Economic small-scale spatial dependencies and segregations: A multi-level analysis with indirect closure

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1 Introduction

Theories and approaches on regional economic development are characterised by an overwhelming plurality and a missing coherent unifying conceptual framework. Consequently, in politics and applied science regional economic development is often discussed in a simplified manner as judged by the following two criteria. Firstly, regions are conceptualised as separable entities, irrespective of scale and neglecting their potential dependence and interrelatedness. Secondly, the discussion often concentrates on one of the many theoretical concepts at a time.

This conceptual reductionism hinders a clear view on the actual complexity of regional economies. A model of regional development that integrates aspects from different theoretic approaches like that developed by Venables (1996) for example shows a large number of possible spatial equilibria. In the respective model, which considers the linkage between industries as well as imperfect competition, the equilibrium depends on the values of different parameters that are related to industry-characteristics. Despite of the complexity of these results, Marshallian externalities or other complications are not even considered. In the light of such results, the plurality of theoretical approaches might be judged as the expression of complex dynamics that questions the adequacy of the paradigms of economic equalization and convergence between regions. Instead, it is rather probable that observed differences in productivity, for example, are caused by spatial specialisation: “Putting the two observations [that different industries and services have different levels of value added per head and that the distribution of industries and services varies from area to area] together means that the mix of industries and services in an area will be an important influence on its GDP per employee” (Gill 2005).

The other problem of inquiries of regional economies mentioned in the first paragraph is the scale-problem. It is not necessarily the case that the wealth of a region, which is defined by its industry-specialisation as proposed above, is evenly spread within this region. Instead, new economic geography, for example, shows that, depending on transport-costs, a concentration of production capacities in a central place is rather probable. At the same time, it is usually assumed that households follow jobs, therefore strengthening the centripetal forces of the development (Kilkenny 1998). Nevertheless, the

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latter aspect underlines scale-dependence. If we assume that small-scale regions, say below the size of labour-market regions, are separable by industry-specialisation while agglomeration-forces due to external economies and supply-effects act within these small-scale regions, we might rather expect a segregation of industry-settlements and residential settlements within these small-scale areas. These residential settlements are economically dependent on the development in industry-settlements. At the same time, the effects of agglomeration forces not necessarily imply the unbounded growth of a single city. Instead, it is rather probable that due to the balancing effect of negative effects of agglomeration smaller cities or even non-urban settlements in the surrounding profit by the central growth. In the consequence, there may even be increasing returns at work in rural areas within certain regions - a possibility so far usually neglected or denied (Castle 2008). Additionally, local demand supports certain industries within the residential settlements. The question is mainly one of the spatial definition and segregation of respective units of observation.

We conclude that the smaller the scale of observation the more a notion of functional differentiation might be justified, which could be motivated by an analogy to ecological concepts. The central idea of the concept are (1) that spatial structures reflect industry-characteristics and (2) that different regions exert different functions in a national economy, while (2) is basically a consequence from (1). The term "functional" is here interpreted within functionalist thinking following Luhmann (Hagen 2000): "function relates a subsystem to the whole, and not to other subsystems or to itself." Therefore, what is meant in the context of regional economics is that different regions serve different functions within the economy, which contribute to the overall development but not necessarily to an autonomous regional self-development.

These considerations are of high relevance for regional policies. Rural development policies, for example, put much emphasis on the support of the development of local potentials. But if these potentials depend on local agglomeration-forces, which are determined by the larger region's industry-specialisation, there will necessarily be localities on a high-growth path alongside localities on a low-growth path. Consequently, "productivity can vary sharply between places that are located close to each other" (Perry 2010). This variation may be due to differing industrial structures on a larger spatial scale and due to differing forces of agglomeration and spatial competition on a smaller spatial scale. Consequently, neither is it necessarily right to infer from a larger region's situation on the situation of the smaller localities that make it up. Nor is it necessarily promising to support a smaller locality's development in a larger depressed economic environment by the promotion of its endogenous potentials. Instead, the situation my mainly depend on the general regional industry-structure.

We know little about the dependence of localities on their environment as compared to their local development potential. Therefore, it is our aim to shed some light on the complex interplay between geographical positions, regional and local functional

differentiation, agglomeration forces and heterogeneous local economic situations. Thereby we hope to support the supposition that structural rigidities, external economies and forces of monopolistic competition are of high relevance and may sustainably inhibit regional convergence. While these sustainable regional differences have partly been taken into account by the idea of club-convergence, our results additionally stress the existence of small-scale heterogeneity. We show that industry-specific structural rigidities contribute systematically to complex small-scale patterns in the spatial economy. The relevance of the coarse notion of convergence is thereby questioned in that the importance of selecting an appropriate scale of analysis depending on the type of research question is stressed.

2 The theoretical concept

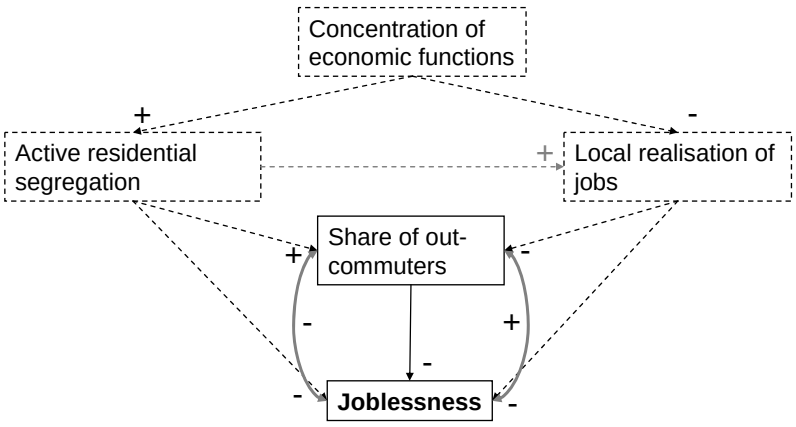
We want to explain differences in the economic situation in localities of different spatial scales by the type of settlements, their geographic position, industry structure and differing forces of agglomeration. The latter depend on the former more general conditions and all four general factors are expected to interact in a complex way. We assume economic actors to respond rationally to the resulting forces. Therefore, the existing situation reflects and to a certain degree reveals the unobservable forces in a given structure. We chose joblessness (the relation of officially registered jobless persons to all employable inhabitants of a region) as our indicator for economic viability of regions. This indicator may be especially appropriate in the light of our research-question because the potential dependence of local joblessness on the larger economic environment becomes obvious immediately. It can be illustrated by the fact that a low unemployment in a certain locality might either be due to the locality's own economic viability or to the jobs offered in a nearby centre. Conclusions from the following work on the local dependence of single localities' development on the development within the larger region therefore partly rest on the observation and interpretation of the importance of commuters.

We face three general problems: (1) The possible non-linear relations implied by the assumed interactions of the three types of influence, (2) the expected spatial dependency between the situation in smaller localities and the larger region they belong to, and (3) the non-observability of many factors contributing to forces of agglomeration. We deal with the first two problems in a technical manner, which is described in the technical chapter on the mixed model that we used. Nevertheless, the way we deal with the third problem is closely interlinked with our theoretical concept. In our approach of indirect closure we interpret the observed heterogeneous relation between out-commuters and local joblessness as an indicator for existing agglomeration-forces. Therein we rely on our assumption that existing structures reveal rational preferences. The dependence of the observed relation between the share of out-commuters in the working population and local joblessness on agglomeration-forces and heterogeneous functions of settlements is depicted in figure 1.

The straight arrow connecting the "share of out-commuters" and "joblessness" in the bottom part of the figure symbolizes the unambiguous but nevertheless unobserved direct negative effect: More out-commuters mean less local applicants for vacant jobs and thereby a higher probability of success on the local job-market for the remaining residents. Nevertheless, a high share of out-commuters might also be an indicator for a low local potential for the creation of jobs. If few [many] local jobs are created due to economic weaknesses [strength] the share of out-commuters is higher [lower] and joblessness is higher [lower], too. This indirect positive relation countervails the direct negative effect of out-commuters.

On the other hand, a high share of out-commuters might also be an indicator for settlements that employees from the centre have actively chosen as their places of domicile ("active residential segregation"). In these settlements the joblessness is usually lower because they are occupied by relatively wealthy employees from nearby industrial centres. This second indirect relation therefore exaggerates the direct negative effect. Consequently, a strong negative relation between the share of out-commuters and joblessness unambiguously hints on a certain concentration of economic functions in central places. The arrow that shows a positive relation between "active residential segregation" and "local realisation of jobs" indicates a possible demand-effect. Those employed at other places raise the income per capita at their place of domicile and therefore the potential for a demand driven realisation of local jobs. This effect might again countervail the usually expected negative relation between the share of out-commuters and joblessness in settlements with many out-commuters.

Figure 1: Relation between out-commuters and joblessness



Source: Own figure

We only observe the *gross* relation between the share of out-commuters and joblessness under differing conditions. In that we compare the observed gross relation under different circumstances we can draw conclusions on the underlying forces of agglomeration because the latter determine whether settlements concentrate on their function as domicile and whether the possibility to create jobs is evenly distributed among neighbouring locations.

This comparative interpretation of heterogeneous gross effects we call a technique of indirect closure. The technique somehow reverses the proceeding of causal inference as described by Pearl (2000), which in contrast serves the isolation of direct causal effects.

3 Estimation

3.1 The model

The problem of the non-observability of agglomeration-forces is tackled by the technique of indirect closure as described above. Nevertheless, the two other problems of the analysis remain: The possible non-linear relations implied by the assumed interactions of the three types of influence and the expected spatial dependence between the situation in smaller localities and the larger region they belong to. We use a mixed multi-level model for the estimation in order to cope with these problems. The mixed model allows for the implementation of common variances on different regional scales. The rational lying behind the applied hierarchical design is the idea that the economic situation of the municipalities depends only to a certain degree on the municipality's specific conditions. It is also influenced by the conditions in the further environment that is, in the districts and labour-market-regions. Therefore we expect significant common variances on these larger scales.

Our smallest regional scale of observation consists of municipalities. While in Germany in 2008 there existed 12.300 municipalities of great spatial heterogeneity, in this study we work with 4551 out of 4628 assemblies that have been created in order to provide roughly comparable units of analyses with respect to size (BBSR 2011a). If not stated otherwise in the following the term "municipality" refers to the respective assemblies of municipalities. In the analysis we differentiate between urban and rural municipalities. Municipalities are classified as "urban" if they show typical urban characteristics. They may have less than 20.000 inhabitants. The residual group of municipalities is named "rural" (BBSR 2011d). Municipalities are nested within 413 districts (NUTS-3 level). Districts make up the second level of random effects, i.e. of potentially common variances, in the model. Districts are nested within 96 labour-market regions (BBSR 2011b), which make up the third level of the hierarchical random effects. Finally we created 24 larger regional entities from cohesive labour-market regions of the same basic type (agglomerated, urban or rural (BBSR 2011c)). These make up the fourth level in the model.

In order to capture the dependencies between the spatial levels statistically consistently we simultaneously estimate fixed and random effects in a mixed model. An excellent introduction to this type of models is in Singer and Willett (2003). In the Multi-level approach the determinants on the different levels are explicitly considered (Singer 1998). At level one, the municipalities' joblessness is expressed in the unconditional model as the sum of an intercept (π_{0j}) and a random error associated with the i^{th} municipality in the j^{th} district (ε_{ij}) (ibid.):

$$Jobless_{ij} = \pi_{0j} + \varepsilon_{ij}. \quad (1)$$

At the second level the district-level intercept π_{0j} is expressed as the sum of the overall mean (γ_{00}) and the districts' random deviations from that mean (ξ_{0j}) (ibid.):

$$\pi_{0j} = \gamma_{00} + \xi_{0j} \quad (2).$$

Substitution yields the final unconditional model:

$$Jobless_{ij} = \gamma_{00} + \xi_{0j} + \varepsilon_{ij}. \quad (3).$$

This description generalises easily to the three- and four-level approach by the inclusion of additional random effects (ζ_{0j} and θ_{0j}) in equation (3).
With respect to the explanatory variables, the expectation of a heterogeneous effect of out-commuters on joblessness is central to our argument.

Therefore, if we include the out-commuters in our first-level equation (equation (1))

$$Jobless_{ij} = \pi_{0j} + \pi_{1j}Commute_{ij} + \varepsilon_{ij}. \quad (4)$$

we should not only consider systematic (spatial) variations of the intercept as in equation 2 but also of the coefficient for "Commute":

$$\pi_{1j} = \gamma_{10} + \xi_{1j} \quad (5).$$

This gives us in the integrated model

$$Jobless_{ij} = \gamma_{00} + \gamma_{10}Commute_{ij} + \zeta_{0j} + \xi_{0j} + \xi_{1j}Commute_{ij} + \varepsilon_{ij}. \quad (6).$$

In the estimation the possibility of co-variation between the different estimated variance-components can be taken into account. Nevertheless, in our case the covariance between the coefficient for out-commuting and the intercept's variance (on the district-level) proved to be insignificant not only in the unconditional but also in the final model. The covariance was therefore not estimated. Table 1 presents the resulting estimated random effects of our model.

Table 1: Estimated Variances on the different levels of the model

		Uncond.	Model 1	Model 2	Model 23
Estimated Variances					
CovParm	Level				
Intercept	Large region	12.37 ***	12.86 ***	1.56 **	1.39 *
		(4.09)	(4.24)	(0.64)	(0.65)
Intercept	Labour-market (large region)	1.68 ***	1.73 ***	0.95 ***	0.75 ***
		(0.41)	(0.39)	(0.22)	(0.17)
Intercept	District (Labour-market)	1.10 ***	0.91 ***	0.89 ***	0.32 ***
		(0.14)	(0.11)	(0.10)	(0.05)
out-commuters	District (Labour-market)		16.60 ***	16.74 ***	0.36
			(2.14)	(2.15)	(1.07)
Residual	municipality	2.54 ***	1.93 ***	1.93 ***	1.14 ***
		(0.06)	(0.04)	(0.04)	(0.03)
Reduced Variance compared with the unconditional model					
Intercept	Large region		-0.04	0.87	0.89
Intercept	Labour-market (large region)		-0.03	0.44	0.55
Intercept	District (Labour-market)		0.17	0.19	0.71
out-commuters	District (Labour-market)				
Residual	municipality		0.24	0.24	0.55
Sum			0.01	0.70	0.80
Model comparison					
-2 Log Likelihood		17992	17092	17013	13325
AIC (smaller is better)		18002	17106	17029	15005

Note: '***', '**' and '*' denote significance at the 0.1, 1.0 and 5.0 percent level respectively

Source: Own calculation with SAS, PROC MIXED

The overall mean γ_{00} as determined by the unconditional model without further fixed effects is 7.63 (percent joblessness). According to table 1 in the unconditional model the variance between the largest regions in the model (12.37) is much higher than that within these large regions. Nevertheless, after a dummy-variable that controls for differences in Germany's western and eastern states was introduced in model 2, this variance on the highest level shrank considerably. Variances on the four spatial levels were afterwards comparable in size. In model 1 the share of out-commuters was introduced into the model as fixed and as random effect. The significant high random effect shows that the relation between out-commuters and joblessness is spatially heterogeneous indeed. The introduction of out-commuters reduces variances between municipalities and variances between districts considerably. Model 23 is the final model. The sum of all variances in the intercept has been reduced by 80%. The variance in the coefficient for out-commuters has with 98% been explained almost totally. Even the variance on the lowest level, i.e. between the 4551 municipalities has been reduced by 55%, even though the model works with a very restricted set of indicators, especially on the level of municipalities.

This result was possible since various interactions in the effects of central parameters have been taken into account. The interaction of variables results naturally from the multi-level design of the mixed model. If the random-effects connected with the out-commuters are to be explained, the respective fixed effects have to be interacted (Singer 1998). This may

easily be understood if one considers the heterogeneous effect of out-commuters as modelled by equation (5). If the variation in the estimated coefficient is explained for example by "centrality" we get, starting from equation (2) and (5),

$$\pi_{0j} = \gamma_{00} + \gamma_{01}\text{Centrality}_{ij} + \xi_{0j} \quad (7) \text{ and}$$

$$\pi_{1j} = \gamma_{10} + \gamma_{11}\text{Centrality}_{ij} + \xi_{1j} \quad (8).$$

Integration in equation (4) yields

$$\text{Jobless}_{ij} = \gamma_{00} + \gamma_{01}\text{Centrality}_{ij} + \gamma_{10}\text{Commute}_{ij} + \gamma_{11}\text{Centrality}_{ij}\text{Commute}_{ij} + \zeta_{0j} + \xi_{0j} + \xi_{1j}\text{Commute}_{ij} + \varepsilon_{ij}. \quad (9).$$

Concretely, we explain the heterogeneous effect of out-commuters on joblessness and joblessness itself by

- the degree of centrality, rurality and remoteness of the municipality,
- the type of settlement (rural/urban),
- the belonging to the western or eastern part of Germany,
- the industry-structure on district-level,
- the quadratic term of out-commuters and
- by the interaction of all of these components.

Additionally, we control various effects of the share of in-commuters. In the estimation two dummy-variables have been created in order to differentiate between rural and urban and between western and in eastern municipalities. Each fix effect in the model has been estimated separately for observations in rural and urban municipalities and for western and eastern observations. Ultimately this proceeding comes down to the estimation of four separate models within one single model. This proceeding allows for the efficient usage of information in the observations and for the consistent judgement on the significance of observed differences in estimated coefficients.

For the estimation values of all variables have been centred on their respective mean in urban and rural municipalities and in the west and in the east. This proceeding facilitates interpretation (Singer 1998) and the assessment of the term's significance. Generally, the significance of the conducted step-wise model extensions has been tested by the likelihood-ratio test. Therefore, all models have been estimated with the maximum-likelihood approach. Nevertheless, maximum-likelihood estimation tends to deliver biased estimates of random effects. Therefore, the model has been re-estimated with the restricted maximum-likelihood approach for the interpretation of coefficients.

The final model that takes into account all of the interactions considered consists of 836 fixed effects including the intercept (or 209 parameters for each of the four "models" within the one model). It is therefore not possible to present the results in table form here. Moreover, due to the manifold interaction-terms the interpretation of the raw-coefficients is very difficult. Generally, the non-interacted coefficients are to be interpreted as the reference-values. Coefficients of interacted terms represent deviations from these reference-values. Their significance shows, whether a significant deviation from the reference-value exist. Therefore, in order to assess the gross-effect of an explanatory variable, all of the interaction-terms in which it is included have to be summed up. This is what we do in the representation of results. That means in order to assess the relevance of an explanatory variable we sum up the respective coefficients of their nested interaction-terms and compare them with the summed up non-nested interaction terms. In doing so each single coefficient is multiplied with one standard deviation of the explanatory variable in order to access the relevance and the size of the different effects. In the case of interaction terms the standard deviation is constructed by the multiplication of the standard deviations of the variables involved in the interaction.

3.1 The data

The endogenous variable of our model is joblessness in the municipalities. Joblessness indicates idle economic (human) capacities as well as a low income at least of the concerned share of the population. Nevertheless, it may not be interpreted as a general indicator of a region's economic situation since population-heterogeneity has to be taken into account. The descriptive statistics of joblessness in table 2 clarify this point.

Table 2: Description of joblessness in 2007 (percent) in German municipalities (N=4551)

Joblessness		N	Mean	Std.dev.	Minimum	Maximum
East	City	244	12.33	3.69	3.10	22.50
	Rural	782	10.69	3.24	3.50	22.60
West	City	1192	5.12	2.06	1.30	13.70
	Rural	2333	3.95	1.55	1.20	15.00

Source: Own calculation based on (INKAR 2009)

The table shows that in rural municipalities joblessness is significantly lower than in urban municipalities. Nevertheless, by all we know this will probably not be due to the higher economic potential of rural municipalities but rather to a different structure in the population. Employable, job-seeking people tend to move to economically dynamic centres, with those persons, which are not employable or have an employment remaining in rural settlements. We control this effect by our differentiation in rural and urban municipalities and by the introduction of the economic-/geographical position of settlements in the model. Even more striking is the difference in joblessness in Germany's east and west as highlighted in table 2. Since this difference is an expression of

historically caused deep structural differences in the general economic situations all coefficients have been estimated separately for east and west. These differences have been confirmed by the model. Explanatory variables of the statistical model are presented in table 3.

Table 3: Descriptive statistics of explanatory variables (N=4551)

Indicators				Statistics			
Regional Level and label	Type	Meaning	Source	Mean	Std.dev.	Min	Max
municipality							
jobless	Ratio	Officially job-seeking residents in relation to all employable residents	INKAR 2009	5.86	3.62	1.20	22.60
out-commute	Ratio	Out-commuting employees in relation to residential employees	Federal Job Agency	0.76	0.15	0.07	1.00
in-commute	Ratio	In-commuting employees in relation to residential employees		0.48	0.32	0.05	4.06
PC_Central	Principal Components describing geographical position	"Centrality"	INKAR 2009	0.00	1.53	-13.06	7.46
PC_Rural		"Rurality"		0.00	0.92	-2.05	9.55
PC_Peripheric		"Remoteness"		0.00	1.00	-3.77	8.96
district							
IndustryDiv	Raw	Number of different industries on the two-digit NACE level; Industry-diversity	Federal Job Agency	25.70	2.18	16.00	30.00
HighQuali	Principal Components describing the industry-structure	Highly qualified labour force		-1.11	2.04	-5.42	10.58
PaperPrintVehicl		Paper Printing SpecialVehicles		0.07	1.11	-6.52	4.87
ChemiGum		Chemical - Gum		-0.04	1.11	-3.99	6.83
DataElectro		Data Electronics		-0.03	1.08	-5.73	5.06
Engineer		Engineering offices		0.05	0.96	-5.38	4.58
SpecialProd		Special Production		0.00	1.01	-6.57	5.60
MachinesTextile		Machines Textile		0.03	1.02	-3.79	4.19
HotelPublTransp		Hotel Public Transport		-0.01	2.13	-8.91	7.32
DominatingAuto		Dominating Enterprise Automotive		-0.22	1.46	-6.41	8.74
Medium-Size		Medium-Size Enterprizes		0.08	1.53	-7.00	3.95
Public		Public Service		-0.11	1.36	-9.55	4.43
SimpleProd		Simple Products		0.22	1.22	-3.98	4.71
Retail		Retail Industry		-0.23	1.16	-3.43	4.71
ChemiPharma		Chemical - Pharma		-0.01	1.18	-11.06	4.10
Finance		Finance		-0.17	1.14	-5.76	4.20

Source: Own calculation based on sources stated in the table

As table 3 shows many exploratory variables, which would be necessary in order to describe the geographic position and the industry-structure of municipalities and districts, have been combined in principal components, which explain the variables' common variance with fewer synthetic variables. The loadings of the identified Principal Components that describe the geographic positions are reported in table 4. It can be shown that the PC labelled "Rural" has high loadings in eastern German municipalities. This is attributable to the fact that in western Germany family-farms dominate, whose labour is

self-employed and not included in the statistic of dependent employees. Comparable "rural" municipalities in the western counties can be shown to have a low value in all of the three uncorrelated PCs. They will therefore make up the reference-group or the intercept in the estimated model. Actually it will become obvious that their results are comparable to those with a high value in the PC "Rural".

Table 4: Loadings of the principal components on geographical position

Original Variables	Principal Components		
	Central	Rural	Peripheric
Share of employees in services	0.36	0.31	0.84
Distance of middle-order centre (travel-time)	-0.70	-0.08	0.28
Distance of high-order centre (travel-time)	-0.68	0.01	0.17
Distance of agglomeration-centre (travel-time)	-0.68	-0.19	0.31
Share of employees in agriculture & forestry	-0.49	0.83	-0.25
Population-density	0.74	0.15	0.14

Source: Own calculation with SAM (Rangel et al. 2010) based on sources stated in table 3

While the other variables were available on the municipality-level this is not the case for the number of firms and of employees in the different industries. Due to statistical non-disclosure rules these are only accessible on the district-level. Variables describing the industry-structure on district level include the share of employees with different educational levels and the share of firms in different size-classes in terms of employees (table 5).

Table 5: Variables for the description of industry-structure by principal components

Variables	Mean	Std.dev.	Min	Max
Share of "lost" employees in an industry due to disclosure-rules; if high, the industry is dominated by max. 3 large establishments.	0.08	0.08	0.00	0.60
Share of employees...				
... in establishments with ...				
>250 employees	26.20	10.88	3.57	72.70
>100 and <250 employees	15.46	3.09	3.41	29.43
<10 employees	19.87	4.95	5.41	35.37
... without professional training	15.52	4.48	6.28	27.67
... with higher professional training	8.45	2.92	3.36	19.24
... with university-degree	5.79	3.41	1.48	21.63

Remark: District-level; N = 413; share of employees in different industries not shown
Source: Own calculation based on data from the federal Job Agency

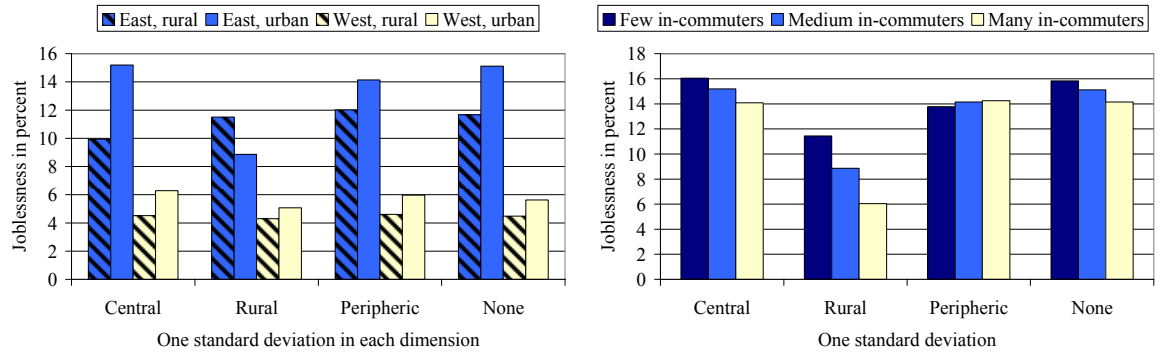
Regional specialisation in industries is captured by the share of employees in each of 85 industries (two-digit NACE-Classification). From the latter the information on the 20 branches of the manufacturing sector was included. The branches of the service-sector have been further aggregated, resulting in 25 aggregated service-industries. With these 45 variables and those on firm-size and education on district-level (table 5) 15 PCs have been constructed. Due to space-limitation we omit the presentation of the loadings. The

description of the variables in table 2 refers to those original indicators with the highest loadings on the different PCs.

4 Results

Results are presented graphically. In the different graphics we compare the estimated joblessness in different situations, which are characterised by one standard deviation in the variables concerned. A first example is given in figure 3. Here in the left figure the estimated joblessness in rural and urban municipalities in the east and in the west is further differentiated by the municipalities' geographic position. Here "Central" means that while all other covariates are at their mean value (zero, due to the centring) the principal component describing centrality is one standard deviation above its mean. Those values described by "None" on the x-axis in figure 3 have their mean-value in all three of the geographic dimensions. According to the left figure with a mean value in in-commuters and out-commuters and a mean value in all industry-dimensions, joblessness in the east and in the west is highest in urban municipalities in a relatively central position (for an interpretation compare table 4). At the same time, especially in the east according to these results under the given conditions joblessness in rural municipalities in central position is low. The latter obviously profit from the nearby economic centre.

Figure 3: Estimated joblessness (left) and further differentiation by the relevance of in-commuters in eastern urban municipalities (right)



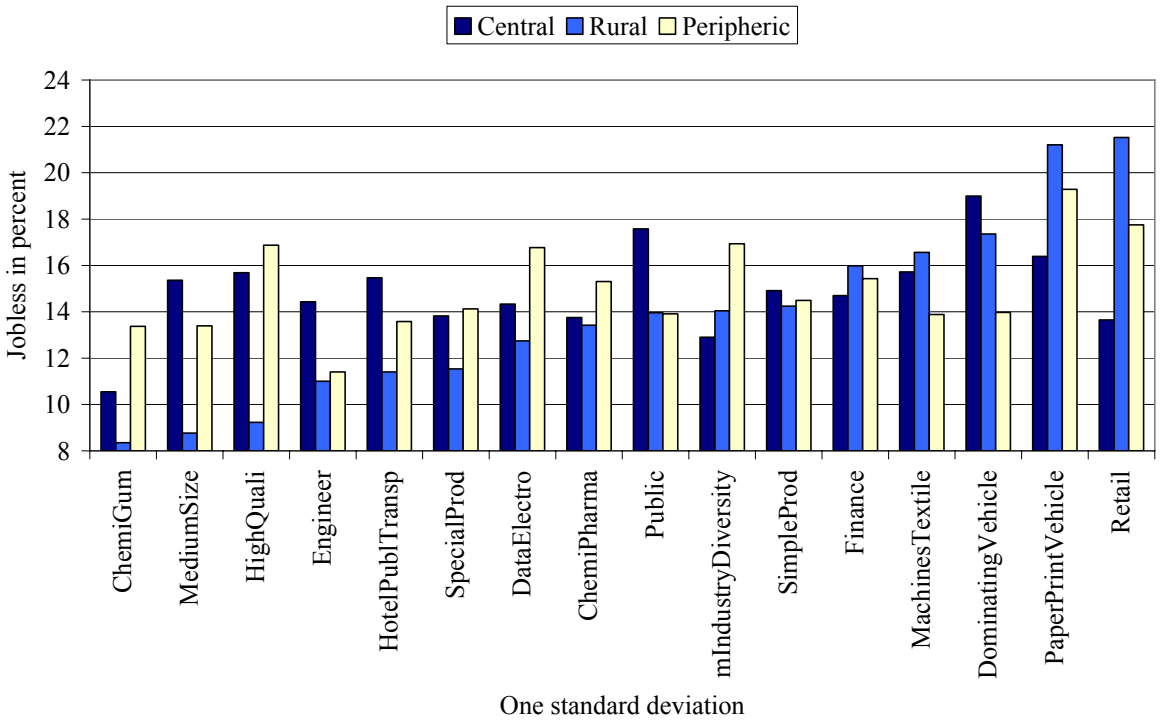
Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

Only among those municipalities in a rather "rural" geographic position in the east is joblessness lower in urban municipalities than in rural municipalities. Obviously, the selection of the population as described above is not as relevant here as elsewhere. The underlying forces that cause joblessness may be illuminated for the example of urban municipalities in the east by the right figure. The right figure further differentiates joblessness in urban municipalities in the east by the share of in-commuters. Here, "few [many] in-commuters" indicates a situation with one standard deviation below [above] the mean value of in-commuters in urban municipalities in the east. The negative relation between joblessness and in-commuters indicates the relatively low level of competition with residents for those jobs provided. Those municipalities in a rather central position in

contrast show a similarly low competition-effect but at the same time a higher level of joblessness, which might therefore be attributable in part to the self-selection of the population. In rather peripheric communities, on the other hand, we observe a slightly positive relation between in-commuters and joblessness. We infer on a stronger competition effect. The relatively high level of joblessness might therefore to a wider degree be attributable to the insufficient potential of job-creation and to a lower degree to a self-selection of the population than in "central" municipalities.

In figure 4 estimated joblessness in eastern urban municipalities is presented at mean commuter-rates again, but this time differentiated by industry-structure and geographic dimensions.

Figure 4: Estimated joblessness in urban municipalities in the east by geographical dimension and industry-structure

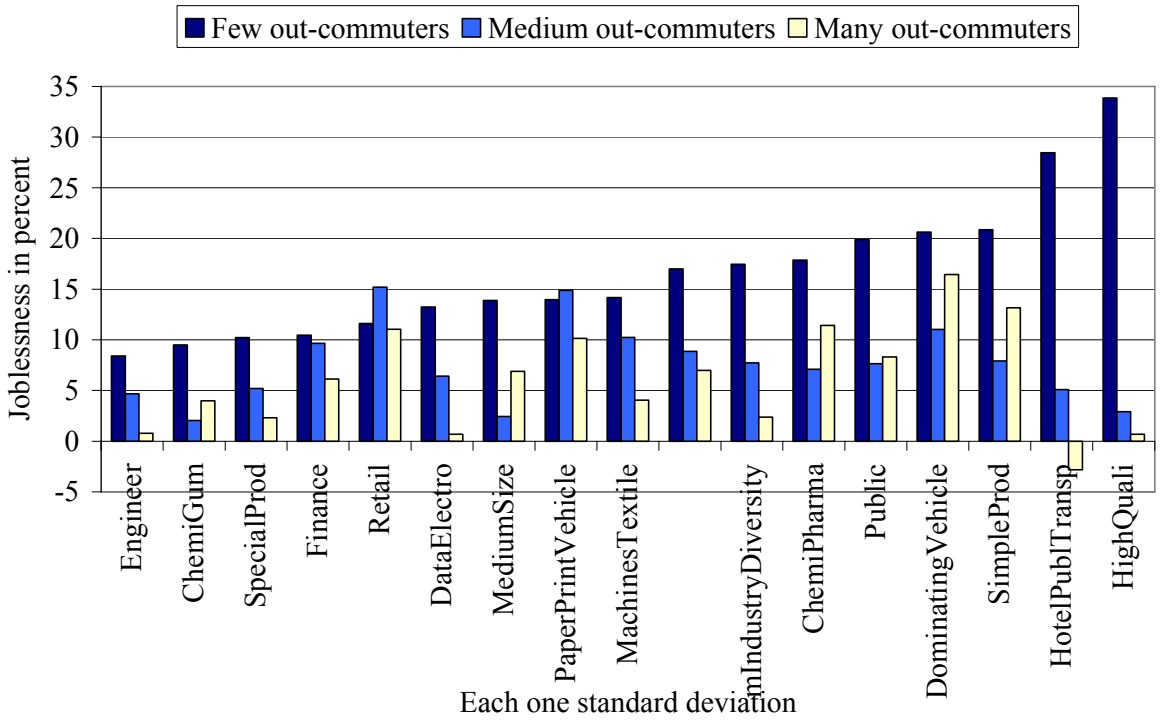


Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

The figure shows that in such industry-structures for which joblessness is low in rather "rural" positions, joblessness is relatively high in rather central and peripheric positions and vice versa. In fact, the dependence of joblessness on industry-structure seems to be highest for those urban municipalities in rather "rural" position. This differentiation in figure 4 further shows that it is only for certain industry-structures that the finding from figure 3 holds true that joblessness is lower in "rural" geographic positions. In urban municipalities in rather "rural" regions in the east joblessness is especially high if the industry-structure is characterised by the retail-sector or by the print- and paper-industries. Nevertheless, a further differentiation of urban municipalities in the east in a "rural"

geographic position shows that this rank order does only hold true if we concentrate on those municipalities with a moderate share of out-commuters (figure 5).

Figure 5: Estimated joblessness in urban municipalities in the east in "rural" geographic position differentiated by out-commuters

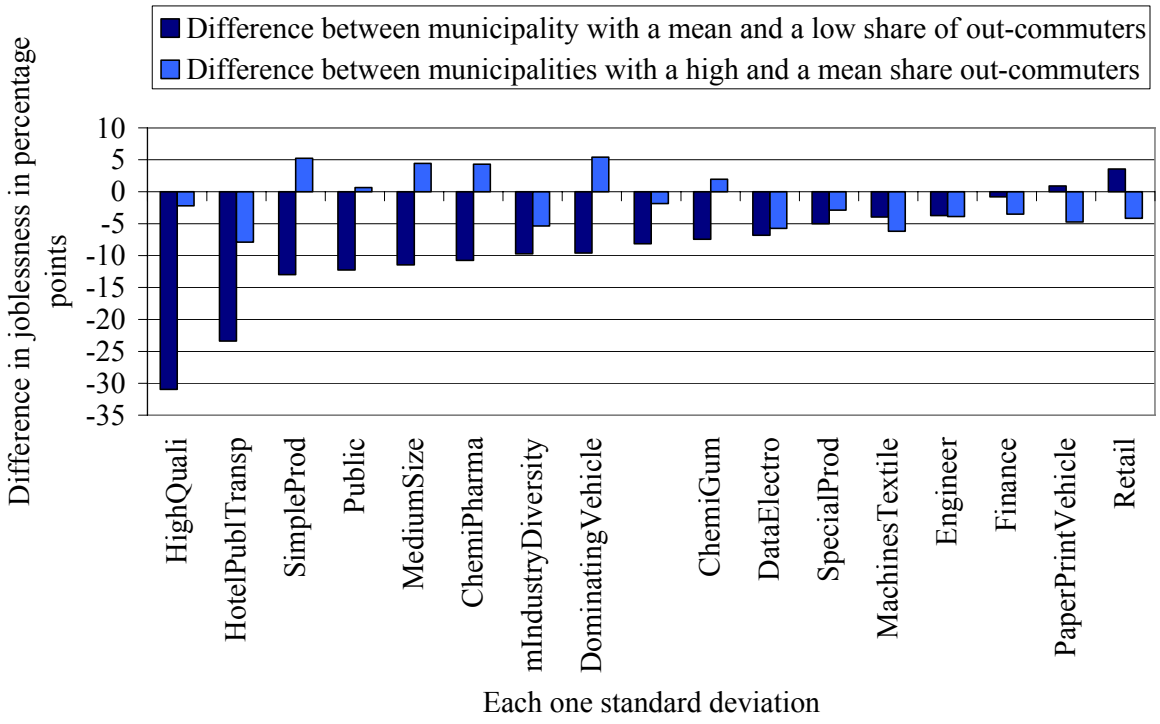


Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

Figure 5 differentiates further among urban municipalities in "rural" position with a low, a moderate and a high share of out-commuters. With few out-commuters, joblessness in eastern urban communities in "rural" position is highest if the regional industry-structure is characterised by highly qualified employees. Simultaneously, here joblessness is extremely low if there is a moderate or a high share of out-commuters. Obviously, jobs in this type of industry-structure are spatially highly concentrated. A low joblessness with few out-commuters hints on a high endogenous potential to create jobs. According to figure 5 this is highest among those municipalities under consideration if the regional industry-structure is characterised by engineering services, by production with synthetic materials and by industries with special products. Nevertheless, in "rural" areas joblessness is generally high with few out-commuters, which clarifies that their economic situation is determined by some centres and much less so by their endogenous development. This "dependence" is obviously favourable in economically viable surrounding as in industry-structures characterised by highly-qualified labour. On the other hand a weaker dependence on the centre, as the relatively low joblessness with few out-commuters in regions characterised by the retail sector shows, needs not be economically positive. This is so because a weaker centre, i.e. lower forces of agglomeration, often means a less vital regional industry structure.

In order to interpret the underlying agglomeration forces in more detail, another way of presentation of the results in figure 5 is chosen in figure 6.

Figure 6: Estimated impact of out-commuters on joblessness



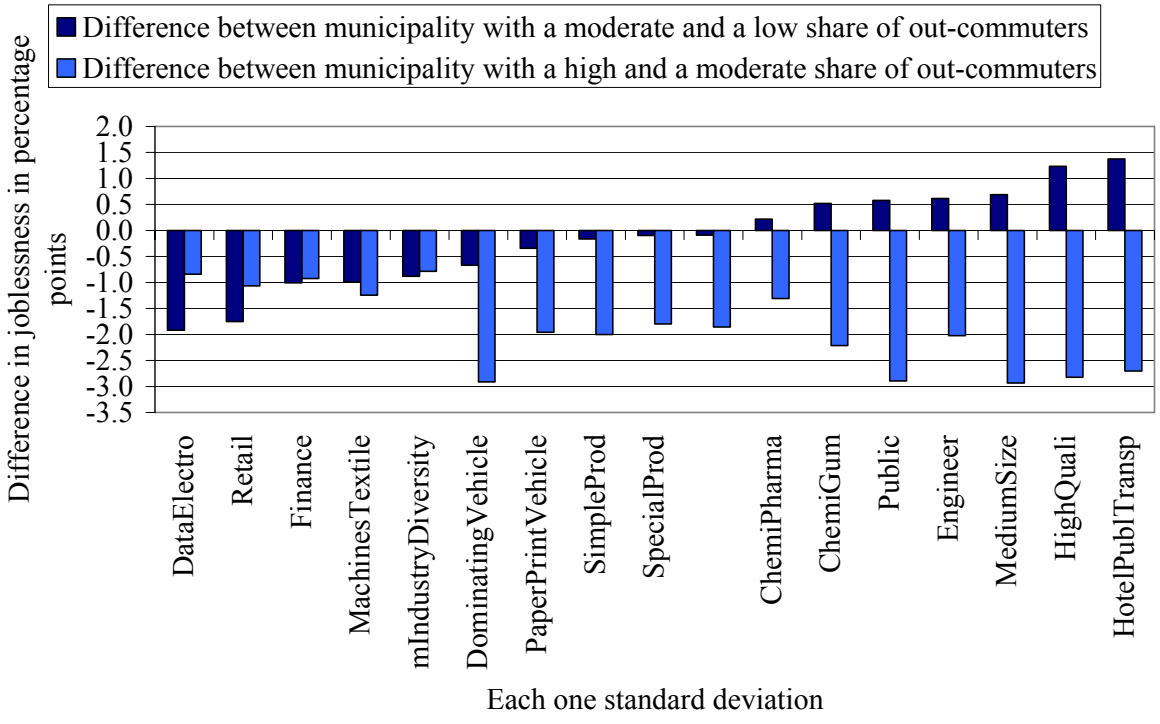
Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

Figure 6 shows the difference in joblessness that is observed between (1) municipalities with a moderate share of out-commuters and those with a low share of out-commuters and (2) between municipalities with a high and a moderate share. The differences in figure 6 represent the differences between the first and the second and between the second and the third bar in figure 5 sorted by the size of the effect of the first difference. The figure shows, for example, that in regions characterised by industries with highly qualified labour, joblessness is much lower with a moderate share of out-commuters than with only few out-commuters. This strong negative relation hints on strong spatial concentration of jobs. On the other hand, municipalities with a high share of out-commuters do not show a comparable reduction in joblessness in reference to the situation with a moderate share of out-commuters in regions with highly qualified labour. According to this observation there is no further qualitative differentiation between municipalities with a moderate and a high share of out-commuters due to active residential segregation. Instead, the *additional* share of out-commuters seems to indicate that the respective municipalities have not yet exhausted their own potential for the creation of jobs. This potential might either arise due to the demand-effect with a high share of out-commuters or it represents those basic jobs in immobile industries that remain everywhere. This same conclusion applies to those cases, where the effect of the first difference is negative and the second is positive.

On the other hand, if the regional industry-structure is characterised by retail services, eastern urban municipalities in a rather "rural" position cannot rely on the provision of jobs by some centre but have to activate their own potential. This is indicated by the respective positive relation between more out-commuters and joblessness in figure 6. Despite of the low concentration of economic functions on specific centres the negative gross effect of out-commuters on joblessness is stronger in municipalities with a high share of out-commuters. This stronger negative relation between a high share of out-commuters and joblessness shows that among theses urban municipalities the potential to create jobs within the structure characterised by retail services is lower than in those municipalities with a moderate share of out-commuters due to some unobserved effects. This contrarian relation between out-commuters and joblessness among municipalities with a low and a high share of out-commuters indicates that some further self-enforcing differentiation takes place among urban municipalities. Interestingly, this pattern is far more obvious among rural municipalities in "rural" (figure 7) or central (not presented) position in eastern Germany.

According to figure 7, the higher the potential/necessity is to create jobs in the respective municipalities themselves in those municipalities with relatively few out-commuters, the lower is the same potential in those municipalities with relatively many out-commuters. Again, this observation hints on a strong endogenous differentiation due to unobserved factors especially among rural municipalities.

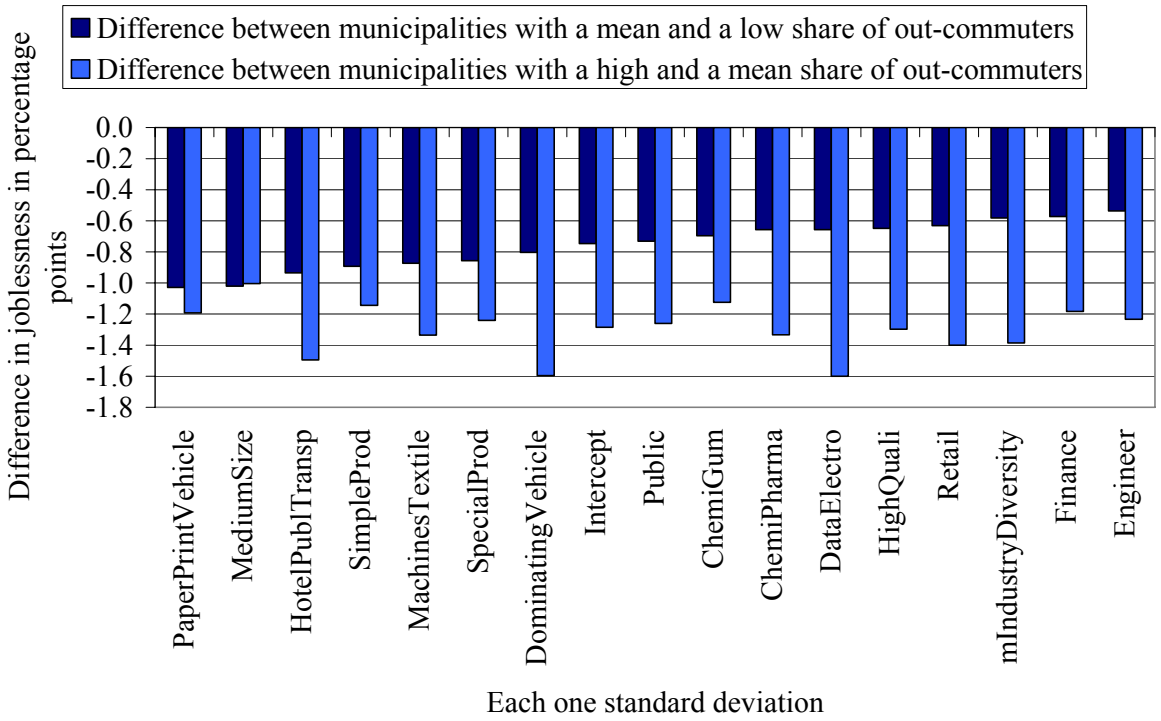
Figure 7: Estimated impact of out-commuters on joblessness in rural municipalities



Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

Figure 8 may be compared with figure 6. It shows the same effect of differences in the share of out-commuters on joblessness in urban municipalities in a rather "rural" position but for Germany's western counties. The effects are much smaller as the absolute joblessness is much lower, too. The observed relation between out-commuters and joblessness is generally negative which indicates that the observed gross-relation may be dominated by the direct effect of out-commuters on joblessness as indicated by the solid arrow in figure 1.

Figure 8: Estimated impact of out-commuters on joblessness in the west



Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

This would imply that the potential for the local creation of jobs depends much less on the regional industry-structure than in the east. At the same time, in nearly all situations as controlled by industry-structure is the relation between out-commuters and joblessness more negative in municipalities with a high share of out-commuters than in communities with a low share of out-commuters. In the possible presence of a relative industry-concentration this may either be due to residential segregation or to a lower potential for local job creation in those municipalities with a higher share of out-commuters. In both cases we would conclude that some further qualitative differentiation between those municipalities with few and with many out-commuters exists. All in all, these results hint on a lower structural differentiation between large-scale regions in the west, which is nevertheless accompanied by a systematic differentiation between municipalities within these larger regions.

4 Conclusions

It was the aim of the current paper to shed some light on the relation between regional industry-structure and the development of settlements within the regions. Thereby, we hoped to gain some knowledge on the dependence of localities on their economic surrounding on the one hand and on their endogenous dynamic on the other. We applied a technique of indirect closure in that we interpreted the observed relation between the local share of out-commuters and joblessness referring to a simple theoretical model. We compared the estimated relation for localities in different geographic position, with different industry-structure and of different settlement-types. We also differentiated between municipalities with a high, a moderate and a low share of out-commuters. This we did, because we had introduced a quadratic term of the share of out-commuters in the model in order to control for non-linear effects that might be due to such phenomena like residential segregation or indirect demand-effects. Each coefficient was estimated separately for Germany's east and west, a proceeding that proved to be highly significant.

We were able to show that joblessness in central urban municipalities is partly determined by the self-selection of residents. Therefore, while high levels ob joblessness may be due to this effect in central regions in rather peripheric position, a stronger competition-effect was shown to exist between in-commuters and residents. This shows the qualitative difference in the kind of the likewise observed high level of joblessness. We also showed that the relation between industry-structure and joblessness depends on the settlement's geographic position. In Germany's east the dependence of settlements on their economic environment was found to depend strongly on the region's industry-structure. At the same time it became obvious that "dependence" of settlements may be favourable in economically viable surroundings as in industry-structures characterised by highly-qualified labour. On the other hand a weaker dependence on the centre needs not be positive economically. This is so because a weaker centre, i.e. lower forces of agglomeration, often goes along with a less vital regional industry structure. Finally, we found that in Germany's east there are some municipalities that show a higher share of out-commuters not because they depend on some centre's jobs but because they have not yet realised their own potential for job-creation. For different industry-structures in Germany's east and generally for Germany's west we found in contrast that those municipalities with a low share of out-commuters and those with a high share of out-commuters are differentiated due to unobserved differences and endogenous differentiation. We found also that in the west the local realisation of jobs depends much less on the regional industry-structure than in the east.

Taken together, the results draw the picture of a complex multi-layered structure of functionally differentiated regions on different scales of observation. Nevertheless, this analysis was only a first approach to the difficult question of regionally heterogeneous small-scale patterns of the economic landscape. Further investigations of these questions are important because of the potential implications for the design of regional policies that

might have to be differentiated depending on the surrounding of a settlement and its dependence. The results shed some doubt on policies that treat regions as separate entities, each with the theoretic ability for endogenously created sustainable growth. The observed functional differentiation of regions rather implies that a municipality's position in a larger regional-economic structure largely determines its economic development.

Analyses that compare the economic development of different regions as well as plans for policy-interventions have to consider such patterns. Likewise, empirical economic inquiries have to take account of the complex patterns that prohibit simple aggregations from small-scale observations. The question of scale has to be approached much more offensively than it is the case currently. As we showed, agglomeration effects may affect all observations independently of scale likewise but it might just as well go along with considerable diffusion of economic activity on the small scale.

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