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## What we can and what we can't say about employment growth in specialised cities

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Employment Growth in Specialised Cities**

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Für den Inhalt der Passauer Diskussionspapiere ist der jeweilige Autor verantwortlich.  
Es wird gebeten, sich mit Anregungen und Kritik direkt an den Autor zu wenden.

# What We Can and What We Can't Say About Employment Growth in Specialised Cities

Oliver Farhauer  
Alexandra Kröll

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## Abstract:

There is an ongoing debate on whether certain sector structures enhance regional employment growth. Often, regional policies promote clusters and, hence, regional specialisation. It is commonly believed that clusters boost regional economic performance. However, in the present manuscript a simple model is introduced which suggests the reverse is true regarding employment growth. It is argued that specialised regions are prone to be affected stronger by sector-specific demand shocks than diversified ones and, therefore, show higher variances in employment growth rates. A test on the equality of variances in employment growth rates across two groups of specialised and diversified cities is conducted. It shows that, in Germany, variances are higher in the group of specialised cities. Thus, regional specialisation is more insecure than diversification with regard to stable employment growth rates.

JEL-Klassifikation: O18, R11, J21

## 1. Introduction

Over the past years, the relation between sector structure and labour market performance has become the subject of numerous empirical studies in regional economics (e.g., GLAESER et al., 1992; BLIEN et al., 2006; COMBES et al., 2004; DAUTH, 2010). It is common practice to interpret rising regional labour demand as a result of productivity advantages generated by agglomeration effects. Therefore, regional politics often focuses on promoting clusters, as they lead to productivity advantages expected to trigger higher employment growth.

However, caution should be applied when linking higher employment growth to a certain sector structure, since the connection between labour demand and changes in productivity is of an indirect nature only: Whether labour demand rises, falls or remains constant upon a rise in productivity levels crucially depends on the price elasticity of the respective sector's goods demand (SCHETTKAT, 1997, 725). Furthermore, labour demand is influenced by uncountable other factors like the thrust of exogenous economic shocks, economic growth (SCHMID, 2000) and the globalisation process (KATZ and AUTOR, 1999; CARD and DiNARDO, 2002, ACEMOGLU, 2002).

Summarizingly, most researchers inquiring into the relation between sector structure and employment growth find labour market performance is enhanced by a diversified sector structure as opposed to regional specialisation (e.g. GLAESER et al., 1992; BLIEN et al., 2006; FRENKEN et al., 2005; HAUG, 2004). These findings are supported by several theories. A central assumption of the New Growth Theory, for instance, is that besides knowledge spillovers among firms belonging to the same sector, cross-sectoral knowledge spillovers exist, too, and prove to be an important source for economic growth and, therefore, employment growth. JACOBS (1969) also emphasises the diffusion of knowledge between firms of different sectors and attributes positive growth and employment effects to these cross-sectoral spillovers.

Another approach stressing the positive effects of a diversified sector structure is the so-called Portfolio Theory (ATTARAN, 1986; HAUG, 2004). According to this theory, a portfolio strategy safeguards a region against sector-specific exogenous demand shocks. This mechanism works in two ways: On the one hand, the employment share of a single sector in total regional employment is lower in diversified regions. Thus, relatively fewer firms and employees are affected by a sector-specific demand shock. On the other hand, there are several different sectors in diversified regions which can, at least to a certain extent, offer alternatives for dismissed employees from another sector. Hence, a diversified sector structure

may be compared to an entrepreneurial investment strategy, where risk is spread over various investment activities.

A further strand of theory emphasising the advantageousness of diversified regional structures is an evolutionary approach dating back to PASINETTI (1981) and SAVIOTTI (1996) (FRENKEN et al., 2005). It relies on the assumption that regions which do not draw new sectors and therefore show increasing specialisation, are going to suffer from structural unemployment and stagnate in the course of time. The reasoning of the evolutionary approach closely follows Product Life Cycle Theory. It is only sectors in the early stages of their life cycles which generate growth impulses and create new jobs. However, these sectors age as time goes by, and the elasticity of demand for their goods becomes more inelastic. Due to productivity effects resulting from process innovations, employment in these sectors first stagnates and eventually declines (SCHETTKAT, 1997, 725). Consequently, structural unemployment rises in the respective regions if they do not manage to diversify their sector structure.

Now the question arises as to which conclusions can be drawn on employment growth in specialised cities. Recently, the specialisation of regions was supported particularly by policies targeted at promoting regional clusters. There is ample evidence on the positive influence of regional specialisation on productivity growth (e.g. CINGANO and SCHIVARDI, 2004; MUKKALA, 2004; CAPELLO, 2002). Anyway, studies stressing the advantageousness of specialisation on employment growth are rare. In most empirical analyses, specialisation is made out to impact labour market performance negatively (e.g. GLAESER et al., 1992). If a negative sector-specific shock hits a region specialised in this very sector, the shock will have greater impact as it affects a larger share of firms and employees in the region. In specialised cities, risk management can be carried out to a very limited extent only.

Negative employment effects of a specialised sector structure are also emphasised by the Product or Sector Life Cycle Theory. Mature sectors agglomerate in small and medium-sized cities, which exhibit comparatively high levels of specialisation. This way, they can profit from local MAR(Marshall/Arrow/Romer)-externalities (DURANTON and PUGA 2000 and 2001). As a result of an increasingly inelastic goods demand with regard to mature sectors, negative employment effects caused by rises in productivity are deduced (SCHETTKAT, 1997, 725).

The consequences of positive exogenous demand shocks on employment levels are hardly ever discussed in literature. Probably, that is because the implications are straight-forward: If a region is specialised in a sector which is hit by a positive demand shock, normally, regional labour market performance is enhanced. Thus, employment levels and, therefore, employment growth rates in specialised cities are assumed to fluctuate stronger in response to exogenous shocks. Positive demand shocks lead to a rise in employment levels, whereas negative shocks result in declining employment levels.

Even if all factors directly exerting influence on regional employment growth are taken into account, it is difficult to predict the influence of sector structure on employment, as the relation is only an indirect one (see above). The nature of the demand shock, i.e. whether it is a positive or a negative shock, as well as a sector's maturity, i.e. its elasticity of goods demand, is decisive in determining the influence of sector structure on regional labour market performance (SCHETTKAT, 1997, 725).

In short, various theories predict positive effects of a diversified environment on the labour market. However, one can deduct that employment growth levels are likely to show higher variances in specialised than in diversified regions. In specialised cities, exogenous shocks – no matter if positive or negative – will result in greater adjustments of employment levels, either upwards or downwards. The aim of the present study is to develop a simple model that illustrates the mechanism of the portfolio strategy, through which variances in employment growth are higher in specialised cities and lower in diversified cities. This model is introduced in section two. Section three is concerned with data and measurement issues, while section four is devoted to testing our hypothesis empirically, and section five draws the corresponding conclusions.

## **2. Model**

In this section, a model is set up which allows to draw important conclusions on the variance of employment growth rates in specialised versus diversified cities. It is formally proven that specialised cities experience higher variances in employment growth than diversified ones. Specialised cities are likely to be hit more severely by shocks in goods and labour demand of the sector they are specialised in, since this sector accounts for a large share of total city employment. Thus, many firms are affected by shocks in goods and labour demand and the shock cannot be absorbed as easily as in diversified cities.

It is assumed that shocks  $\theta_i$  in goods demand hit a sector  $i$  irrespective of its location. I.e., if a sector is located in city A and in city B, the shock hits the sector in both cities. The sector-specific shock is exogenous to the model and is expected to occur randomly. Therefore,  $\theta_i$  is normally distributed with mean zero and variance one ( $\theta_i \sim N(0;1)$ ). If sector  $i$  is hit by a positive (negative) demand shock,  $\theta_i$  takes the value +1 (-1 respectively), and is zero otherwise. As the shocks occur randomly, positive and negative deviations are expected to cancel out each other; its expected value is zero,  $E(\theta_i) = 0$ ; and its variance is one,  $\text{var}(\theta_i) = 1$ .

A further assumption is that the change in employment between two periods only depends on sectors being – or not being – hit by demand shocks. Admittedly, this is an oversimplification of matters. However, as we do not propose a model of employment growth, but intend to show the implications of sector structure on the stability of employment growth, this seems to be perfectly justified.

Total employment in city  $j$  at time  $t$  equals total employment in city  $j$  at time  $t-1$  plus the sum of sector-specific changes in employment between the two periods. Sector employment only changes if a sector is hit by a demand shock;  $\theta_i$  is zero otherwise, resulting in the sector-specific term of change in employment being zero as well. This relation is shown in equation (1), where  $Emp$  is the total employment in city  $j$ , and  $\beta_i e_{ij}$  is the fraction of a city's absolute employment  $e_{ij}$  in sector  $i = 1, \dots, I$ , that is either won or lost, depending on whether  $\theta_i$ , which represents a random shock hitting sector  $i$ , is positive or negative. Therefore, sector-specific demand shocks are weighted by the respective sectors' importance (in terms of employment) in a city. The parameter  $\beta_i$ , that is, the fraction by which sector employment either rises or declines, is assumed to be the same across cities. E.g., if  $\beta_i$  is 0.25, sector employment in period  $t$  in a sector that was hit by a negative demand shock will only reach three quarters of its level in  $t-1$ . Note that employment in  $t$  may be lower than in  $t-1$  if negative demand shocks on a city's sectors dominate positive ones and the second term on the right-hand side of equation (1) turns negative.

$$Emp_j^t = Emp_j^{t-1} + \sum_{i=1}^I \beta_i e_{ij} \theta_i \quad (1)$$

As a starting point, the expected value of change in employment is computed. Taking differences and rewriting equation (1) in terms of expected values yields equation (2), which means that the expected change in total city employment equals the expected sum of changes in sector employment.

$$E(Emp_j^t - Emp_j^{t-1}) = E(\sum_{i=1}^I \beta_i e_{ij} \theta_i) \quad (2)$$



Employing conditional expected means in order to solve equation (2) yields:

$$E(Emp_j^t - Emp_j^{t-1}) = E\left(\sum_{i=1}^I \beta_i e_{ij} * E(\theta_i | \beta_1 e_{1j}, \beta_2 e_{2j}, \dots, \beta_I e_{Ij})\right) \quad (3)$$

Since the sector-specific demand shock  $\theta_i$  is independent from sector employment levels  $e_{1j}, e_{2j}, \dots, e_{Ij}$ , the inner expected value on the right-hand side of equation (3) is zero, turning the outer expected value zero, too. Consequently, equation (4) is derived:

$$E(Emp_j^t - Emp_j^{t-1}) = 0 \quad (4)$$

So far, it has been shown that the expected change in employment is zero, as the expected value of the random shock variable is zero as well. Now we turn to analyse the variance of employment growth.

$$var(Emp_j^t - Emp_j^{t-1}) = var\left(\sum_{i=1}^I \beta_i e_{ij} \theta_i\right) \quad (5)$$

The right-hand side of equation (5) is expanded with  $e_j$ , so the ratio  $e_{ij}/e_j$  turns up. Then, the equation is simplified.

$$\begin{aligned} var(Emp_j^t - Emp_j^{t-1}) &= var\left(\sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} e_j \theta_i\right) \\ &= var\left(e_j \sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i\right) \\ &= e_j^2 var\left(\sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i\right) \\ &= e_j^2 \left[ \sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i - E\left(\sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i\right) \right]^2 \end{aligned}$$

$E\left(\sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i\right)$  is zero (see equation (3), with the same reasoning applying here).

$$\begin{aligned} var(Emp_j^t - Emp_j^{t-1}) &= e_j^2 \left(\sum_{i=1}^I \beta_i \frac{e_{ij}}{e_j} \theta_i\right)^2 \\ &= e_j^2 \sum_{i=1}^I \beta_i^2 \left(\frac{e_{ij}}{e_j}\right)^2 \theta_i^2 \end{aligned} \quad (6)$$

It remains to be shown that this variance is larger for specialised cities than for diversified ones.

$$var(Emp_{Spec}^t - Emp_{Spec}^{t-1}) > var(Emp_{Div}^t - Emp_{Div}^{t-1}) \quad (7)$$

Now, consider two cities with equal total employment  $e_j$ . However, the cities differ in their sector structure; let one city be specialised and the other city be diversified. Substituting equation (6) into equation (7) yields:

$$\left[ e_j^2 \sum_{i=1}^I \beta_i^2 \left( \frac{e_{ij}}{e_j} \right)^2 \theta_i^2 \right]_{Spec} > \left[ e_j^2 \sum_{i=1}^I \beta_i^2 \left( \frac{e_{ij}}{e_j} \right)^2 \theta_i^2 \right]_{Div} \quad (8)$$

As the cities do not differ in their characteristics of  $e_j$ , equation (8) reduces to

$$\left[ \sum_{i=1}^I \beta_i^2 \left( \frac{e_{ij}}{e_j} \right)^2 \theta_i^2 \right]_{Spec} > \left[ \sum_{i=1}^I \beta_i^2 \left( \frac{e_{ij}}{e_j} \right)^2 \theta_i^2 \right]_{Div}. \quad (9)$$

Since a demand shock hits a sector irrespective of its location, and the share by which sector employment rises or falls due to a demand shock is the same across all cities, the random shock variable  $\theta_i$  and the parameter  $\beta_i$  take on the same value for sector  $i$ , in both locations. Therefore, the expression deserving special attention is the share of industry employment in total city employment  $e_{ij}/e_j$ . Specialised cities typically have one large sector (or, in many cases, a few large sectors) and lots of smaller ones of lesser importance in terms of employment numbers. Consequently, the sum of squares of this ratio is higher than in diversified cities where sectors are similar in size and account for roughly equal shares in total employment. That is, the employment growth variance is larger in specialised cities than in diversified ones; a sector-specific demand shock  $\theta_i$  is weighted stronger in a city where sector employment is high relative to total employment, and equations (7)-(9) hold.

The assumptions of this simple model are quite restrictive and leave aside various determinants of employment growth. Nevertheless, in section 4 it is shown that, on aggregate, it turns out to fit the data.

### 3. Data and Measurement

The dependent variable of our analysis is the employment growth rate in German *kreisfreie Städte* (cities administered as an independent district). It can either be measured by considering the growth of the number of employees subject to social insurance contributions or by considering the total number of people employed. The former has the advantage of being the most important type of regular employment in Germany, whereas the latter also takes account of all forms of employment. That is why both the growth rate of the number of employees subject to social insurance contributions and the total number of people employed are considered. Data on the former are available at the German Federal Employment Agency, while data on the latter can be obtained from the Federal Statistical Office. In Germany,

employment subject to social insurance contributions represents the most important branch of dependent employment. It is characterised by a regular, dependent employment relationship coming along with dismissal protection. Employees are fully insured against the risks of life via public social insurance (e.g. health insurance, pension scheme, unemployment insurance, nursing care and accident insurance). The total number of people employed considers various forms of employment such as self-employment, marginal employment and family members assisting in privately-owned firms and, of course, employment subject to social insurance contributions. Therefore, it is robust against variations in employment forms.

The growth rates are calculated on a year-by-year basis, that is, they each cover a growth period of one year from 1998 to 2008. On the whole, there are 1180 observations (118 kreisfreie Städte \* 10 years) on the growth rates of employees subject to social insurance contributions. With regard to the growth rates of the total number of people employed, the cities of Plauen, Zwickau, Görlitz and Hoyerswerda in Sachsen need to be excluded as there have been changes in administrative boundaries during the observation period. Unfortunately, the German Federal Statistical Office does not provide data on the total number of people employed in these cities, adjusted to consistent boundaries. Thus, there are only 1140 observations on the growth rate of the total number of employees from 1998 to 2008.

In order to distinguish specialised from diversified cities, it is necessary to compute measures of specialisation and diversification. Data from the Federal Employment Agency on employees subject to social insurance contribution, classified according to 222 3-digit branches of the 2003 classification system (WZ03), is employed to calculate indices of regional specialisation/diversification.

The Krugman Index of Specialisation, proposed by KRUGMAN (1991) and further developed by MIDEFART et al. (2004), has become quite a common measure for the degree of specialisation. For city  $j$ , it is computed by  $K_j = \sum_{i=1}^I |s_{ij} - \bar{s}_{ij}|$ , where  $i=1, \dots, I$  denotes the sectors,  $s_{ij}$  gives the share of sector employment in total employment of city  $j$  and  $\bar{s}_{ij}$  gives the average of the same share calculated across all other regions, excluding city  $j$  (see FARHAUER and KRÖLL, 2010 for a detailed treatment of the Krugman Index of Specialisation). The index is standardized on values between 0 and 2; the higher its value, the higher the degree of a city's specialisation.

To make sure our results are not biased by the choice of the specialisation index, an additional measure of sector structure, the Relative Diversity Index proposed by DURANTON and PUGA (2000), is employed. It is similar to the inverse of the Krugman Specialisation Index,

and for city  $j$  is computed by  $RDI_j = 1/|s_{ij} - s_i|$ ,  $s_{ij}$ , again gives the share of city sector employment in total employment of city  $j$  and  $s_i$  gives the share of total employment in sector  $i$  in economy-wide total employment (see DURANTON and PUGA, 2000, for a detailed treatment of the Relative Diversity Index). The higher the index value, the stronger is a city's diversification. Specifically, diversification is defined relative to Germany as a whole. A city is considered to be diversified, if its sector structure deviates only marginally from the aggregate sector structure in German *kreisfreie Städte*.

#### 4. Empirical Results

First, the objects of observation, i.e. the cities, need to be grouped into specialised and diversified ones by their respective index values. This proceeding is illustrated with respect to the classification according to the *Krugman Index of Specialisation* (KSI); the procedure is the same when employing the *Relative Diversity Index* (RDI) instead. To split up the cities in specialised and diversified ones, the median value of all KSI-values is determined. Cities exhibiting KSI-values higher (lower) than the median value are considered to be specialised (diversified).

Under the null hypothesis, the employment growth variances of the two groups of specialised and diversified cities, respectively, are equal. More precisely, under the null hypothesis, the variance of employment growth rates in specialised is expected to be the same as in diversified cities. Table 1 shows descriptive statistics of the number of observations as well as the mean and the standard deviation in each of the considered groups. It can be seen that the employment growth rate's standard deviation of the group of specialised cities is higher than that of the group of diversified cities in every single case.

**Table 1: Descriptive Statistics and Statistical Results**

			Obs.	Mean	Std.Dev.	F-Stat.	p-value
Employees subject to social insurance contributions	KSI	Spec	590	0.0463	2.9357	1.8080	< 0.001
		Div	590	0.0948	2.1833		
	RDI	Spec	590	0.0312	2.9368	1.8125	< 0.001
		Div	590	0.1098	2.1814		
Total number of employed people	KSI	Spec	570	0.5964	1.8527	1.3971	< 0.001
		Div	570	0.4719	1.5675		
	RDI	Spec	570	0.5511	1.8631	1.4310	< 0.001
		Div	570	0.5172	1.5575		

Source: Federal Employment Agency, Federal Statistical Office, authors' calculations.

In order to determine the statistical significance of this observation, we conduct tests on the equality of variances of the growth rates of the number of employees subject to social insurance contributions and of the total number of people employed respectively, across the

two groups of our sample. Growth rates on a year-by-year basis are used, as these are expected to best reflect sudden changes in demand as possibly caused by sector-specific demand shocks.

The data support the model proposed above, and lead to the dismissal of the null hypothesis. The variance of employment growth rates in the group of specialised cities is found to be significantly higher than in diversified cities at the 1% significance level. It does not make much of a difference whether the growth rate of the number of employees subject to social insurance contributions or the total number of people employed is considered, although the F-statistics are slightly lower in the latter case. Also, the results are robust against a change of the specialisation/diversification measure. They do not vary markedly, regardless of whether the *Krugman Index of Specialisation* or the *Relative Diversity Index* is employed.

In a nutshell, employment growth rate variances are significantly higher in specialised cities. The authors argue that, in this regard, specialised cities show an unfavourable sector structure that does not allow them cushion positive and negative shocks in demand as easily as diversified cities can do. Therefore, employment growth rates in specialised cities soar if a sector is hit by a positive demand shock, and drastically fall in the case of a negative demand shock. Diversified cities, on the other hand, show relatively equal employment shares in a city's sectors and, consequently, can absorb demand shocks more easily as a smaller fraction of firms and employees is impacted.

## 5. Conclusion

There is a large number of studies inquiring into the relation between sector structure and regional employment levels/growth. Most of them yield a positive influence of a diversified structure, as opposed to regional specialisation. However, these results are to be interpreted cautiously, since the connection they establish is only of indirect nature. In the present study, it is argued that no clear impact of sector structure on regional employment growth can be determined. In order to do so, it would be necessary to take into account further factors influencing employment growth and, most importantly, the relation between sector structure and employment growth, i.e., different sectors' maturity stages and changes in productivity.

Even if no direct inferences can be drawn, theory leads to the conclusion that variances in employment growth rates should be higher in specialised cities, because they are not able to practice risk-spreading via a portfolio strategy in terms of sectors. A model which illustrates this mechanism is set up and investigated empirically. This shows that variances in

employment are, in fact, higher in the group of specialised cities. Hence, policies promoting clusters and, therefore, regional specialisation, should be viewed with caution. On the one hand, employment growth may be boosted if the sector a region specialises in is hit by a positive demand shock. On the other hand, however, employment growth may decline drastically if the sector is hit by a negative demand shock. Local authorities wishing to avoid the risk of strongly varying employment growth might be better off refraining from promoting clusters.

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