

## Measuring Regional Economic Dynamics

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**Abstract** This article describes the use of some statistical instruments widely used for explaining the interrelationship between the national and regional growth of regions and industries. The uses and limits of the shift-share model as a predictive tool are presented and illustrated with the help of a database containing employment data about the regions and industries of Germany. In addition, a graphical approach to visualizing the growth profiles of regional industries is presented.

**Keywords:** • structural change • local industry structure • local employment growth • Germany

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## 1 Introduction

Economic growth is by no means uniformly distributed within countries. In most industrialized countries, there are vast differences in economic growth across different regions. In the United States, for example, cities like New York, Chicago, San Francisco and many cities in the southernmost states have flourished over the last couple of decades. During the same time period, other cities, most predominantly those in the so-called rust belt such as Detroit and Cleveland, have severely declined. Aside from geography, there are obvious differences between these cases: The flourishing cities on the one hand have experienced particularly strong growth rates in modern service industries and in the high-tech sector. The declining cities, on the other hand, used to be very prosperous due to their reliance on heavy manufacturing, which today is in decline.

According to the Three-Sector Hypothesis (often also referred to as Petty's Law), a country's economy will change its foundation from the secondary to the tertiary sector as the country's economy develops (Murata 2008). This results in the secular trend of structural change that most industrialized countries are currently undergoing: employment is declining in the manufacturing sector and increasing in the service sector.

The above examples of US cities document that this structural change does not occur uniformly in all regions to the same extent. This also applies in the case of Germany.

In southern Germany, there are many regions that have grown over the past three-and-a-half decades. These regions either successfully underwent structural change and overcompensated for the decline in manufacturing with even faster growth of the service sector, or they developed in opposition to this trend and even expanded their manufacturing sector.

Other regions have suffered from structural change. Notable examples include cities in the Ruhr area. While they used to be Germany's powerhouses of heavy manufacturing, they have not recovered from the decline in these industries during the past 30 years.

In this article, we build on the methodology developed by Dauth and Südekum (2016) to examine the patterns of long-term structural change in German regions. The analysis will show that both the speed and the direction of structural change vary substantially. In contrast to what one would expect from Petty's Law, undergoing structural change from a manufacturing to a service economy at a faster pace is not a necessary condition for regional growth. The crucial determinant is regional industrial structure. Regions that had just the right industry mix and which managed to build on this mix appear to have grown particularly strongly.

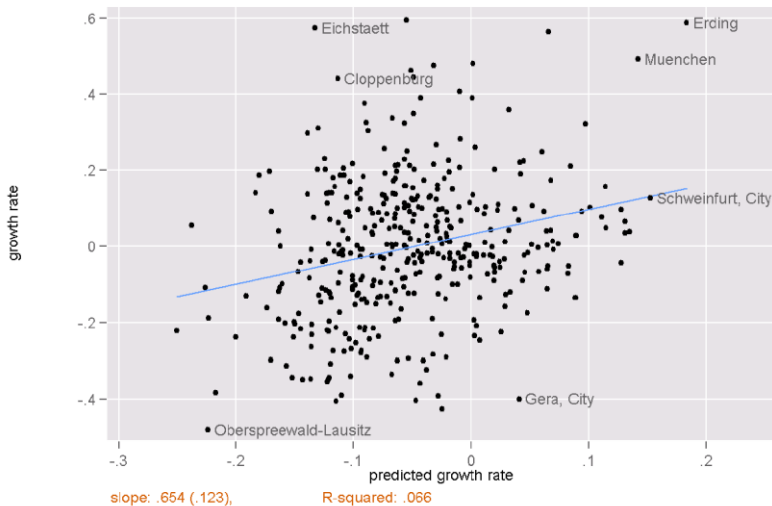
## 2 Measuring national and regional growth

The tool most commonly used to analyse the structural components of regional economic growth is so-called *shift-share analysis*. The basic idea of shift-share analysis is that regional growth can be disentangled into components idiosyncratic to each region and the growth related to the industries located in these regions. Bartik (1991) generalizes this idea and suggests that, in the absence of regional idiosyncrasies, *the rate of regional employment growth* can be calculated using the weighted average of the national growth rates of each industry:

$$\widehat{g}_r = \sum_{i=1}^N \frac{E_{irt}}{E_{rt}} \frac{E_{it+1} - E_{it}}{E_{it}}$$

where  $E$  denotes the number of employees and the subscripts  $i, r, t$  denote industry, county, and time, respectively.  $\widehat{g}_r$  (i.e. *the estimated rate of regional employment growth*) is commonly used as an instrument for predicting local employment growth that is not correlated to local characteristics. However, its predictive power is limited.

**Figure 1:** Actual versus predicted regional employment growth in Germany (1994–2014)



The scatterplot of Figure 1 displays the actual employment growth over the period 1994–2014 in 402 German counties (Kreise and kreisfreie Städte) versus the *estimated rate of regional employment growth*; i.e., the weighted average of the national industrial growth rate.

Figure 1 is based on the author's own calculations using the database Establishment History Panel (BHP) by the Research Data Centre of the German Federal Employment Agency and the Institute for Employment Research (IAB) in Nürnberg (BHP 7514). The database classifies economic activities into 222 groups. In this article these groups are called industries or sectors.

The above figure shows that for a wide range of districts, actual employment growth can be predicted with the help of the shift-share model.

For example, counties like Munich and Erding are among the fastest growing regions in Germany. Since they also rank among the regions with the highest predicted growth rate, we assume they had a regional industrial structure similar to the German national industrial structure and also grew in a comparable way to national growth as a whole.

On the other hand, the East German county of Oberspreewald-Lausitz is located at exactly the opposite end of the spectrum: it is the most rapidly shrinking county in Germany in terms of employment, which is precisely what its economic structure predicts. All these regions have one thing in common: they have experienced the same (positive or negative) trend of industrial growth as the aggregate of the country, just at a faster pace.

However, the statistical relationship between actual and predicted growth is positive but weak. The predicted growth rate can only explain 6.6% of the total variation in growth rates. Accordingly, there are many regions that deviate from the rule.

On the one hand, there are counties like Eichstätt and Freising, which rank among the fastest growing regions, but the shift-share instrument predicts negative growth in these counties.

On the other hand, counties like Schweinfurt and Gera exhibit average or low growth (respectively), although they were predicted to grow faster than average.

In sum, these deviations seem to be more the rule than the exception.

The bottom line is that regional industrial structure predicts regional growth only to a certain extent. This is good news for regions that for historical reasons have an unfavourable industrial structure, as they still have the potential to experience exceptional growth in the rate of employment.

## 2.1 Local profiles of industrial change

The previous analysis demonstrated that local industries do not necessarily grow at the same speed and in the same direction as their national aggregates. Growth of local industries is also determined and explained by a wide range of idiosyncratic (e.g. region-specific) components. The interplay of the latter can cause regions to grow even though they were ex-ante specialized in nationally declining industries.

The following equations replicate the procedure proposed by Dauth and Südekum (2016) for German counties in the period since German reunification. Consider the rate of employment growth of a region  $r$ . This rate can be rewritten as the average growth rate of each industry in this region  $w_{ir}$ , weighted by its share in total regional employment:

$$gr_r = \frac{E_{rt+1} - E_{rt}}{E_{rt}} = \sum_{i=1}^N \frac{E_{irt+1} - E_{irt}}{E_{rt}} = \sum_{i=1}^N \frac{E_{irt}}{E_{rt}} \frac{E_{irt+1} - E_{irt}}{E_{irt}} \equiv \sum_{i=1}^N w_{ir}$$

Similarly, the rate of national employment growth  $gr_{nat}$  can also be depicted as the weighted average of the national industries' growth rates  $w_i$ :

$$gr_{nat} = \frac{E_{t+1} - E_t}{E_t} = \sum_{i=1}^N \frac{E_{it+1} - E_{it}}{E_t} = \sum_{i=1}^N \frac{E_{it}}{E_t} \frac{E_{it+1} - E_{it}}{E_{it}} \equiv \sum_{i=1}^N w_i$$

An intuitive measure of whether a region grew faster or slower than the national average is the difference between regional and national growth rates. We can call this the “excess growth rate” of a region:

$$gr_r - gr_{nat} = \sum_{i=1}^N w_{ir} - w_i \equiv \sum_{i=1}^N \Delta w_{ir}$$

Note that in the last equation the difference between the regional and the national growth rates is the sum of the difference of the local industries' growth rates  $w_{ir}$  and their national counterparts  $w_i$ , which is denoted as the excess growth rate of a local industry  $\Delta w_{ir}$ . In other words, summing up the excess growth rates of all industries gives the region's excess growth rate.

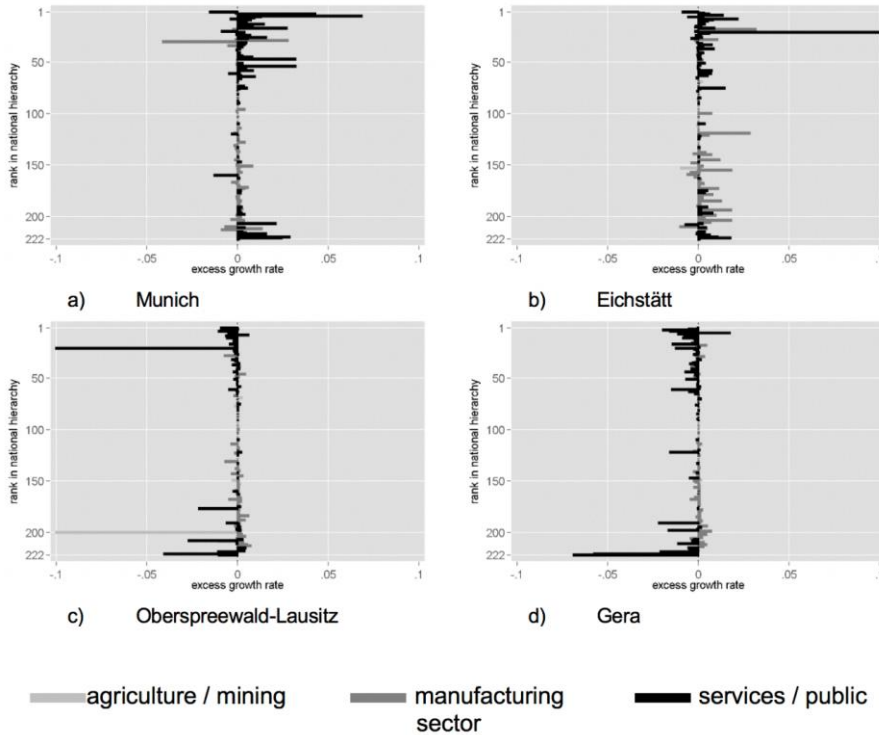
Comparing the excess growth rates of different industries in the same region provides interesting information about the economic development of that region. This is best done

graphically, whereby all of a region's industries are first ranked according to their rank in the national hierarchy of industry growth rates. Then, for each industry, the excess growth rate is plotted against its rank.

As illustrative examples let us explain the growth/decline of employment in four German cities during the period 1994–2014 by examining the different dynamics of their respective industrial structures:

- Munich is the biggest city in the Free State of Bavaria. Employment in Munich has grown at a higher-than-average rate, mainly due to the above-national rate of growth of service industries that also increased on the national scale. In other words, in Munich the excess growth rates for most service industries were positive, a tendency which has determined the shift in the sectoral composition of Munich's economy. As for the manufacturing sector, Munich underwent the long-term trend of deindustrialization much more quickly than the county average.
- Eichstätt is a smaller town in the Free State of Bavaria. Employment in this town also grew, but predominantly in those industries that declined nationally. This is why the shift-share instrument fails to predict this region's exceptional growth. For most industries in Eichstätt, the excess growth rate – which was above the national industry-specific average growth rate – was positive.
- Oberspreewald-Lausitz is a district in the southern part of the State Brandenburg, East Germany. Employment in this district has significantly declined, predominantly in those industries that also nationally declined. Moreover, for some agricultural and service industries in this district the decline was much more significant than the respective national sector-specific averages.
- Gera is the third-largest city in the State of Thuringia, East Germany. Employment in Gera in both nationally growing industries and in nationally declining industries has shrunk. Moreover, for a wide range of service industries in this district the decline was much more significant than the respective national sector-specific average.

**Figure 2:** Profiles of local industrial change in four example regions



\* Notes: The figures display the excess growth rates of local industries ordered by the respective national industry growth rates (fastest growing industries on top). Bars extending to the right denote higher local growth compared to the national average, and bars extending to the left denote lower growth than the national average.

### 3 Conclusion

Shift-share analysis can be used as an initial explanation for regional employment growth. However, in understanding and predicting regional growth, such a top-down approach has its limits. It is also important to account for the idiosyncratic growth potential and weaknesses of the most important industries in a region.

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