11 (0)
20	2 (1)	2 (1)	2 (1)	2 (1)	2 (2)	10 (6)
21	2 (1)	2 (1)	2 (1)	3 (1)	1 (1)	10 (5)
22	2 (0)	3 (0)	3 (0)	4 (0)	5 (0)	17 (0)
23	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	10 (10)
24	1 (1)	2 (1)	3 (1)	5 (2)	6 (1)	17 (6)
25	8 (3)	8 (3)	8 (3)	7 (3)	7 (3)	38 (15)
26	6 (3)	6 (3)	6 (3)	11 (3)	9 (2)	38 (14)
27	5 (1)	5 (1)	5 (1)	6 (1)	7 (1)	28 (5)
28	0 (0)	0 (0)	1 (0)	1 (0)	0 (0)	2 (0)
29	5 (1)	5 (1)	4 (1)	4 (1)	5 (1)	23 (5)
30	1 (0)	1 (0)	1 (0)	0 (0)	0 (0)	3 (0)
31	1 (1)	2 (2)	2 (2)	2 (2)	2 (2)	9 (9)
32	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	10 (10)
33	3 (2)	3 (2)	3 (2)	3 (2)	2 (2)	14 (10)
34	10 (1)	10 (2)	10 (2)	11 (2)	9 (1)	50 (8)
35	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	5 (5)
36	8 (0)	10 (0)	9 (0)	12 (0)	10 (1)	49 (1)
37	6 (0)	8 (0)	8 (0)	11 (0)	9 (0)	42 (0)
38	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)
39	14 (0)	14 (0)	14 (0)	16 (0)	16 (0)	74 (0)
40	3 (2)	3 (2)	3 (2)	3 (2)	4 (2)	16 (10)
41	6 (2)	6 (2)	6 (2)	8 (2)	10 (2)	36 (10)
42	13 (0)	12 (0)	13 (0)	17 (0)	16 (0)	71 (0)
44	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)	3 (3)
45	4 (0)	4 (0)	4 (1)	5 (1)	5 (1)	22 (3)
46	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	2 (2)
47	4 (0)	4 (0)	4 (0)	4 (0)	5 (0)	21 (0)
48	12 (2)	15 (2)	16 (2)	15 (2)	19 (1)	77 (9)
49	3 (1)	3 (2)	4 (2)	6 (2)	5 (2)	21 (9)
50	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	2 (2)
51	2 (0)	2 (0)	2 (0)	3 (0)	4 (0)	13 (0)
53	7 (2)	8 (2)	8 (2)	8 (2)	8 (2)	39 (10)
55	6 (1)	7 (1)	7 (0)	8 (0)	11 (0)	39 (2)
72	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	5 (0)
Total	174 (35)	187 (38)	190 (38)	230 (41)	232 (39)	1013 (191)

Table 17: Counties observed per state and time-period within the U.S. The number of regions that is considered large is denoted in parentheses. [part 1]

	Δ '91-'92	Δ '92-'93	Δ '93-'94	Δ '94-'95	Δ '95-'96	Δ '96-'97	Total
10	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (5)
12	15 (1)	15 (1)	15 (1)	15 (1)	15 (1)	15 (1)	356 (9)
13	3 (0)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	94 (0)
16	2 (2)	2 (2)	2 (1)	2 (1)	2 (1)	3 (2)	56 (37)
17	7 (1)	7 (1)	7 (1)	7 (1)	7 (1)	7 (1)	178 (20)
18	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	135 (24)
19	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	42 (0)
20	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	45 (22)
21	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	41 (20)
22	2 (0)	2 (0)	3 (0)	3 (0)	3 (0)	3 (0)	71 (0)
23	2 (1)	2 (1)	2 (1)	2 (2)	2 (2)	2 (2)	45 (37)
24	1 (1)	1 (1)	1 (1)	1 (1)	2 (1)	3 (1)	79 (29)
25	8 (3)	8 (3)	8 (3)	8 (3)	8 (3)	8 (3)	161 (60)
26	6 (1)	6 (1)	6 (3)	6 (2)	6 (3)	6 (3)	173 (52)
27	5 (2)	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	110 (21)
28	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (0)
29	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	5 (1)	93 (20)
30	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	19 (0)
31	1 (1)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	39 (39)
32	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	38 (38)
33	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	59 (40)
34	10 (1)	10 (1)	10 (1)	10 (1)	10 (1)	10 (2)	222 (34)
35	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	20 (20)
36	8 (0)	8 (0)	9 (0)	10 (0)	10 (0)	10 (0)	220 (2)
37	6 (0)	6 (0)	6 (0)	6 (0)	8 (0)	8 (0)	187 (0)
38	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (8)
39	14 (0)	14 (0)	13 (0)	13 (0)	14 (0)	14 (0)	301 (0)
40	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	69 (40)
41	6 (2)	6 (2)	6 (2)	6 (2)	6 (2)	6 (2)	145 (40)
42	14 (0)	13 (0)	13 (0)	13 (0)	13 (0)	14 (0)	311 (0)
44	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	12 (12)
45	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	96 (10)
46	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	10 (10)
47	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	4 (0)	89 (0)
48	12 (2)	14 (2)	14 (2)	14 (2)	15 (2)	15 (2)	350 (37)
49	3 (1)	3 (1)	3 (1)	3 (1)	3 (2)	4 (2)	85 (36)
50	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	10 (10)
51	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	1 (0)	57 (0)
53	7 (2)	7 (1)	7 (2)	8 (2)	8 (2)	8 (2)	162 (39)
55	5 (1)	6 (1)	7 (1)	7 (1)	7 (1)	7 (1)	170 (10)
72	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	19 (0)
Total	176 (34)	179 (33)	181 (35)	183 (35)	188 (37)	191 (39)	4393 (781)

Table 18: Counties observed per state and time-period within the U.S. The number of regions that is considered large is denoted in parentheses. [part 2]

	Δ '97-'98	Δ '98-'99	Δ '99-'00	Δ '00-'01	Δ '01-'02	Δ '02-'03	Δ '03-'04	Total
10	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)	1 (1)	1 (1)	5 (5)
12	15 (1)	15 (1)	15 (0)	16 (1)	19 (0)	19 (0)	20 (0)	356 (9)
13	4 (0)	4 (0)	4 (0)	4 (0)	6 (0)	7 (0)	5 (0)	94 (0)
16	3 (2)	3 (2)	3 (2)	2 (2)	3 (2)	3 (2)	3 (2)	56 (37)
17	7 (1)	7 (1)	7 (1)	7 (1)	9 (1)	11 (1)	11 (1)	178 (20)
18	6 (1)	6 (1)	6 (1)	7 (1)	10 (1)	9 (1)	8 (2)	135 (24)
19	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	2 (0)	3 (0)	42 (0)
20	2 (1)	2 (1)	2 (1)	2 (1)	3 (1)	3 (1)	2 (1)	45 (22)
21	2 (1)	2 (1)	2 (1)	2 (1)	3 (1)	2 (1)	2 (1)	41 (20)
22	3 (0)	3 (0)	3 (0)	3 (0)	4 (0)	5 (0)	4 (0)	71 (0)
23	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	45 (37)
24	3 (1)	3 (1)	3 (1)	3 (1)	6 (2)	5 (2)	5 (3)	79 (29)
25	8 (3)	8 (3)	8 (3)	8 (3)	8 (3)	8 (3)	8 (3)	161 (60)
26	6 (3)	6 (3)	6 (3)	6 (3)	11 (3)	11 (3)	11 (3)	173 (52)
27	5 (1)	5 (1)	5 (1)	4 (1)	6 (1)	6 (1)	6 (1)	110 (21)
28	1 (0)	1 (0)	1 (0)	0 (0)	0 (0)	1 (0)	1 (0)	11 (0)
29	5 (1)	5 (1)	5 (1)	4 (1)	4 (1)	4 (1)	4 (1)	93 (20)
30	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	19 (0)
31	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	39 (39)
32	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	1 (1)	38 (38)
33	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	59 (40)
34	10 (2)	10 (2)	11 (2)	10 (2)	12 (2)	13 (2)	15 (2)	222 (34)
35	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	20 (20)
36	10 (0)	10 (0)	10 (0)	9 (0)	15 (0)	13 (0)	14 (0)	220 (2)
37	8 (0)	8 (0)	8 (0)	8 (0)	13 (0)	11 (0)	11 (0)	187 (0)
38	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	8 (8)
39	14 (0)	14 (0)	14 (0)	14 (0)	14 (0)	17 (0)	17 (0)	301 (0)
40	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	4 (2)	2 (2)	69 (40)
41	6 (2)	6 (2)	6 (2)	6 (2)	8 (2)	8 (2)	8 (2)	145 (40)
42	14 (0)	15 (0)	15 (0)	15 (0)	17 (0)	17 (0)	16 (0)	311 (0)
44	1 (1)	1 (1)	1 (1)	1 (1)	0 (0)	0 (0)	1 (1)	12 (12)
45	4 (0)	4 (0)	4 (1)	3 (1)	5 (1)	7 (1)	5 (1)	96 (10)
46	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	1 (1)	10 (10)
47	4 (0)	4 (0)	4 (0)	4 (0)	5 (0)	5 (0)	4 (0)	89 (0)
48	16 (2)	16 (2)	16 (2)	16 (2)	21 (2)	20 (2)	20 (2)	350 (37)
49	4 (2)	4 (2)	4 (2)	3 (2)	5 (2)	6 (2)	5 (2)	85 (36)
50	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	1 (1)	10 (10)
51	1 (0)	2 (0)	2 (0)	2 (0)	4 (0)	3 (0)	3 (0)	57 (0)
53	8 (2)	8 (2)	7 (2)	7 (2)	9 (2)	9 (2)	9 (2)	162 (39)
55	7 (1)	7 (1)	8 (1)	8 (1)	11 (0)	11 (0)	10 (0)	170 (10)
72	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	0 (0)	19 (0)
Total	195 (40)	197 (40)	198 (40)	191 (40)	251 (41)	255 (41)	246 (43)	4393 (781)

Table 19: Counties observed per state and time-period within the U.S. The number of regions that is considered large is denoted in parentheses. [part 3]

	Δ '04-'05	Δ '05-'06	Δ '06-'07	Δ '07-'08	Δ '08-'09	Δ '09-'10	Δ '10-'11	Total
10	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (5)
12	20 (0)	20 (0)	20 (0)	20 (0)	21 (0)	23 (0)	23 (0)	356 (9)
13	6 (0)	5 (0)	5 (0)	6 (0)	5 (0)	6 (0)	4 (0)	94 (0)
16	3 (2)	4 (2)	4 (2)	3 (2)	3 (2)	3 (2)	3 (2)	56 (37)
17	10 (1)	12 (1)	12 (1)	12 (1)	11 (1)	10 (1)	10 (1)	178 (20)
18	9 (2)	8 (2)	8 (2)	8 (1)	7 (1)	6 (1)	7 (1)	135 (24)
19	2 (0)	2 (0)	3 (0)	2 (0)	2 (0)	2 (0)	2 (0)	42 (0)
20	2 (1)	3 (1)	3 (1)	2 (1)	2 (1)	3 (2)	2 (2)	45 (22)
21	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	2 (1)	41 (20)
22	4 (0)	4 (0)	5 (0)	5 (0)	4 (0)	3 (0)	5 (0)	71 (0)
23	2 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	2 (2)	45 (37)
24	7 (2)	6 (2)	5 (2)	6 (2)	6 (2)	6 (1)	6 (1)	79 (29)
25	8 (3)	8 (3)	8 (3)	8 (3)	9 (3)	8 (3)	8 (3)	161 (60)
26	12 (3)	13 (3)	12 (3)	10 (3)	11 (2)	10 (2)	12 (2)	173 (52)
27	6 (1)	6 (1)	5 (1)	9 (1)	5 (1)	6 (1)	6 (1)	110 (21)
28	1 (0)	1 (0)	1 (0)	0 (0)	1 (0)	1 (0)	0 (0)	11 (0)
29	4 (1)	4 (1)	4 (1)	5 (1)	5 (1)	5 (1)	5 (1)	93 (20)
30	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	0 (0)	19 (0)
31	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	2 (2)	39 (39)
32	2 (2)	2 (2)	1 (1)	2 (2)	2 (2)	2 (2)	2 (2)	38 (38)
33	3 (2)	3 (2)	3 (2)	2 (2)	3 (2)	3 (2)	3 (2)	59 (40)
34	14 (2)	14 (2)	13 (2)	10 (2)	11 (2)	9 (2)	10 (1)	222 (34)
35	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	20 (20)
36	14 (0)	14 (0)	12 (0)	9 (0)	11 (0)	12 (1)	12 (1)	220 (2)
37	12 (0)	12 (0)	12 (0)	14 (0)	12 (0)	10 (0)	8 (0)	187 (0)
38	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	8 (8)
39	18 (0)	17 (0)	17 (0)	16 (0)	15 (0)	15 (0)	17 (0)	301 (0)
40	2 (2)	5 (2)	5 (2)	5 (2)	5 (2)	4 (2)	4 (2)	69 (40)
41	8 (2)	9 (2)	10 (2)	9 (2)	8 (2)	8 (2)	9 (2)	145 (40)
42	18 (0)	18 (0)	17 (0)	18 (0)	17 (0)	16 (0)	18 (0)	311 (0)
44	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (12)
45	5 (1)	4 (0)	5 (0)	6 (1)	7 (1)	7 (1)	6 (1)	96 (10)
46	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	10 (10)
47	4 (0)	4 (0)	6 (0)	6 (0)	5 (0)	5 (0)	5 (0)	89 (0)
48	20 (2)	19 (2)	20 (2)	20 (2)	20 (1)	20 (1)	22 (1)	350 (37)
49	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	5 (2)	85 (36)
50	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	1 (1)	10 (10)
51	5 (0)	5 (0)	3 (0)	3 (0)	2 (0)	4 (0)	7 (0)	57 (0)
53	9 (2)	9 (2)	8 (2)	8 (2)	8 (2)	9 (2)	9 (2)	162 (39)
55	8 (0)	8 (0)	9 (0)	9 (0)	11 (0)	12 (0)	12 (0)	170 (10)
72	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	1 (0)	19 (0)
Total	254 (43)	257 (41)	254 (40)	251 (41)	247 (39)	246 (40)	253 (39)	4393 (781)