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04.19

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Philipps Universität Marburg

Imprint:

Working Papers on Innovation and Space
Philipps-University Marburg

Herausgeber:

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Published in: 2019

Location, industry structure and (the lack of) locally specific knowledge: On the diverging development of rural areas in Germany's East and West

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Abstract:

Some rural regions in Western Germany have experienced a very positive economic development in terms of employment and incomes in the past decade. This development, however, is in sharp contrast to the the enduring economic lag of many rural regions in Eastern Germany. This paper seeks to find out, to what extent these differences in employment development can be explained by sectoral patterns and region-specific capacities and capabilities.

We employ an extended shift-share regression model that explains the employment development in German districts between 2007 and 2016. The model differentiates between Western and Eastern German regions as well as between urban and rural regions by means of spatial location effects. This specification helps us to capture both: the historically evolved differences inherent in the socialist and capitalist past of Eastern and Western Germany and the varying economic environments in urban and rural areas. The extended shift-share regression confirms that simple industry effects, i.e. linear effects of industry shares, only explain a small part of the differences in employment development between rural regions. Most deviations are instead captured in the competitive share effects (CSE) that represents how employment development in a region systematically deviates from the average development of its industries at national level.

Further analyses of the CSE reveal that the manufacturing sector, despite its general loss in employment shares, is of crucial importance for rural prosperity. In this regard, the apparent disadvantage of rural districts in Germany’s East can be explained by a lack of locally specific, complementary immobile production capacities and capabilities for manufacturing. These locally specific skills develop endogenously. Urban districts in the East, in contrast, do not have to rely on endogenous factors alone but may overcome their historical disadvantage if they manage to exploit their agglomeration advantages in order to attract knowledge intensive industries and high-skilled workers.

Keywords: rural regions, urban regions, East Germany, West Germany, employment development, structural change, industry structure, spatial externalities, shift share regression

JEL Classifications: O14, O18, R11

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1 Introduction

Ever since the German re-unification, regional economic research has been concerned with the comparison of economic developments in West and East Germany. From a policy perspective, it was hoped that these developments would be accompanied by steadily decreasing disparities between the two areas. In this regard, however, the results are still mixed. On the one hand, the first half of the 1990s had witnessed perceivable signs of economic convergence as, for instance, Eastern labor productivity had quickly risen from only 34 percent of the Western level in 1991 to 64 percent in 1995. On the other hand, though, not only was the rise in productivity partly driven by a sharp drop in employment, it also had come more or less to a halt during the 2000s. In 2015, that is twenty-five years after re-unification, productivity in East Germany still amounted to only 79 percent of the West while at the same time unemployment rates, though decreasing, were still significnatly higher in the East (Müller *et al.*, 2017). Besides, neither (increasing) labour productivity nor (decreasing) unemployment rates necessarily mirror a positive socio-economic development. Instead, both indicators are likely to be affected by the seizable emigration from Eastern rual areas which is why we rather choose regional employment development as the leading indicator in our analysis.

Many reasons for the enduring East-West divide in employment dynamics have been proposed, among them the difficult starting conditions for East German companies after reunification and – partly as long-term consequences – a smaller manufacturing sector, a smaller average firm size, lower investment rates, and, not less crucial, the lack of corporate headquarters and thus less research and development activities (Niebuhr, 2017). Many of these features are either directly (e.g., size of manufacturing sector) or indirectly (e.g., average firm size) related to the characteristics of the regional industry structure whose impact on employment development is often estimated by shift share regression techniques. As for German regions, shift share regressions have been carried out, for instance, by Blien and Wolf (2002) and Suedekum *et al.* (2006) who each put a focus on Eastern Germany, and by Klinger and Wolf (2008) and Blien *et al.* (2014) who respectively investigated the development in Western Germany and in Bavaria.

What has been missing so far, however, is a systematic East-West comparison which simultaneously takes into account the distinction between urban and rural areas in order to capture the fundamental economic differences being inherent to different types of settlement. Moreover, discussions of the *competitive share effect* (CSE) that represents how employment development in a region systematically deviates from the the average development of its industries at national level have to date remained vague and without empirical fundament. As this effect has a bearing on employment in most of a region's industries, it can cautiously be interpreted as the result of a region-specific trans-industrial competitive advantage that could have its roots in the locally specific mix of industries, capacities and capabilities. Another aspect that has not yet received sufficient attention is the role of the *unexplained deviations* (UEDs). They denote deviations of regional employment dynamics within individual industries from their national averages that go beyond the scope of systematic CSEs and thus could result from industry-specific localization effects.

In this paper, we employ an extended shift-share regression model that explains the employment development in German districts between 2007 and 2016. Compared to the aforementioned studies and in light of the so far unresolved shortcomings, our analysis offers two additional elements. First, the shift share regression differentiates between Western and Eastern German regions as well as between urban and rural regions by means of *spatial location effects* (SLEs). This specification helps us to capture both the historically evolved differences inherent in the socialist and capitalist past of Eastern and Western Germany and the varying economic environments in urban and rural areas. Second, we provide a detailed examination of the CSE and of the UEDs to specify the driving forces behind regional employment development. Potential driving forces explaining CSEs are subdivided into positive (intra-regional) spillover and negative saturation effects, while potential driving forces of UEDs are divided into positive cluster and negative competition effects.

The remainder of this descriptive[1] empirical study reads as follows: section 2 characterizes the four types of spatial location and describes some general industry characteristics. Section 3 introduces the shift share regression model and provides estimation results for the (linear) industry mix effects as well as some further calculations. Based on these results, section 4 analyzes in how far regions' structural characteristics and industries' potential spatial externalities explain CSEs, UEDs and industry structure effects, and in how far the effects' determinants differ by location. Section 5 concludes and proposes a knowledge-based explanation for the identified strong role of manufacturing for rural development and for the different growth regimes identified in the rural East and in the rural West.

2 Characteristics of urban and rural areas in West and East Germany

In a first step, we classify our units of analysis, i.e. a total of 401 German districts (also referred to as "regions"), according to their geographical location (East or West) and their respective type of settlement. The latter has been determined by a typology that relies on the following indicators: population density, population potential, share of agricultural and forestry area in total area, share of one- and two-family houses in all buildings, and reachability of large urban centers (Küpper, 2016). While the original typology distinguishes three types of regions, classes have been aggregated to "urban" and "rural" districts for the purposes of this study. After an

[1] Due to the descriptive character of our analysis, and as we analyze the whole "population" of 401 districts and do not aim at an empirical extrapolation of our results, we relinquish from the presentation of p-values and significance tests in order to avoid wide-spread misinterpretations (see, for instance, Wasserstein and Lazar, 2016). In our opinion, the possible harm of such misinterpretations exceeds the merit of p-values' very limited informational content in the context of most descriptive and many observational studies (see also Matthews *et al.*, 2017).

additional differentiation by East (districts in the area of the former GDR without Berlin) and West, we obtain the following distribution:

Table 1: Frequencies of districts by spatial location

		urban	rather rural	distinctly rural	Total
West	urban	87			**87**
	rural		96	142	**238**
East	urban	9			**9**
	rural		37	30	**67**
	Total	**96**	**133**	**172**	**401**

Source: Own figure

In order to gain a first impression of the economic capacities of each location type, we employ a multinomial logistic regression where the log odds for being classified as 'West rural', 'West urban', or 'East urban' in reference to the type 'East rural' are being explained by selected economic indicators:

$$ln(\Pr(\delta_z = i)/\Pr(\delta_z = east\ rural)) = \sum_j \beta_j X_{j,z}$$
$$\text{for} \quad i \in \{urban\ west, rural\ west, urban\ east\}$$

with δ_z as spatial location of region z and $X_{j,z}$ as explanatory variable *j* in region *z*.

Log odds with their non-linear link-function or odds ratios that express chances relative to a reference class that takes on varying values itself are difficult to interpret. Therefore, Table 2 instead presents the results of this descriptive model in terms of economic fundamentals' marginal effects on districts' probabilities to belong to a specific location. Grey shaded are the highest marginal effects per line, which can be used to distinguish locations from each other. The marginal effect has been calculated as the differences in probabilities when the determinant takes on the value of its first and of its third quartile, while all other determinants remain at the median level. If, for example, the share of employees in large firms with more than 250 employees is on its third-quartile level, a district's probability to belong to the location 'East urban' is 63 percent higher than if this share is on its first-quartile level all other determinants equal.

Table 2: Characterization of spatial locations in terms of economic fundamentals' marginal effects on the probability to belong to a specific spatial location (results from a multinomial logistic regression)

	East		West	
	Rural	Urban	Urban	Rural
Industry concentration	-2	-28	-3	1
Share employees in large firms	13	63	41	-17
Exports from processing industries	-21	6	11	2
Business services	-92	81	57	31
Knowledge intensive production	-20	-18	-14	8
GVA per employee	-81	-80	68	5
GDP per inhabitant	-61	-72	-31	11
Primary sector share in GVA	-19	-47	-85	34
Secondary sector share in GVA	-15	-44	-5	9

Notes: Cox-Snell Pseudo R-square of 0.7. Grey shaded are the highest marginal effects per line, which distinguish locations from each other.

Source: Own figure based on data from INKAR 2016 edited by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR), Bonn and on data from the Federal Employment Agency on employment (within the scope of national insurance) for specified industry groups, Nuremberg 2017.

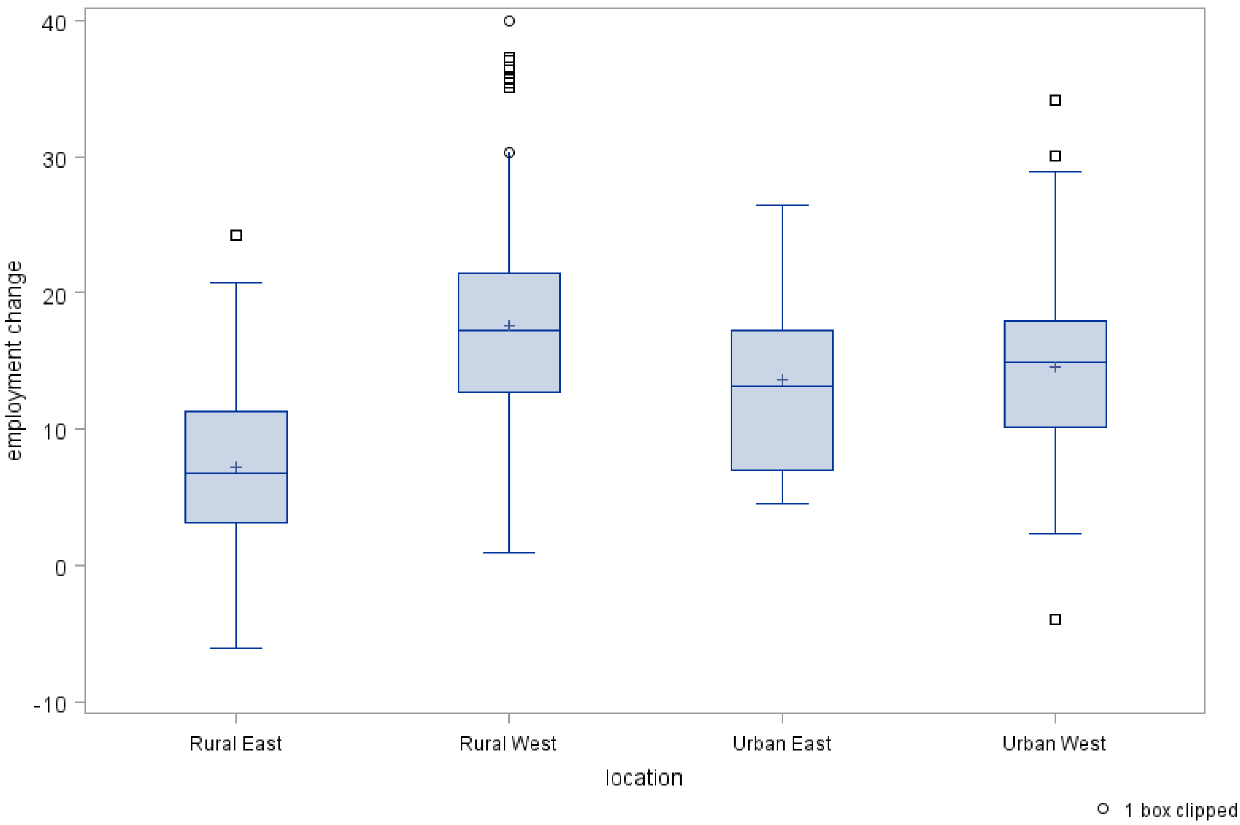
In a first approximation, the economic profile of each spatial location can be described as follows: *Urban districts in the West* can be characterized by a high level of exports from processing industries and a high degree of productivity (measured as Gross Value Added (GVA) per employee). *Rural districts in the West*, in turn, distinguish themselves by relatively high shares of GVA from the primary and secondary sector, high income potentials in terms of Gross Domestic Product (GDP) per inhabitant and a high share of employees in knowledge intensive production, i.e., in those processing industries that are usually classified as knowledge intensive. Specific characteristics of u*rban districts in the East* include a relatively high share of large firms with at least 250 employees and of employees in business services. *The rural East,* by contrast, does not show a specific strength in any of these dimensions and thereby shows signs of being structurally disadvantaged.

Overall, the economic features of the West seem to be more favourable for economic growth than the features of the East. This finding largely corresponds with the employment[2] dynamics

[2] Due to data restrictions, we concentrate on employment within the scope of national insurance.

observed for the time period between 2007 and 2016.[3] As displayed in Figure 1, districts in the East and distinctively in the rural East show a weaker development in terms of employment than districts in the West. The question of whether these diverging developments can be attributed to differences in regional industry structures or rather to locally specific competitive advantages will be addressed in the following sections.

Figure 1: Box-plots of employment changes from 2007 to 2016 by spatial location in percentages



Source: Own figure based on data from the Federal Employment Agency on employment (within the scope of national insurance), Nuremberg 2017.

To begin with, we take a quick glance at the industry shares across regions in 2015 and their respective development between 2007 and 2016. As displayed in Table 3, the largest industries in terms of average employment shares comprise 'supply and disposal' incl. 'construction' (8.1), 'production of electric and electronic products as well as of machines and vehicles' (9.4), 'retail sales' (8.1), 'health and social services' (14.7), and the 'public sector with education and training' (9.7). In the mean of all districts, employment development has been positive in almost all

[3] Having been mitigated by a number of anti-cyclical policy measures, the labor market impacts of the Great Recession (2008/2009) were only of transitory character in Germany. Therefore, the impacts can be expected to be effectively controlled by the year dummies in our panel data approach.

industries in the period of observation. Only ‘simple production’ and ‘finance and insurance services’ have shown a slight decline.

Manufacturing industries generally show a much weaker development in employment than the primary sector[4] or services, while trade related services show a relatively weak development as well. ‘Labour placement and temporary employment’, in turn, exhibits the strongest growth among all industries. This is a hint that employment growth does not necessarily imply growth in terms of high-quality labour and productivity.

An implicit assumption of shift-share analyses is that the general trend in industry development should be similar for all regions of an economy. Yet, the standard deviations of employment developments turn out to be rather high for quite a few industries: Variation coefficients ('Var Coeff' in Table 3), which are calculated as standard deviation divided by mean, are well above one for all manufacturing industries which points towards considerable regional heterogeneity in the development of these industries. Variation Coefficients for services in contrast are in most cases only high if the share of employees in an industry is generally low.

[4] Usually, given the general tendencies of structural change, one would expect a weak employment development in agriculture. Nevertheless, farming has traditionally been organized with family labour in West Germany and only recently, family labour has been increasingly replaced by employees within the scope of national insurance. Consequently, while the total number of employees in agriculture still tends to decrease, the number of employees liable for social insurance increases in the sector.

Table 3: Industry shares (2015) and developments (2007-2016) across regions (percent)

Industries	Industry shares*				Industry developments*			
	N	**Mean**	Std Dev	Var Coeff	*N*	**Mean**	Std Dev	Var Coeff
Agriulture, Forestry, Fish; Mining, pit and query	*399*	**1.4**	1.6	1.2	*401*	**1.7**	4.4	2.7
Food and feedingstuff	*399*	**2.9**	1.9	0.6	*401*	**0.8**	3.2	3.9
Simple production	*401*	**3.6**	2.8	0.8	*401*	**-0.4**	3.1	7.0
Mineral oil, rubber, glas etc.; Chemistry & Pharmaceuticals	*399*	**4.2**	3.7	0.9	*401*	**1.1**	3.5	3.2
Metal processing	*401*	**4.3**	3.6	0.8	*401*	**0.6**	3.7	5.9
Electric & electronic products; Machines and vehicles	*396*	**9.4**	7.0	0.7	*401*	**1.3**	3.1	2.3
Supply and disposal; Construction	*401*	**8.1**	2.5	0.3	*401*	**1.3**	1.5	1.1
Vehicle trade & maintenance	*401*	**2.9**	0.8	0.3	*401*	**1.1**	2.2	2.1
Wholesale	*401*	**4.4**	2.1	0.5	*401*	**0.5**	2.4	4.5
Retail sale	*401*	**8.1**	1.8	0.2	*401*	**1.7**	1.7	1.0
Logistics	*401*	**4.7**	2.4	0.5	*401*	**2.5**	2.3	0.9
Hotel and restaurants	*401*	**2.9**	1.5	0.5	*401*	**3.2**	1.7	0.5
Information	*382*	**0.5**	0.7	1.5	*401*	**1.8**	8.2	4.6
Communication (ICT)	*382*	**1.4**	1.4	1.0	*401*	**2.8**	6.5	2.3
Finance- & insurance services	*401*	**2.7**	1.6	0.6	*401*	**-0.1**	1.7	11.7
General services	*390*	**4.0**	1.9	0.5	*401*	**4.4**	3.7	0.8
Business services	*398*	**4.4**	2.4	0.5	*401*	**3.8**	3.6	0.9
Labour placement & temporary employment	*385*	**2.3**	1.6	0.7	*401*	**6.1**	9.9	1.6
Public sector; Education & Training	*401*	**9.7**	3.1	0.3	*401*	**1.3**	1.8	1.3
Health & social services	*401*	**14.7**	3.8	0.3	*401*	**3.0**	1.0	0.3
Arts, entertainment, recreation	*401*	**2.0**	1.2	0.6	*401*	**2.1**	2.8	1.3
Private & household services	*401*	**1.4**	0.9	0.7	*401*	**0.6**	2.5	3.9

* in terms of employees that are liable for social insurance

Source: Own calculations based on statistics of the German Federal Labour Agency (Nuremberg, 2018) on employment sorted by 22 industries based on the NACE (2008) classification.

3 Extended shift-share regression

3.1 Model structure and data

We agree with Combes *et al.* (2004, p. 220) that "studies linking local industrial growth to local economic structure […] have to be viewed as proposing stylized facts and not as validating a given theory". In this manner, the following analysis is expected to describe the relationship between local industry-structure and employment development. The results motivate further descriptive analyses with the potential to reveal possible non-linear relationships between industry-structure and development in line with agglomeration theories. Against the background of this relatively modest ambition, the analysis relies on a shift-share regression as it has been proposed by Patterson (1991). We explain the development of employment (*emp*) in relative terms:

$$y_{r,z,s,t} = \frac{emp_{r,z,s,t} - emp_{r,z,s,t-1}}{emp_{r,z,s,t-1}}$$

where $y_{r,z,s,t}$ represents the relative employment development in region *z* in industry *s* at time *t* differentiated by spatial location *r* (with r ϵ {urban West, rural West, urban East, rural East}).

The estimated fixed effect panel model simply is:

$$\hat{y}_{r,z,s,t} = \delta_r + \alpha_{r,s} + \beta_t + \gamma_{r,z} + \varepsilon$$

with

δ_r as **SLE** that measures the change in regional employment attributable to a region's spatial location r,

$\alpha_{r,s}$ as **industry mix effect**[5] that attributes changes in regional employment to changes in the regional industry structure whilst reflecting the impact of regional specialization in sectors that are slow or fast growing relative to the national average across industries

β_t as **time effect** that controls for annual cyclical trends by means of dummy variables

$\gamma_{r,z}$ as **CSE** that measures the change in regional employment attributable to region-specific competitive advantages

ε as **stochastic error term** with $\varepsilon_i \sim N(0, \sigma^2)$.

In order to address the problem of heteroskedasticity that results from much larger variances in the relative development of employment for small initial employment shares (see Table 3),

[5] The fact that our sample contains 4 types of spatial location (see section 2) and 22 industries (see below) leads us to a total of 88 industry mix effects differentiated by spatial location.

weights are applied in the estimation. These weights equal the square-root from the industry's employment share in the region (Blien *et al.*, 2014):

$$w_{z,s} = \sqrt{\frac{N_{z,s}}{\sum_z \sum_s N_{z,s}}}$$

$$\hat{y}_{r,z,s,t} = w_{z,s}\delta_r + w_{z,s}\alpha_{r,s} + w_{z,s}\beta_t + w_{z,s}\gamma_{r,z} + \varepsilon$$

In this form, the relative last industry mix, competitive share, location and time effect could be calculated by summation from all other effects within each effect group. In other words, the model is plagued by perfect multicollinearity and parameters cannot be identified. In order to overcome this problem, additional restrictions on potential parameter values are introduced in order to identify the model (Patterson, 1991; Möller and Tassinopoulos, 2000). The sum of all weighted **industry mix effects** differentiated by spatial location r is forced to zero:

$$\sum_r \sum_z \sum_s \theta_r w_{z,s}\alpha_{r,s} = 0$$

In the same manner, the sum of all weighted **CSEs** differentiated by spatial location r is forced to zero:

$$\sum_r \sum_z \sum_s \theta_r w_{z,s}\gamma_{r,z} = 0$$

where $\theta_r = 1$ if the region belongs to region type r, otherwise $\theta_r = 0$.

Finally, the sum of **time effects** is also forced to zero:

$$\sum_t \sum_z \sum_s w_{z,s}\beta_t = 0$$

Our model is to some extent similar to the model of Blien and Wolf (2002), who estimated a (spatial) location coefficient as well. Nevertheless, Blien and Wolf do not differentiate industry mix effects by spatial location and relinquish from estimating an intercept by forcing the sum-of CSEs to identity with the SLE. In our model, SLEs serve as intercepts while time effects are assumed to be identical across location types. The four SLEs are estimable because the undefined sum of all CSEs provides the estimation with the required additional degree of freedom to prevent perfect multi-collinearity among the aforementioned SLEs.

For our analyses, we employ data from the German Federal Labour Agency at the district level that report the number of employees liable for social security insurance by industry for the years 2007 to 2016. Industries have been further aggregated based on the two-digit level from the industry classification system NACE 2008 in order to minimize a loss of observations due to missing data due to data protection disclosure rules. The number of industries in our sample thus amounts to 22. With the selected aggregation, observations on specific industries are missing for some districts for selected years but not for all years. Therefore, all industries can be considered for all districts in the shift-share regression.

3.2 First empirical findings

Some selected results of the basic shift-share regression are presented in Table 4. As the model produces CSEs for all 401 districts, the respective coefficients cannot be presented here in detail. Instead, Table 4 focuses on the SLEs (pseudo-intercepts[6] for each of the four spatial locations) as well as on the industry mix effects differentiated by spatial location. Differences in SLEs (intercepts) capture the differences in levels of development between locations, while industry effects explain within-location differences in regional employment development by the development of industries.

The coefficients represent each industry’s distinct contribution to employment development in each of the four spatial locations. According to the linear industry coefficients, employment in rural districts in the West would grow by 2.21 percentage points per year with a "normal" or mean industry structure. In the hypothetical case, in contrast, where 100 percent of employees were employes in "simple production", employment development would be reduced by 2.64 percentage points, i.e. in this region, employment would decrese by 0.43 percentage points per year. These coefficients when summed up with the intercepts by design roughly mirror the numbers from Table 3 on individual industries' mean employment development.The results reveal signs of heterogeneity among the industry mix effects depending on spatial location. Production of electronics and machines, for example, contributes negatively to employment development in the West but positively so in the East. Information and communication technology (ICT) activities are positive for employment development everywhere but in rural districts in the East. Logistics and ‘health and social services’, on the other side, contribute specifically positively to employment development in rural districts in the East. This heterogeneity implies the existence of between-location heterogeneity in the relative development of employment in specific industries.

[6] These "intercepts" do not reflect the situation with all explanatory variables (industry shares) on zero, but the locations' mean development across the years of observation given the restrictions applied in the estimation.

Table 4: Estimated industry mix effects by spatial location

	Development employees							
	East Urban		West Urban		East Rural		West Rural	
Intercept	1.11	(0.21)	1.51	(0.07)	0.76	(0.09)	2.21	(0.05)
Agriulture, Forestry, Fish; Mining, pit and query	-1.35	(1.46)	-0.61	(0.37)	-1.23	(0.34)	0.40	(0.19)
Food and feedingstuff	-2.02	(1.26)	-0.81	(0.36)	-0.02	(0.42)	-1.30	(0.22)
Simple production	-0.14	(0.98)	-2.98	(0.29)	-0.54	(0.39)	-2.64	(0.20)
Mineral oil, rubber, glas etc.; Chemistry & Pharmaceuticals	-0.34	(1.24)	-0.57	(0.37)	0.22	(0.45)	-1.09	(0.25)
Metal processing	-1.35	(1.08)	-2.30	(0.31)	-0.19	(0.39)	-1.24	(0.21)
Electric & electronic products; Machines and vehicles	1.13	(1.02)	-1.41	(0.32)	0.86	(0.43)	-0.71	(0.22)
Supply and disposal; Construction	-1.42	(0.67)	-0.22	(0.20)	-0.64	(0.25)	-0.41	(0.14)
Vehicle trade & maintenance	1.07	(0.85)	-0.22	(0.26)	-0.57	(0.33)	-1.01	(0.18)
Wholesale	-2.73	(0.79)	-1.55	(0.23)	-1.51	(0.35)	-1.07	(0.18)
Retail sale	1.56	(0.63)	-0.04	(0.19)	0.37	(0.26)	-0.26	(0.14)
Logistics	0.86	(0.83)	0.61	(0.25)	0.70	(0.33)	0.63	(0.18)
Hotel and restaurants	1.49	(0.72)	1.80	(0.22)	1.71	(0.30)	1.08	(0.16)
Information	0.11	(1.19)	-0.33	(0.37)	-0.55	(0.69)	-0.16	(0.35)
Communication (ICT)	2.63	(0.87)	1.40	(0.27)	-1.28	(0.49)	1.24	(0.26)
Finance- & insurance services	-1.69	(0.84)	-1.37	(0.27)	-1.69	(0.37)	-2.35	(0.19)
General services	2.51	(0.66)	2.61	(0.21)	1.90	(0.30)	2.81	(0.18)
Business services	2.20	(0.61)	2.69	(0.20)	0.96	(0.31)	2.22	(0.16)
Labour placement & temporary employment	0.84	(1.03)	1.99	(0.36)	3.39	(0.56)	3.95	(0.34)
Public sector; Education & Training	-1.69	(0.81)	0.37	(0.26)	-2.12	(0.33)	-0.28	(0.17)
Health & social services	2.34	(0.61)	1.81	(0.20)	2.02	(0.27)	0.77	(0.15)
Arts, entertainment, recreation	-2.23	(0.76)	0.21	(0.25)	-0.91	(0.36)	0.61	(0.19)
Private & household services	-1.80	(0.80)	-1.08	(0.23)	-0.87	(0.34)	-1.18	(0.17)

Note: Standard errors in brackets

Source: See table 3; own calculation

The recognition that industry mix effects vary between spatial locations, however, is in contrast to a basic implicit assumption of shift-share analyses according to which general industry trends should be similar for all regions in an economy. In order to further analyze the relationship between structure and development, region-specific **industry structure effects** (ISE) are calculated from the industry mix effects, which have been estimated in a panel structure with one observation for each of 22 industries per region.

Technically, **ISEs** are computed by summation of industry mix effects ($\alpha_{s,r(z)}$) that are weighted by their regional industry shares ($I_{s,z}$):

$$\zeta_z = \sum_s \alpha_{s,r(z)} I_{s,z}$$

The **UEDs on district level** have been calculated in reference to $\bar{y}_z$ as mean observed region specific employment development over time $y_{z,t}$ by the substraction of the SLE, the CSE and the ISE:

$$\xi_z = \bar{y}_z - \delta_{r(z)} - \gamma_z - \sum_s \alpha_{r(z),s} I_{s,z}$$

UEDs indicate that employment development in individual industries within a region has deviated from the industry's mean employment development and from the region's systematic employment trend that is captured by the CSE.

If industry trends were similar for all regions in an economy, one should expect a positive relationship between ISE and regional development: If growing (declining) industries dominate in a region, its economy would be expected to grow (decline) in terms of employment as well. Accordingly, a correlation analysis that relates the ISE to regional employment development would be expected to reveal a strong positive correlation coefficient. Instead, as displayed in Table 5 (A-1), the respective correlation coefficient indicates a negative relationship between ISE and emploment development. What is more, the respective correlation coefficients of the spatial location and in particular of the CSE exhibit high and positive values and thus seem to explain regional employment development much better than the ISE (A-1).

Table 5: Correlation analysis (Pearson) of estimated effects from the shift-share regression at regional level

A	Correlations of all effects in all locations	Location effect	Competitive share effect	Industry structure eff.	Unexplained deviations
1	Employment development	0.46	0.72	-0.16	0.15
2	Location effect	1	0.00	-0.58	-0.06
3	Competitive share effect	0.00	1	-0.05	-0.31
4	Industry structure effect	-0.58	-0.05	1	-0.13

B	Correlations of industry structure effects by locations	Urban west	Rural west	Urban east	Rural east
1	Employment development	0.26	0.04	0.57	-0.05
2	Location effect	-0.70	Identical	0.66	Identical
3	Competitive share effect	0.02	-0.11	0.56	-0.20

Source: Own calculation

The ISE exhibits a strong negative relationship with the coefficients of the four SLEs (intercepty in table 4; see Table 5, A-2). As the ISE is the weighted sum of the industry mix effects (see Table 4), it will be low, where the share of employment in manufacturing is high as all manufacturing industries show a weak employment development (see Tables 3 and 4). The share of manufacturing is high, i.e. the ISE is low, in the rural West, which at the same time has the highest location coefficient. The ISE is high, in contrast, where services have a high share in employment due to services' positive employment development (see Tables 3 and 4). Employment in services is relatively dominant in urban regions and, more generally, in regions in the East. At the same time, SLEs are higher in the West than in the East, and in urban areas in the East higher than in rural areas in the East (see Table 4). These relationships illustrate that high shares of fast growing industries in a region or in a location in line with the negative correlation coefficient in Table 5 (A-1 and A-3 respectively A-4) do not necessarily imply general positive economic dynamics.

Consequently it seems to be necessary to control for, respectively stratify upon, spatial locations in order to identify the expected relationships. According to Table 5-B, the expected positive relationship between employment development and ISE (B-1) applies to urban, but not so to rural districts. In other words: A higher share of service jobs contributes to positive development in urban but not in rural districts. Consequently, the ISE relates positively (negatively) to the SLE in the East (West), where the SLE is higher (lower) in urban locations (see Table 4 and Table 5, B-2). Only in the urban East goes a more positive ISE along with a higher propensity for a strong

CSE. In other words: High shares of fast growing services do not contribute much to regionally specific employment dynamics in all other locations.

A statistical relationship between competitive share and SLE as well as between competitive share and ISE is ruled out by the design of the shift share regression as the CSEs captures those developments that deviate systematically from the industry effects (see Table 5-, A-3). Deviations, too, show no strong and systematic relationships with any of the other effects.

4 Detailed analyses of individual shift share effects

4.1 Characterisation of regions in reference to development and estimated effects

As demonstrated by the correlation analysis in section 3, regional employment development is more closely related to the competitive share than to the industry structure effect or UEDs (Table 5). In order to further investigate this observation, we employ three identical OLS models to respectively explain the observed employment development (y_z) the CSE (γ_z) (as estimated in the initial shift share regression), the ISE (ζ_z) and the UED (ξ) (as derived from the estimated effects) by selected economic fundamentals ($X_{j,z}$). The model(s) are not explanatory in character but purely descriptive and can be written as follows:

$$\psi_{i,z} = \beta_0 + \sum_j \beta_j X_{j,z} + \varepsilon \quad \text{for} \quad i \,\epsilon\, \{y, \gamma, \zeta, \xi\}$$

The results are presented in Table 6. Negative (positive) coefficients indicate weaker (stronger) effects $\{y, \gamma, \zeta, \xi\}$ respectively in regions with higher values of determinants X_j. Table 6 identifies a number of multivariate correlations that align with expectations. If, for example, the share of academically trained employees is one standard deviation above the mean,

- employment development (model 1) increases by 0.248 percentage points;
- the CSE (model 2) increases by 0.148 percentage points, which implies that regions with more academically trained employees tend to experience more positive employment development across industries;
- the ISE (model 3) increases by 0.027 percentage points, which implies that fast growing industries tend to concentrate in regions with many employees in fast growing industries, which is possibly due to the fact that fast growing industries like business or health services (see Table 3) employ relatively many academically trained employees;
- and the UEDs (model 4) increase by 0.1 percentage points, which indicates that in regions with more academically trained employees individual industry developments tend to be above the average employment development in these industries.

The weak employment development in the East (model 1) can neither be explained by lower competitive share nor by ISEs (models 2 and 3). Only individual industries idiosyncratically exhibit much weaker developments in Eastern districts according to the UEDs (model 4). The remaining difference in employment development between East and West is captured by the SLEs (see Table 4), i.e., by the general weaker employment dynamic in the (rural) East.

A relatively high employment share in knowledge intensive production relates negatively to employment development and to the UEDs, but not so to the CSE. Besides this, it is evident that the relationships between economic fundamentals and employment development (Table 6, model 1) are much more congruent with their relationships to CSEs (model 2) than with their relationships to ISEs or to UEDs (models 3 and 4). Employment development and the CSE, for example, are rather weak in regions with a high population potential (model 1), while the ISE is higher in these densily populated regions (model 3). In summary, regions with high employment shares in strong growing industries (model 3) holding everything else constant

- are located in densely populated regions,
- provide relatively few employment opportunities for unskilled people
- but many jobs in large firms,
- exhibit strong export orientation,
- are strong in business services,
- experience a low productivity in terms of GVA per employee
- but a high income potential in terms of GDP per inhabitant and
- have low GVA shares from the primary and specifically from the secondary sector.

Quite on the contrary, regions with strong CSEs (model 2), whose employment development systematically deviates positively from the mean development of their industries

- are frequently not located in densily populated areas,
- provide jobs for relatively many high-skilled, but also relatively many low-skilled employees,
- have a relatively small employment share in large firms,
- show a high productivity in terms of GVA per employee but not necessarily a high income potential in terms of GDP per inhabitant and
- have a high share in primary sector (and no specifically low share in secondary sector) GVA.

Industry concentration (diversification) relates negatively (positively) to employment development, to the CSE and to the ISE. Industry concentration is measured here by the National Average Index[7]. Nevertheless, concentration measures have to be treated with caution: High industry concentration may indicate structurally disadvantaged locations with low industrial diversity, where the (relative) concentration of "residual" industries is high. It therefore remains unclear whether the index realy indicates industry concentration or other covarying (structural) conditions.

In summary, those factors that characterize locations with high employment shares in fast growing industries are not the same factors that characterize regions that experience above average growth given the local industry structure. Specifically, while the secondary and the primary sector experience a weak employment development (see Table 3), employment in regions with a high share of the secondary or the primary sector does not necessarily decline as well (models 1 and 2). Employment in regions with a high share of the primary sector might show above average growth because of catch up phenomena in other industries, while employment in regions with a high share of the secondary sector might show a relative positive employment development because manufacturing firms in these production oriented regions are specifically competitive. Such phenomena have been analyzed in the context of the cluster thesis (Porter, 2010) or in the context of localization effects that are due to positive scale effects (Hanson, 2001). These non-linear effects will be further analyzed in chapter 4.2.

[7] The *National Average Index* N_i (Mack et al. 2007) is used in order to measure industry concentration. It determines the concentration of industries in terms of employment shares in reference to the distribution of industries in the national average:

$$N_i = \sum_s \frac{(e_{si}/e_s) - (e_s/e)}{e_s/e}$$

Here, e_{si} indicates the number of employees in industry s and region i, e_s indicates the number of employees in industry s in the total economy and e the total number of employees in the economy.

Table 6: OLS regression results on the relationship between district level economic fundamentals and employment development, competitive share and ISEs and UEDs

		Employment dev.	Comp. share effect	Ind. Struct. effect	Unexplained dev.
		Model 1	Model 2	Model 3	Model 4
	Intercept	1.804 (0.052)	-0.029 (0.053)	-0.007 (0.012)	-0.189 (0.030)
	Location east	-1.159 (0.209)	0.169 (0.214)	0.114 (0.049)	-0.166 (0.121)
z-standardised	Population potential	-0.127 (0.042)	-0.037 (0.043)	0.070 (0.010)	-0.010 (0.024)
	Share academically trained employees	0.248 (0.072)	0.148 (0.074)	0.027 (0.017)	0.100 (0.042)
	Share untrained employees	0.005 (0.075)	0.109 (0.077)	-0.078 (0.018)	-0.053 (0.043)
	Industry concentration	-0.124 (0.039)	-0.106 (0.040)	-0.036 (0.009)	0.002 (0.023)
	Share employees in large firms	-0.191 (0.051)	-0.169 (0.052)	0.041 (0.012)	-0.051 (0.029)
	Exports from processing industries	-0.0084 (0.0384)	-0.0314 (0.0392)	0.0472 (0.0090)	-0.0211 (0.0222)
	Business services	-0.054 (0.067)	-0.054 (0.068)	0.046 (0.016)	-0.038 (0.039)
	Knowledge intensive production	-0.059 (0.053)	0.025 (0.054)	-0.012 (0.012)	-0.108 (0.031)
	GVA per employee	0.176 (0.068)	0.228 (0.069)	-0.054 (0.016)	0.018 (0.039)
	GDP per inhabitant	0.033 (0.078)	0.031 (0.080)	0.045 (0.018)	0.010 (0.045)
	Primary sector share in GVA	0.249 (0.044)	0.229 (0.045)	-0.026 (0.010)	0.046 (0.025)
	Secondary sector share in GVA	0.020 (0.062)	-0.014 (0.064)	-0.084 (0.015)	0.128 (0.036)
	R-Square	0.41	0.19	0.76	0.09

Note: Explained effects in percent. Explanatory variables apart from 'Location east' are z-standardised. Standard errors in brackets.

Source: See Table 2; own calculations.

In an additional step, we employ a generalized least square model that, in contrast to OLS models, allows for an inclusion of interaction effects to control for potential between-location heterogeneity among the competitive share and ISEs. For this purpose, economic fundamentals

($X_{j,z}$)[8] are interacted with dummies for the four locations r while the location coefficients δ_r themselves are treated as intercepts to allow for the simlutaneous estimation of all four 'spatial location models'. The model(s) then take the following form:

$$\psi_{i,r} = \sum_r \delta_r + \sum_r \sum_j \delta_r \beta_{r,j} X_{j,r} + \varepsilon \text{ für } i \in \{\gamma, \zeta\}$$

The results are displayed in Table 7 and they confirm significant differences between spatial locations in different respects. Firstly, above average growth across industries in districts of different spatial locations depends on different conditions: The CSE tends to be high

- in the rural East with many untrained employees,
- in the rural West with high shares of primary sector GVA, high income potential and high productivity,
- in the urban East with low shares of secondary sector GVA, and
- in the urban West with low shares of employees in large firms and high income potentials.

Secondly, fast growing industries' location depends on other conditions than those that are supportive for the CSE. The ISE is high in districts

- in the rural East with a high share of untrained employees and low productivity,
- in the rural West with high shares of academically trained employees, low shares of untrained employees, high income potentials, and low shares of untrained employees, as well as of primary and secondary sector GVA,
- in the urban East with high industry diversity (low industry concentration) and low secondary sector share in GVA, and
- in the urban West with high shares of academically trained employees, of low shares of untrained employees and of secondary sector in GVA like in the rural West, but also with high shares of employees in large firms and low productivity (GVA per employee).

In conclusion, optimal conditions for fast growing industries do not necessarily support regions' above average growth. It remains to be explained why conditions for employment growth differ between regions with similar industry structures. We do this under consideration of possible non-linear industry effects in chapter 4.2.

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8 For this exercise only the most significant exogenous variables were retained in order to create parsimonious models that remain estimable despite the interaction with region types that quadruples the number of variables in each model.

Table 7: GLS regression results on the relation between district level economic fundamentals and competitive share and ISEs by location

		Competitive share effect				Industry structure effect			
		Urban		Rural		Urban		Rural	
		West	East	West	East	West	East	West	East
		Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
	Intercept	0.227 (0.199)	-3.353 (11.891)	-0.088 (0.068)	2.196 (0.633)	0.246 (0.044)	-1.629 (2.639)	-0.059 (0.015)	0.465 (0.141)
z-standardised	Share academically trained employees	0.144 (0.090)	0.904 (0.682)	0.003 (0.097)	0.360 (0.210)	0.053 (0.020)	0.041 (0.151)	0.078 (0.021)	-0.063 (0.047)
z-standardised	Share untrained employees	-0.038 (0.144)	-1.840 (3.686)	0.046 (0.085)	1.322 (0.349)	-0.172 (0.032)	-0.143 (0.818)	-0.043 (0.019)	0.112 (0.077)
z-standardised	Industry concentration	-0.139 (0.093)	-1.464 (1.710)	-0.116 (0.046)	-0.110 (0.122)	-0.026 (0.021)	-0.433 (0.380)	-0.025 (0.010)	-0.039 (0.027)
z-standardised	Share employees in large firms	-0.295 (0.106)	-0.447 (0.743)	-0.238 (0.069)	-0.212 (0.156)	0.064 (0.024)	0.110 (0.165)	-0.019 (0.015)	0.026 (0.035)
z-standardised	GDP per inhabitant	0.216 (0.110)	-1.966 (6.337)	0.191 (0.097)	-0.883 (0.556)	0.039 (0.024)	0.396 (1.406)	0.072 (0.022)	0.178 (0.123)
z-standardised	GVA per employee	-0.069 (0.107)	0.606 (2.995)	0.266 (0.095)	0.598 (0.203)	-0.055 (0.024)	-0.274 (0.665)	-0.021 (0.021)	-0.070 (0.045)
z-standardised	Primary sector share in GVA	0.288 (0.241)	4.003 (10.960)	0.349 (0.054)	0.049 (0.095)	-0.025 (0.054)	-0.989 (2.433)	-0.021 (0.012)	-0.029 (0.021)
z-standardised	Secondary sector share in GVA	0.098 (0.067)	-2.300 (1.401)	0.087 (0.064)	0.077 (0.123)	-0.061 (0.015)	-0.308 (0.311)	-0.116 (0.014)	0.013 (0.027)
	R-Square				0.31				0.80

Note: Explained effects in percent. Explanatory variables are z-standardised. Standard errors in brackets.

Source: See Table 2; own calculations.

4.2 Inspecting potential spatial externalities

In this sub-section, we further examine the CSEs and the UEDs as derived from the initial shift share regression (section 3). The shift-share regression estimates one single coefficient for each industry mix effect and thereby assumes linearity in effects across all regions, independently of industry shares. Nevertheless, the results presented in Table 6 (section 4.1) demonstrate that industry effects do not translate directly into regional development of employees. Deviations from linear industry mix effects are collected in the CSEs and UEDs. While CSEs point towards a *region-specific trans-industrial* competitive advantage, UEDs indicate the presence of *industry-specific* localization effects. Both components, however, collect regional dynamics that cannot be explained by general industry trends but have to be atributed to non-linearities or to 'irregular' idiosyncratic developments within single industries.

'Irregular' idiosyncratic developments, to begin with, describe dynamics that are neither systematically related to general industry dynamics nor to the region-specific dynamics beyond isolated industry effects. Examples for such contingent shocks are big plant closures due to mismanagements or, on the positive side, the foundation of a new production site within a region. While these shocks are contingent, i.e., unpredictable, in nature, their probability or the probability that they exert large effects depends on certain local conditions (Jofre-Monseny *et al.*, 2018). Non-linearities, on the other hand, denote non-linear relationships between industry share and industry development. Concretely, an industry's effect on employment development in this industry or across industries within a region may depend on its own or other industries' current employment shares.

In order to identify these non-linear effects, an additional regression explains CSEs (γ_s) and UEDs (ξ_s) from the shift-share regression again by the share of employees per industry in a region. The latter is referred to as industry share effect ($I_{s,z}$). Sizeable industry share effects in this regression imply non-linear industry effects indicating that relationships between explanatory and to be explained factors depend on the level of the explanatory factors themselves. In order to avoid perfect multicollinearity, the sum of all industry share effects in the model is forced to zero:

$$\sum_s \beta_s^I = 0$$

The corresponding restricted least-square model(s) can be written as follows:

$$\psi_{i,r,z} = \beta_0 + \sum_s \beta_s^I I_s + \sum_s \beta_s^L L_s + \sum_j \beta_j^X X_j + \varepsilon_i \text{ for } i \in \{\gamma, \xi\}$$

with $I_{s,z}$ as the industry share of industry s in region z and X_j as control variable j in region s. In addition, we include the regional average firm-size per industry L_s in order to account for the possibility that within industry resource distribution affects employment growth within and across industries. The results are summarized in Table 8.

A negative (positive) industry share effect indicates that a higher share of employees within that industry relates negatively (positively) to the CSEs or UEDs. In other words, the industry share effects now explain those deviations from the linear industry mix effects, i.e. those non-linearities and irregularities that have been collected in the CSEs and UEDs. The firm size and the industry share effects have to be interpreted simultaneously: At a given industry share in employment, a low mean firm size within an industry implies a larger number of firms or smaller firms within that industry. At a given employment share, a negative (positive) firm size effect then implies that smaller firms or larger numbers of firms affect development positively (negatively). In the following, we concentrate on the interpretation in terms of firm numbers rather than of firm size. Firm numbers can be interpreted in terms of external scale effects analogously to employment shares. An interpretation in terms of firm sizes, in contrast, would attribute more importance to within-firm scale effects. Given the interpretation in terms of firm numbers, the mirror-inverted results for industry share effects on the one and firm size effects on the other hand in Table 3 reveal a large symmetry between both effects: A high share of employees in an industry almost always has a similar effect like a large number of firms in the same industry.

With respect to the explanation of **CSEs**, we interpret results as follows: Positive industry share and negative firm size effects imply that larger numbers of employees and firms in an industry contribute positively to the development of regional employment across industries. We call this **spillover effect**. Negative employment share and positive firm size effects, in contrast, indicate that larger numbers of employees and firms in an industry contribute negatively to the development of regional employment across industries. We call this **saturation effect**.

With respect to the explanation of **UEDs**, we interpret results as follows: Positive employment share and negative firm size effects imply that larger numbers of employees and firms in an industry contribute positively to the development of that specific industry. We call this **cluster effect**. Negative employment share and positive firm size effects, in contrast, indicate that larger numbers of employees and firms in an industry contribute negatively to the development of that specific industry. We call this **competition effect**. In Table 8, dark bars that point to the center between columns emphasize cluster resp. spillover effects, while light bars that point to the outside highlight competition respectively saturation effects.

All four effects can be referred to as spatial externalities. Proof of their economic relevance is well documented in the fact that they clearly help to improve the explanatory power of the regression models. As can be seen from Table 8 and Table 6, respectivily, the inclusion of spatial externalities in the explanation of unexplained deviations and competitive share effects renders most of the other economic variables insignificant and boosts the explanatory power of the model for the explanation of UEDs (CSEs) without spatial externalities (Table 6) from an R-square of 0.09 (0.19) to an R-square of 0.34 (0.42).

Positive **cluster effects** that point towards the presence of localization economies most clearly arise in ‘vehicle trade and maintenance’, ‘information’ and ICT services, and, with restrictions, in 'arts entertainment, recreation'. ‘Metal processing’ and 'Agriculture, Forestry, …' show some weak cluster effects as well. For ‘information’ and ICT services this result is not unexpected as they are knowledge and information intensive and potentially benefit from within-industry knowledge-spillovers. Similar arguments concerning positive external effects of creativity and rising attractiveness of large localized markets relate to 'arts entertainment, recreation'. Clustering of metal processing and the primary sector could potentially be explained by the supportive spatial distribution of natural resources or by positive effects of labour market pooling. The coefficients for vehicle trade and maintenance are more difficult to explain. Possibly they are due to the fact that vehicle trade typically concentrates in regions with large vehicle production sites, and typically benefit from this proximity.

Table 8: The impact of Industry share and firm size effects on CSEs and UEDs

	Unexplained deviations (in %)				Competitive share effects (in %)			
Intercept	0.965	(0.897)			-0.390	(1.640)		
Location East	-0.150	(0.152)			-0.030	(0.277)		
z-standardized								
Share academically trained employees	0.038	(0.061)			0.447	(0.111)		
Share untrained employees	-0.051	(0.050)			0.075	(0.091)		
Population potential	-0.060	(0.032)			-0.017	(0.059)		
Industry concentration	-0.027	(0.033)			-0.019	(0.061)		
Share employees in large firms	-0.106	(0.043)			-0.101	(0.079)		
Exports from processing industries	-0.012	(0.025)			-0.053	(0.045)		
GDP per inhabitant	-0.093	(0.058)			0.218	(0.106)		
Mean firm size	0.187	(0.222)			-0.355	(0.406)		
	Industry share effects (in %)		**Firm size effects (in employees)**		**Industry share effects (in %)**		**Firm size effects (in employees)**	
Agriulture, Forestry, Fish; Mining, pit and query	0.023	(0.019)	-0.006	(0.002)	-0.026	(0.035)	0.001	(0.003)
Food and feeding stuff	-0.026	(0.019)	0.006	(0.002)	0.135	(0.035)	-0.012	(0.004)
Simple production	0.017	(0.014)	-0.005	(0.004)	-0.016	(0.025)	0.000	(0.007)
Mineral oil, rubber, glas etc.; Chemistry & Pharmaceuticals	0.016	(0.011)	-0.001	(0.001)	-0.042	(0.020)	0.001	(0.002)
Metal processing	0.014	(0.011)	-0.004	(0.002)	-0.020	(0.019)	0.002	(0.003)
Electric & electronic products; Machines and vehicles	-0.018	(0.009)	0.002	(0.001)	0.009	(0.017)	-0.002	(0.001)
Supply and disposal; Construction	-0.003	(0.018)	0.002	(0.016)	0.051	(0.033)	-0.008	(0.030)
Vehicle trade & maintenance	0.059	(0.046)	-0.024	(0.012)	0.004	(0.084)	0.008	(0.022)
Wholesale	0.009	(0.020)	-0.013	(0.009)	-0.094	(0.037)	0.060	(0.017)
Retail sale	-0.062	(0.029)	0.036	(0.032)	0.020	(0.054)	0.069	(0.058)
Logistics	-0.029	(0.016)	0.008	(0.007)	0.011	(0.029)	-0.006	(0.013)
Hotel and restaurants	0.005	(0.020)	-0.010	(0.026)	-0.032	(0.037)	0.014	(0.047)
Information	0.025	(0.054)	-0.010	(0.004)	0.081	(0.098)	-0.010	(0.008)
Communication (ICT)	0.053	(0.040)	-0.017	(0.007)	-0.016	(0.073)	0.002	(0.013)
Finance- & insurance services	-0.056	(0.045)	0.015	(0.009)	0.144	(0.081)	-0.034	(0.016)
General services	0.001	(0.038)	-0.002	(0.022)	0.183	(0.070)	-0.107	(0.041)
Business services	-0.074	(0.034)	0.040	(0.021)	-0.145	(0.062)	0.057	(0.039)
Labour placement & temporary employment	-0.024	(0.022)	-0.002	(0.001)	0.016	(0.040)	0.003	(0.002)
Public sector; Education & Training	-0.036	(0.015)	0.007	(0.004)	-0.045	(0.028)	-0.003	(0.007)
Health & social services	-0.004	(0.017)	-0.013	(0.014)	-0.060	(0.031)	0.038	(0.026)
Arts, entertainment, recreation	0.073	(0.045)	0.006	(0.014)	-0.101	(0.082)	0.039	(0.026)
Private & household services	0.038	(0.063)	-0.028	(0.032)	-0.058	(0.115)	0.046	(0.058)
Effects:	Competitio	Cluster	Competition		Saturatior	Spill-over	Saturation	
R-square			0.34				0.42	

Note: The sum of the industry share effects has been restricted to zero. The alternative estimation without restrictions and intercept delivered almost identical results. Standard errors are presented in brackets behind coefficients.

Source: See Table 2; own calculations.

Spillover effects typically indicate that industries support the development of other industries located within the same region. The most prominent spillover effects are identified for 'finance- and insurance services' and 'general services' as well as for 'food and feeding stuff'. 'Finance- and insurance services' and 'general services' obviously have the potential to support firms and their employees from other industries. This potential is usually expected to be enhanced by spatial proximity. The positive spill-over effect of 'food and feeding stuff' implies that if there are many employees in the food industry a systematic above-average development of employment in a number of non-food industries in the district is to be observed. This finding is at odds with the interpretation of Möller and Tassinopoulos (2000), who do not differentiate between cluster and spillover effects but only discuss concentration and de-concentration effects[9] and interprete their positive coefficient on the food sector as indication of concentration tendencies in this industry. Table 8, however, shows that food industry shares do not explain UEDs, i.e. within industry effects, but CSEs, i.e. across industry effects. This observation could be due to historically contingent positive developments in a few rural regions that happened to be early adopters of large scale food processing industries.[10] It is also possible that the coefficients indicate a catching-up process of regions that have been coined by agriculture and food processing until recently.

Industries that are affected by localization dis-economies in the form of **competition effects** comprise 'food and feeding stuff', 'Electric & electronic products; Machines …', 'retail sale', 'logistics', 'finance- and insurance services', 'business services', as well as the public sector with education and training. With respect to services and specifically for trade services the results suggest that for services, local competition is usually relevant and potentially restricting. As regards production of electronics and machines, the negative relationship is likely due to competition on sales- or factor-, specifically labour-markets or a combination of both.

Effects that are assumed to hamper the development of other industries in the region are labelled as **saturation effects**. Within the service sector, we find saturation effects for the 'health- and social services', 'business services', and 'wholesale'. 'Health- and social services' can be seen as "residual industries" that tend to have high employment shares in structurally disadvantaged regions. 'Business services' and 'wholesale' usually complement activities from other industries: High shares of them could hint at a possible excessive supply. Regarding the manufacturing sector, saturation effects can be found for 'oil, rubber and glass' as well as for 'chemical and pharmaceutical products'. In both industries, it is imaginable that saturation effects are due to local resource restrictions. If, for example, local high-skilled personnel prefer to work for large pharmaceutical firms, firms from other industries might suffer from skill-shortage.

No further differentiation by spatial locations has been applied here due to the limited number of observations that limits model complexity. In fact, this limitation is of fundamental character if one deals with evolutionary processes that result in a potentially unlimited number of local equilibria. Not all of the factors that cause these differences are observable. Specifically knowledge related factors tend to remain hidden behind artificial and rather rough (industry) classifications. The high impact of unobserved factors can be illustrated at hand of exemplary

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[9] Blien and Wolf (2002) introduce some additional controls into the shift-share regression, among them an adjustment effect as proposed by Möller and Tassinopoulos (2000). This adjustment effect is meant to correct the industry mix effect for potential non-linearities in the relationship between industry share and industry development.

[10] We can observe, though, that the food industry is strong in two larger fast-growing locations: rural districts in the west of Lower-Saxony and in some parts of Bavaria. The existence of these two large clusters could drive the results. Historically conditioned paths of development that happen to fit likewise for successful rural districts in Bavaria and Lower Saxony possibly cause the impression of "spill-over effects" of the food sector and render them less economically significant.

district profiles of regions with similar or opposite employment dynamics. Table 9 presents profiles of exemplary districts from our analysis along those determinants that have been found to be meaningful for the explanation of development differentials.

Table 9: Exemplary opposed location profiles for selected urban and rural city districts

	East urban:		City districts		West very rural:		City districts	
	Mean	**Std Dev**	**Jena**	**Leipzig**	**Mean**	**Std Dev**	**Schweinfurt**	**Emden**
Development employees 2007-2016 (%)	**11.19**	**7.11**	21.00	22.75	**15.05**	**6.47**	3.65	22.24
Annual development employees (%)	**1.42**	**0.74**	2.31	2.65	**1.82**	**0.70**	0.43	2.20
Location effect	**1.11**	**0.00**	1.11	1.11	**2.21**	**0.00**	2.21	2.21
Competitive share effect	**0.00**	**0.62**	0.68	0.98	**0.03**	**0.69**	-1.74	1.14
Industry structure effect	**0.49**	**0.10**	0.62	0.63	**-0.19**	**0.20**	-0.22	0.15
Unexplained deviation	**-0.17**	**0.15**	-0.10	-0.07	**-0.23**	**0.40**	0.17	-1.29
Population potential (1000 persons)	**503.73**	**197.75**	-1.06	1.14	**227.86**	**77.52**	0.05	-0.43
Share high-skilled (%)	**20.09**	**4.24**	2.08	0.07	**6.74**	**1.86**	1.43	0.30
Share low-skilled (%)	**6.78**	**0.46**	-1.04	0.49	**13.74**	**1.78**	-0.42	-2.61
Mean firm-size (persons)	**16.91**	**0.84**	2.11	-1.05	**12.82**	**3.21**	4.99	4.14
Industry concentration (index)	**0.28**	**0.13**	-0.74	-0.41	**0.41**	**0.34**	2.80	2.56
Share large firms (%)	**4.63**	**0.83**	0.54	-0.26	**2.79**	**1.30**	2.32	0.80
Exports (mining & production) (1000€/emp	**77.23**	**47.43**	-0.15	1.90	**77.07**	**56.10**	0.01	-0.23
GVA per earner (1000€/employee)	**50.68**	**3.28**	0.77	0.19	**55.14**	**5.82**	1.90	1.13
GDP per inhabitant (1000€/employee)	**33.92**	**3.26**	0.91	-0.04	**31.66**	**11.06**	5.62	2.32
Share of employees (%) in:								
Agriulture, Forestry, Fish; Mining, pit and qu	**0.16**	**0.14**	-1.19	-0.42	**1.37**	**1.27**	-1.04	-0.89
Food and feedingstuff	**0.90**	**0.39**	-0.55	-1.11	**3.71**	**2.23**	-1.44	-1.39
Simple production	**1.08**	**0.29**	1.62	0.50	**4.68**	**3.54**	-0.52	-1.17
Mineral oil, rubber, glas etc.; Chemistry & P	**0.87**	**0.66**	2.38	-0.41	**5.12**	**3.96**	-1.09	-1.21
Metal processing	**1.36**	**0.91**	0.42	0.19	**4.91**	**3.65**	-1.28	-0.85
Electric & electronic products; Machines an	**5.04**	**3.45**	1.87	-0.07	**11.07**	**8.21**	3.68	3.31
Supply and disposal; Construction	**6.90**	**1.07**	-1.02	-0.34	**8.51**	**2.44**	-1.68	-1.03
Vehicle trade & maintenance	**2.12**	**0.46**	0.01	0.78	**3.06**	**0.78**	0.58	-0.87
Wholesale	**2.34**	**0.58**	-1.33	0.04	**4.24**	**1.99**	-1.00	-0.97
Retail sale	**7.34**	**0.73**	-0.25	1.24	**8.30**	**2.15**	-0.97	-1.78
Logistics	**4.67**	**1.59**	-1.70	0.67	**4.13**	**1.71**	-1.48	3.40
Hotel and restaurants	**3.17**	**0.76**	-1.08	0.17	**2.76**	**1.46**	-0.77	-0.91
Information	**1.12**	**0.93**	-0.94	0.99	**0.27**	**0.28**	-0.65	-0.98
Communication (ICT)	**2.75**	**0.87**	-0.46	1.03	**0.72**	**0.53**	-0.49	-1.34
Finance- & insurance services	**2.75**	**0.68**	-1.46	1.17	**2.68**	**1.50**	0.05	-0.86
General services	**9.10**	**2.40**	-1.70	0.16	**2.85**	**1.25**	0.30	-0.59
Business services	**6.94**	**1.31**	0.92	0.33	**3.46**	**1.56**	-0.78	-0.57
Labour placement & temporary employmei	**4.59**	**1.11**	-0.59	0.82	**1.91**	**1.63**	0.37	3.91
Public sector; Education & Training	**16.33**	**2.63**	-0.21	-1.58	**8.66**	**2.47**	-0.22	-0.80
Health & social services	**15.12**	**3.06**	1.50	-0.28	**14.85**	**3.88**	-0.58	-1.20
Arts, entertainment, recreation	**4.01**	**0.92**	-1.31	-0.50	**1.54**	**0.80**	-0.95	0.43
Private & household services	**1.37**	**0.22**	0.64	-1.49	**1.42**	**0.84**	0.67	-1.06

Source: See Table 2; own calculations.

Comparison of the two 'East urban' city districts Jena and Leipzig demonstrates that above average employment development can be realized with almost opposite economic profiles: 'East urban' districts with a production regime (Jena) can be similarly successful like 'East urban' districts with a service regime (Leipzig). Comparison of the two distinctively rural western city districts Schweinfurt and Emden in contrast shows that it is possible to find above and below average growth among regions with similar economic profiles. In Schweinfurt and Emden the concentration in one manufacturing industry is strong and the dependence on a few large firms is high. Consequently, historically contingent developments can cause divergent developments. Schweinfurth, for example, was hit by strong concentration tendencies in the rolling bearing industry in the 1990's, when it lost many of its corporate headquarters to other locations. Emden, in contrast, has gained long-term benefits from the opening of a large production site of Volkswagen in 1964, whose enlargement in the following decades buffered the local economy against the severe shock from structural change in the ship-building industry.

Therefore, we find divergent developments for districts with similar industry patterns, and similar developments for regions with oppositional economic structures.

5 Summary and discussion

In this paper, we have analyzed in how far different German locations are characterized by different employment developments in the observation period 2007 to 2016 and to what extent these differences are attributable to structural differences between locations and between districts within locations. In the analysis, "location" has been defined by districts' geographical position in the "new counties" in Germany's East or in the "old counties" in its West as well as in rural versus urban region types (Table 1). "Structural differences" have mainly been gauged by means of different employment shares by industry, and the familiar patterns of structural change, namely declining employment shares of the primary and secondary sector, could be confirmed (Tables 3 and 4). In addition, the results indicate that industries' employment developments differ markedly between regions and that an industry's effect on regional employment development might not be restricted to its own employment development. Regions with high industry structure effects, i.e. with many fast growing (service) industries tend to be characterized by economic profiles that are almost opposite to the profiles of regions with above average growth given their industry structure (see Table 7). In other words: Regions with a high share of manufacturing experience higher growth rates than predicted by their industry structure. Further analyses in this context confirm the existence of positive cluster and spillover effects but also of negative competition and saturation effects (see Table 8). Specifically, employment dynamics in agriculture and manufacturing but also in ICT services tend to be above average where their employment shares are high, while high employment shares in food and feeding stuff processing as well as in business services relate positively to regional development across industries.

Furthermore, our results suggest the existence of three regional development regimes that can be allocated to urban districts, Western rural districts, and Eastern rural districts. Indications for distinctive geographical patterns can be found in, to begin with, Table 4. Here, it is shown that employment development by industry differs to a greater extent between locations in the East and in the West than between urban and rural locations. This East-West divide, however, applies specifically to rural districts while urban districts in the East and in the West have been found to be relatively alike in terms of both structural characteristics and employment dynamics (Table 2 resp. Figure 1). Urban districts in general benefit from positive industry structure effects that are due to service sector employment growth which clearly sets urban districts apart from rural districts (Table 5). The recognition that urban centres in the East, despite difficult starting conditions after reunification, can experience growth and convergence if they manage to exploit their agglomeration advantage and to attract knowledge intensive industries and high-skilled workers is in line with what we know from the literature so far (Tables 2 and 7).

As regards rural districts, employment dynamics are considerably weaker in the East than in the West (Figure 2). Simultaneously, rural districts in the West show nearly opposite characteristics from rural districts in the East (Table 2). The rural West, in contrast to the rural East, benefits from high income potentials in terms of GDP per inhabitant and high primary and secondary sector shares (Table 7). The impact of income is attributable to demand effects that spur the local supply of, for instance, household-related services. While rural districts in the West are still characterized by a high secondary sector share in GVA they simultaneously experience a specifically weak employment growth in this sector (Table 4). Nevertheless, employment development in the rural West remains largely unaffected by this negative industry structure effect (Table 5). In fact, quite to the contrary, the secondary sector tends to contribute positively to above average growth in the rural West (Table 7). More generally speaking, high employment shares of weakly growing industries in a region do not regularly translate into weak regional employment development (Tables 5 and 6).

Our explanation of the differences in employment development in rural districts in the East and in the West is based on the following recognitions: (1) urban districts show more convergence than rural districts (Figure 1 resp. Tables 2 and 4); (2) high secondary sector shares contribute positively to regional above average growth (CSE) in the West but not so in the East (Tables 5 and 7); (3) a high share of untrained employees and low income potentials in terms of GDP per inhabitant relate positively to CSE in the rural East. One could therefore conclude that successful rural districts follow a manufacturing based high productivity regime in the West but a low-cost regime in the East. Other than in urban regions, this East-West divide between rural districts has not been overcome by attraction of skilled labour or competitive firms.

One possible explanation for the apparent immobility of competitive, high-wage manufacturing firms and their employees can be found in the inertia of regionally specific knowledge resources. Unlike firms in urban districts whose competitive strength often originates from the steady influx of tacit knowledge in the form of academically trained employees (Table 2), rural manufacturing firms have to generate their competitive advantage by themselves, that is within the production process (Barney, 1991). Here, the firms produce specific solutions by means of complementary capacities and capabilities that serve as scarce and thus valuable resources in the market competition. Due to the immobility of the complementary capabilities, the respective knowledege tends to be regionally bound. Hence, mobile employees cannot easily apply their firm-specific skills in other firms or locations and other firms cannot simply imitate another manufacturing firm's new solutions. The exploitation of this locally specific know-how in manufacturing industries thus might explain the specific strength of manufacturing-based production regimes despite of the declining share of industrial employment.

Many Western rural districts, in particular in the German South, benefit from more than 100 years of experience in the manufacturing industries under free market conditions. Here, complementary and locally specific capacities and capabilities have been (co-)created within manufacturing firms in the course of time. Due to locally restricted knowledge-spillovers through common labour- and local product-markets and direct contacts along the value chain, positive localization effects (Table 8) that serve the stabilization of firms might have supported this manufacturing-based development. The rural East, by contrast, joined the world market only thirty years ago and is thus less experienced with market-driven growth. One consequence is a relative lack of locally specific capacities and capabilities for the exploitation of market opportunities. Consequently, rural firms in the East experience competition on prices rather than competition on quality, which favors low-cost production with low-wage jobs, often created in the service sector. Hence, the long-term processes required for the creation of "sustained competitive advantages" (Barney, 1991) could explain the enduring differences between rural regions in Germany's East and West.

While the extended shift-share analysis (section 3) and its meta-analysis (section 4) have generated interesting results, limitations of this purely empirical reduced form analysis have become apparent as well. As historical events, path-dependence, contingencies and idiosyncratic influences are likely to affect regional economic development, no region is fully comparable with any other because of the endogenously developed complementary capacities and capabilities (Table 9). The idiosyncrasies increase within the process of development. From a methodological perspective this implies that statistical analyses alone will then not be able to fully explain, why specific locations develop more favorably than others. We propose that in this case, the analytical statistical approach has to be complemented by a case based configurational approach (Meyer *et al.*, 1993).

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