Small scale economic differentiation – 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 is often applied in order to secure analytical tractability. As a matter of fact the simultaneous acceptance of all these qualifications would have dramatic consequences in terms of rising complexity. If, for example, we consider Marshallian externalities simultaneously with the possibility of spatial price discrimination, differing agglomeration-patterns should be expected depending on the historically caused differing industry-structures. Qualitative knowledge on characteristics of different industries then becomes relevant for the assessment of economic development potentials in different regions and on different regional scales. Torre (2008) classifies industries along two dimensions: (1) the strength of the organization of inter-firm relations and (2) the strength of localisation-tendencies of inter-firm relations. He summarizes some possible reasons for disadvantages of agglomerations. According to his classification of industries the weight of these (dis-)advantages may differ for different industries and firm-sizes. Therefore, localities within regions might be differently affected by forces of agglomeration depending on the prevailing industry structure. These differentiated patterns of economic development on small scale geographic levels have seldom been analysed so far.

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Storper and Walker (1989) have stressed the relevance especially of large and innovative enterprises for the economic development of regions. Markusen (1996) has worked out a scheme of differing local business structures depending on the types of industries that characterise the regional economy. Spatial consequences of these differences within the regions under consideration have not been addressed in depth, though. Much less so has the concrete relevance of the qualitative differences for small-scale localities been in the focus of systematic empirical analyses so far. Nevertheless, small scale spatially differentiating effects are important for two reasons. Firstly, their observation allows drawing conclusions on the very nature of spatially differing industry structures. Secondly, small scale heterogeneity in the relation between industry structure and local prosperity is of social relevance if we consider the question of endogenous potentials of localities for self-sustained developments. Regional policies have to be designed differently, depending on the way by which localities depend on their economic surrounding.

Thereby, the second shortcoming of many analyses as identified in the first paragraph, the definition of regions irrespective of the problem of separability and scale-effects turns out to be critical. The lower the scale of observation is, the stronger is the dependence of the separate regions on their environment and on other regions. The higher the scale of observation is, the less pronounced is the specifity of different regions and thereby the variance to be explained. The continuum of space consists of virtually innumerably many “types” of regions and techniques of rather arbitrary segregation might cause misleading results due to oversimplification and misleading generalisations. This problem has been identified by Robinson (1950) and labelled as “ecological fallacy”.

We try to assess the real-world complexity that results from spatial dependencies and resulting small-scale heterogeneity with a specific quantitative approach. The technique of indirect closure therein allows us to handle the problem of scarce data on low spatial dimensions while we model spatial dependencies within a mixed multi-level model.

2 The theoretical concept

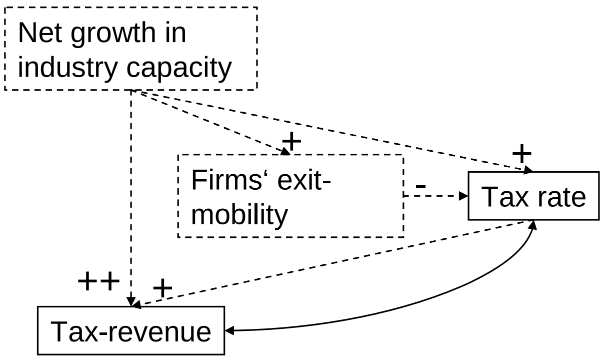
We analyse the relationship between regional industry-structure, geographic location and the type of agglomeration-effects respectively small-scale competition among industry-locations. We are especially interested into the degree to which the municipalities’ situation is determined by the larger economic environment. The competitiveness of locations depends on its attractiveness for new firms and on the willingness to leave of existing firms. We view the existing situation as the result of these very forces. Given structures therefore reveal the respective strength of the economic forces involved. Therefore, we interpret a high business-intensity as an expression of otherwise unobserved factors that contribute positively to business location. These we call “agglomeration factors”. We conclude that firms’ willingness to settle down (their “entry-mobility”) is positively related to agglomeration-factors.

On the other hand those firms that entered last are expected to have the highest exit-mobility for two reasons. Firstly, they have not yet built up a strong regional embeddedness. Secondly, there are certain industries, which are principally immobile or able to pass on possible local disadvantages to their customers (regional monopolistic competition). We assume that the strength of agglomeration-forces and the relation of entry- and exit mobility of firms depend on the local industry-structure, on the region’s remoteness and on a combination of these two factors. Industry-dynamics determine regional competition between potential industry-locations. If, for example, a regional economy is geographically characterised by local agglomeration-forces, then some localities are characterised by the attraction of new firms, while the other localities’ development will largely depend on the development of these agglomerations. If, on the other hand agglomeration-forces are low, then this causes the majority of localities to strive for the attraction of industries.

Nevertheless, the foundation of firms and firm-exits are not well documented in German statistics and especially on the small regional scale of municipalities only very few economic indicators exist. Therefore we take advantage of the fact that in Germany a local business-tax exists with municipalities exerting autonomous choice of the tax-rates. In order to optimise their choice, municipalities have to consider the institutional rules of federal redistribution of fiscal resources as well as the competition-effect of their decision. In the federal system of redistribution, the single municipality’s contribution is calculated on the basis of business-tax-revenue less the share that is due to a higher tax-rate. This proceeding is supposed to prevent tax-rates from a race to the bottom in ruinous competition among industry-locations. In the following discussion we abstract from these institutional aspects[1] since their effects on the relation between tax-rate and tax-revenues are of linear nature and we restrict ourselves on the interpretation of relative effects among neighbouring municipalities.

We concentrate on the competition-effect of the local business-tax. In our approach the relation between tax-rate and tax-revenue under different conditions serves as an indicator for the type of competition between municipalities. Specifically the relation is assumed to reveal the strength of non-observable agglomeration-forces at a low-scale regional level. This proceeding of "indirect closure" somehow reverses the proceeding of causal inference as described by Pearl (2000).The competition-effect influences the observed relation between the local tax-rate and local business-tax revenues (figure1).

Figure 1: Relation between local business-tax rate and revenue



Source: Own figure

In figure 1 one-directional arrows represent causal relations, which cannot be observed as indicated by the dotted lines. We also do not observe the net growth in industry-capacity on the local level nor are we able to take track of firms' propensity to leave their location, their exit-mobility. We only observe the tax-rate and the business-tax revenue in the single municipalities. We also estimate their relation under different circumstances, as indicated by the solid, double-headed arrow. This estimated gross effect is determined by the direct causal effect that the tax-rate exerts upon tax-revenues and by the unobserved causal effects as they are depicted by the other dotted arrows. If the relation was determined by the outer triangle of causal arrows, the observed gross effect would be strongly positive. According to this figure, if new industry-settlement is on a

[1] For discussion on the incentive effect of federal redistributive institutions and local business-tax rates see

high [low] level, tax rates will be high [low] and tax-revenues will be high [low], too. This moderated indirect positive relation adds to the positive direct effects. We call this indirect positive relation between tax rates and tax revenues the agglomeration effect.

If, on the other hand, we take into consideration that with a growth in industry-capacity the mobility of existing and of new firms rises, we expect municipalities to lower their tax rate. On the contrary, if the net growth in the number of firms is low, the firms' exit-mobility is low, too. Tax rates in this case are chosen relatively high in spite of the low tax-revenues. If this "competition-effect" is high, the positive relation between tax rate and tax revenue becomes lower and turns finally negative: the higher the net-growth in firm-number the lower in this case the tax rate but the higher the tax revenue.

So far, a strong positive relation between tax rate and tax revenue is interpreted as an indicator for agglomeration effects. This means a development along a low-growth path for some localities and along a high-growth path for others. A negative relation in contrast has been interpreted as indicator for a competition-effect that is, for the potentially equal distribution of growth among municipalities. There is one ambiguity in the interpretation of the relation described. The discussion seems to imply that in each region either the agglomeration or the competition effect prevails. It is rather probable, though, that in a region the competition-effect dominates among those municipalities, which are negatively affected by the agglomeration effect of the high-growth municipalities. This would imply that among municipalities with high growth-rates we observe a positive relation between tax-rates and tax revenues and among those with low growth rates we observe a negative relation between tax rates and tax revenues. In this case, those municipalities with a medium tax-rate would show the lowest tax-revenues. The rational for this expectation is that low tax-rates in this case are an indicator for potentially mobile firms and thereby for a rather vital economy. Higher tax rates in the presence of low tax-revenues show that municipalities maximise tax revenues in taking advantage of the immobility of the few remaining firms. In the empirical investigation we are going to test this hypothesis by the inclusion of quadratic terms.

There is a possible endogeneity in this problem: Tax-rates influence firms' mobility and vice versa. Therefore, in figure 1 the arrows between tax rate and "net growth in industry capacity" respective "firms' exit mobility" and the respective signs of causality

for example (Büttner 2005).

could be reversed. Nevertheless, tax-rates may be adapted to a changing mobility of firms much faster than the mobility of firms may react towards changed tax-rates. Additionally, we assume to observe relations between tax rate and tax revenues that are the result of rational, optimizing behaviour of local authorities. Therefore, if we explained an observed negative relation between tax rate and net growth in industry capacity the critical reader would have to ask, why municipalities do not lower their tax-rates in order to overcome this disadvantage. The only answer would be that some underlying unobserved causes justify this behaviour, which leads us back to the direction of causality chosen in figure 1.

3 Estimation of the relations

3.1 Data

In the following we explain business tax revenues in the municipalities per inhabitant statistically by local business tax rates and other regional characteristics such as indicators of remoteness and industry-structure. Local business taxes are the main source of municipality funds. The tax revenue per inhabitant is an (imperfect) indicator of the municipalities' industry-intensity and of their institutional wealth. While in Germany in 2008 there existed 12.300 municipalities of great spatial heterogeneity, in this study as in many others we work with 4628 assemblies that have been created in order to provide roughly comparable units of analyses with respect to size (BBSR 2011a). Some indicators are provided on this basis, others have been aggregated or the assemblies' mean-values of their municipalities have been created. If not stated otherwise in the following the term "municipalitiy" 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 2011c). In the estimation a dummy-variable has been created in order to differentiate between rural and urban municipalities according to this classification. Another dummy-variable differentiates between municipalities in western and in eastern counties of Germany. Table 1 shows basic statistics describing business-tax revenues in those 4551 municipality-assemblies used in the analysis.

Table 1: Description of business tax revenues per inhabitant 2007 (Euro) in German municipalities (N=4551)

Local business tax		N	Mean	Std.dev.	Minimum	Maximum
East	City	244	210.12	155.54	26.30	1132.50
	Rural	782	182.67	337.31	-97.30	4501.70
West	City	1192	386.82	459.16	-94.50	7149.90
	Rural	2333	216.52	283.82	-243.50	6192.40

Remark: Data are net the municipalities' contribution to the federal system of fiscal redistribution
Source: Own calculation based on (INKAR 2009)

The table shows that the mean municipalities' business tax revenues per inhabitant net their contribution to the federal system of fiscal redistribution is higher in rural municipalities than in urban municipalities and higher in the west than in the east (before reunification). Explanatory variables of the statistical model are presented in table 2.

The share of employed inhabitants has been included due to the fact that the tax revenue is given in relation to the number of inhabitant. It therefore corrects for the different employment-intensities in the populations of municipalities. The relative commuting balance is central in that it helps to differentiate between economically central and economically peripheric municipalities. The tax-rate variable has been differentiated into the mean-value of each labour-market region (BBSR 2011b) and the deviations of the tax rates of the single municipalities within these labour-market regions from the respective mean.

The same procedure has been applied to the Principal Components (PCs), which describe the municipalities' position in the economical geography. The respective PCs have been constructed with the help of central variables in the definition of "rurality" and "remoteness".

Table 2: Descriptive statistics of explanatory variables (N=4551)

Regional Level and label	Type	Meaning	Source	Mean	Std.dev.	Min	Max
municipality							
Tax_revenue	Raw	Local business tax revenue per inhabitant	INKAR 2009	254.97	351.58	-243.50	7149.90
Commute_balance	Ratio	In- minus outcommuting employees in relation to residential employees	Federal Job Agency	-0.28	0.41	-0.92	3.26
Employment	Raw	Share of employed adult inhabitants		51.71	4.66	24.70	92.90
labour market region			Statistical federal and county offices				
mean_Taxrate	Aggregate	Mean tax rate		343.22	30.20	294.79	457.08
municipality							
dev_Taxrate	Deviation	Deviation of mean tax rate		0.00	23.99	-141.70	171.46
labour market region			INKAR 2009				
meanPC_Central	Principal Components describing geographical position	Mean "Centrality"		0.00	0.96	-3.01	3.04
meanPC_Rural		Mean "Rurality"		0.00	0.48	-0.76	1.81
meanPC_Remote		Mean "Remoteness"		0.00	0.46	-1.04	1.94
municipality							
devPC_Central		Deviation of Mean "Centrality"		0.00	1.19	-11.15	7.74
devPC_Rural		Deviation of Mean "Rurality"		0.00	0.78	-2.50	8.68
devPC_Remote		Deviation of Mean "Remoteness"		0.00	0.88	-4.27	7.32
district			Federal Job Agency				
IndustryDiv		Industry-diversity		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
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
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

Source: Own calculation based on sources stated in the table

The loadings of the identified Principal Components are reported in table 3. 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 3: 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 2

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, the share of firms in different size-classes in terms of employees and the share of firms 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 15 PCs have been constructed. Due to space-limitation we omit the presentation of all loadings. The description of the variables in table 2 refers to those original indicators with the highest loadings on the different PCs.

3.2 The model

The statistical model has to reflect the hierarchical structure of the data that became obvious in the discussion of table 2. The rational lying behind this 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, the municipality's relative situation as compared to its neighbouring municipalities might be of higher relevance in the explanation of its specific situation than absolute values.

In order to capture these dependencies 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' tax revenue 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.):

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

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.):

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

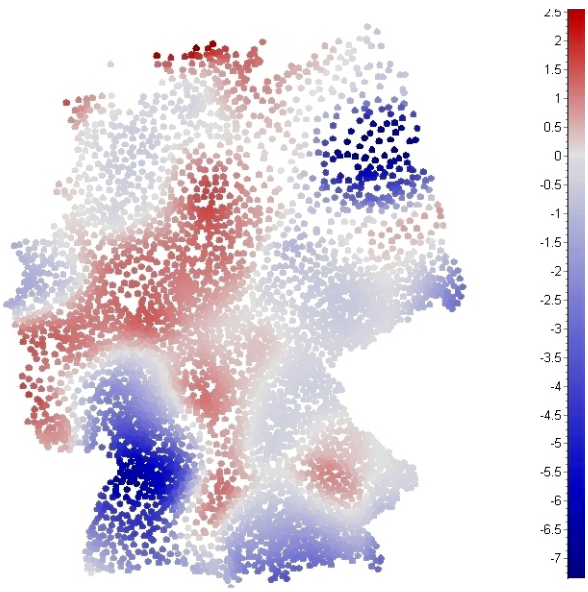
Substitution yields the final unconditional model:

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

This description generalises easily to the three-level approach by the inclusion of an additional random effect (ζ_{0j}) in equation (3).

With respect to the explanatory variables the expectation of a heterogeneous effect of tax-rate on tax-revenue is central to our argument. The actual heterogeneity of the relation between tax-rate and tax-revenue even on a rather large scale may easily be shown by the spatially differentiated coefficient of tax-rate in explaining tax-revenue in a simple linear but spatially weighted regression-model (GWR). The spatial distribution of this coefficient in Germany is shown graphically in figure 2.

Figure 2: Spatially differentiated estimated relation between local business-tax rate and revenue



Source: Own figure

Therefore, if we include the tax-rate in our first-level equation (equation (1))

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

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

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

This gives us in the integrated model

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

Similarly we expect the commuter-balance (see table 2) to relate differently to tax-revenues, depending on the respective relevance of agglomeration effects in the different districts:

$$Revenue_{ij} = \gamma_{00} + \gamma_{10}Taxrate_{ij} + \gamma_{20}Commuter_{ij} + \zeta_{0j} + \xi_{0j} + \xi_{1j}Taxrate_{ij} + \xi_{2j}Commuter_{ij} + \varepsilon_{ij}. \quad (7).$$

In the estimation the possibility of co-variation between the different estimated variance-components is being taken into account. Table 4 presents the resulting estimated random effects of our model.

Table 4: Estimated Variances and covariances on the different levels of the model

	Labour-market region	District	Tax-rate effect	Commuter-balance effect	Municipality
Unconditional model					
Labour-market region	3997				
District		7832			
Tax-rate effect					
Commuter-balance effect					
Municipality					110900
With fix tax-rate and commuter-balance effects					
Labour-market region	2123				
District		3385			
Tax-rate effect					
Commuter-balance effect					
Municipality					88329
With fix and random tax-rate and commuter-balance effects					
Labour-market region	2010				
District		17846	-324	25737	
Tax-rate effect		-324	16	-470	
Commuter-balance effect		25737	-470	36286	
Municipality					67104
Final Model					
Labour-market region	246				
District		7738	-99	8885	
Tax-rate effect		-99	5	-82	
Commuter-balance effect		8885	-82	9468	
Municipality					35983

Source: Own calculation with SAS, PROC MIXED

The overall mean γ_{00} as determined by the unconditional model without further fixed effects is 261 (Euro per inhabitant). According to table 4 in the unconditional model about 90% of the total variance is attributed to the errors at the lowest level (ε_{ij}), that is, to the municipalities. The remaining variance is attributed by the estimation to differences between districts and labour-market regions. Consequently, the variance between municipalities within larger regions is much higher than the variance between these larger regions[2]. The inclusion of the deviation of the municipalities' tax-rates from the labour-market region's mean tax-rate and of the relative commuter-balance of the municipalities as fixed effects reduces the variances between higher-level observational units by about 50% ant between municipalities by about 20%. Nevertheless, the additional inclusion of both variables as random effects doubles the reduction in observed variances in tax-revenue on the municipality level making it now 40%, while the observed variance on the district-level jumps up. Obviously, controlling the effects of tax-rate and of commuter-balance helps in the identification of systematic differences in tax-revenues between districts.

Interpretation of the covariances offers some additional insights. The negative covariance between district-level variation and a varying tax-rate effect shows, that the higher the tax-revenue in the district the more negative the tax-rate effect. Similarly, we observe that a more positive effect of the commuter-balance on tax-revenues coincides with a more negative relation between tax-rates and tax-revenues. This means that with a strong positive impact of agglomeration-effects on tax-revenue, the competition effect that is caused by the rising exit-mobility of firms prevails. Obviously we have to differentiate between agglomeration in labour and agglomeration in terms of production-capacities.

Other fixed effects besides those with expected heterogeneous effects my simply be included as such in the model depicted in equation (7). If the random-effects connected with the tax-rate and the commuters are to be explained, though, the respective fixed effects have to be interacted (Singer 1998). This may easily be understood if considering the heterogeneous effect of tax-rates as modelled by equation (5). If the variation in the

[2] This is in sharp contrast to results of a similar model that explains local unemployment-rates (own unpublished work).

estimated coefficient is explained for example by “Centrality” we get starting from equation (2) and (5)

$$\pi_{0j} = \gamma_{00} + \gamma_{01}\text{Centrality}_{ij} + \xi_{0j} \quad (8) \text{ and}$$

$$\pi_{1j} = \gamma_{10} + \gamma_{11}\text{Centrality}_{ij} + \xi_{1j} \quad (9).$$

Integration in equation (4) yields

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

Concretely, we explain the effect of commuter-balance and of the tax-rate

- by the geographical position on the level of the municipality (devPC_Central, devPC_Rural and devPC_Remote in table 2),
- by the industry-structure on district-level (the last block in table 2),
- by an interaction of these two,
- by themselves (inclusion of quadratic terms) and
- by each other (interaction of commuter-balance with tax-rate).

The whole model, that is, each single coefficient, is additionally interacted with the dummy-variable that differentiates rural from urban municipalities. Thereby, the possibility is acknowledged that there are qualitative differences in the spatial structures of urban and rural observations. The final model explains 68% of the originally observed variance on the municipality-level (see table 4) and the larger proportion of all other variance-components, too.

For the estimation for each variable values from urban and rural municipalities have been centred on their respective mean in order to facilitate interpretation 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.

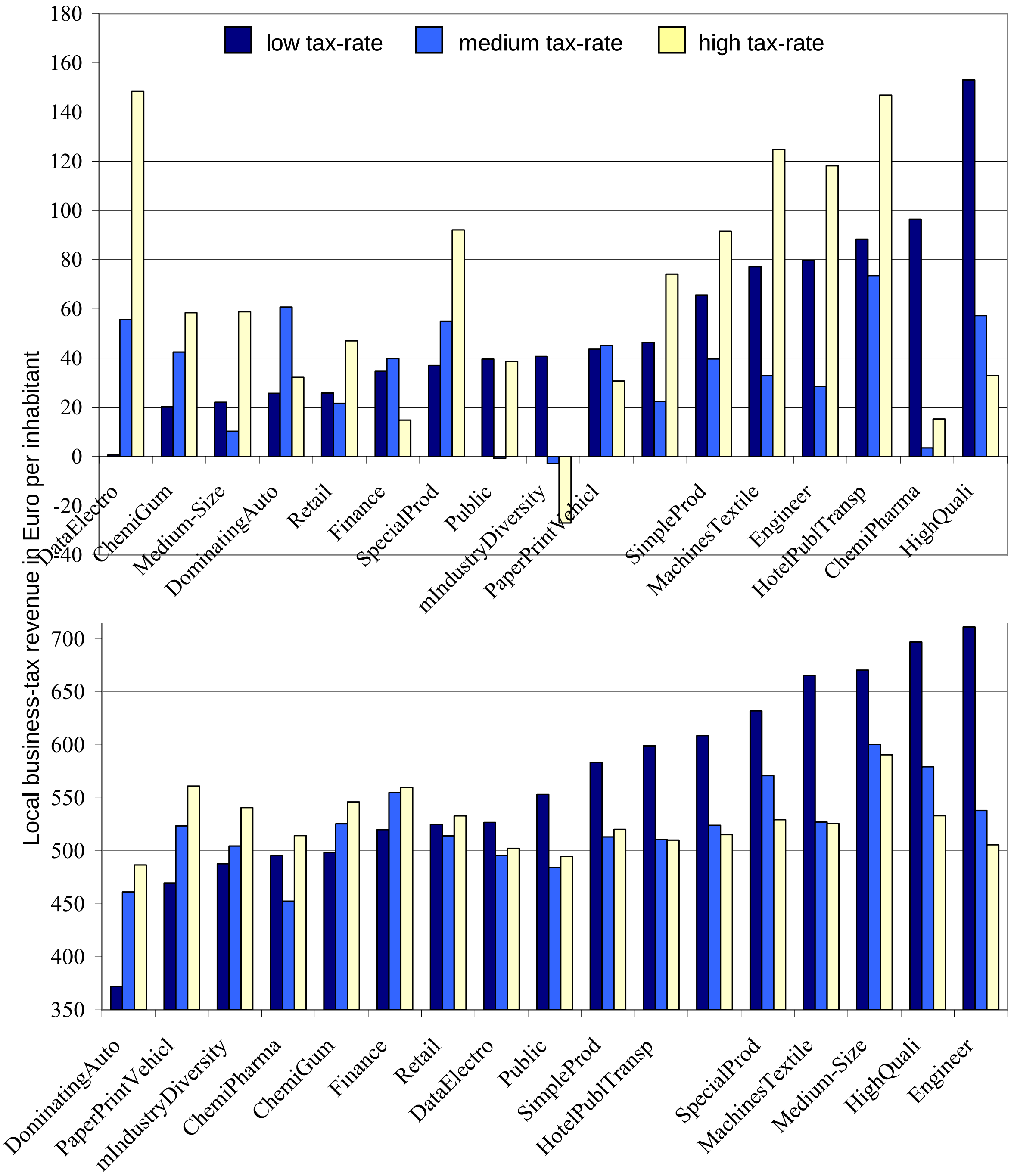
The final model that takes into account all of the interactions considered consists of 711 fixed effects besides the intercept. It is therefore not possible to present the results in table form here. Moreover, due to the manifold interaction-terms the interpretation of the raw-coefficients is very difficult. 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 following. 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 order to access the relevance and the size of the different effects in doing so each single coefficient is multiplied with one standard deviation of the explanatory variable. 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.

3.3 Results

Results are presented graphically. In the different graphics we compare the estimated tax-revenue with one standard-deviation of non-nested cumulated effects. In figure 3 we compare the estimated gross-situation for the simulated situations that one of the PCs on industry-structure at a time is higher by respectively one standard deviation. Since the variables had been centred to their mean this implies that we compare the situations where one of the industry-PCs is by one standard deviation above its mean while the others are at their mean-value. In the same vein a low [high] tax-rate depicts a tax-rate that is one standard deviation below [above] its mean value. A municipality is in a “peripheric” [“rural”, “central”] position if the according PC for geographic position is one standard deviation above its mean, and there is a high [low] commuter balance if the corresponding condition is given with respect to this variable.

Figure 3 depicts the situation for rather peripheric urban municipalities, comparing municipalities with a negative (top) and a positive (bottom) commuter-balance.

Figure 3: Tax-revenue with low, medium and high tax-rate in rather peripheric urban municipalities with a low (top) and a high rate of in-commuters (bottom)



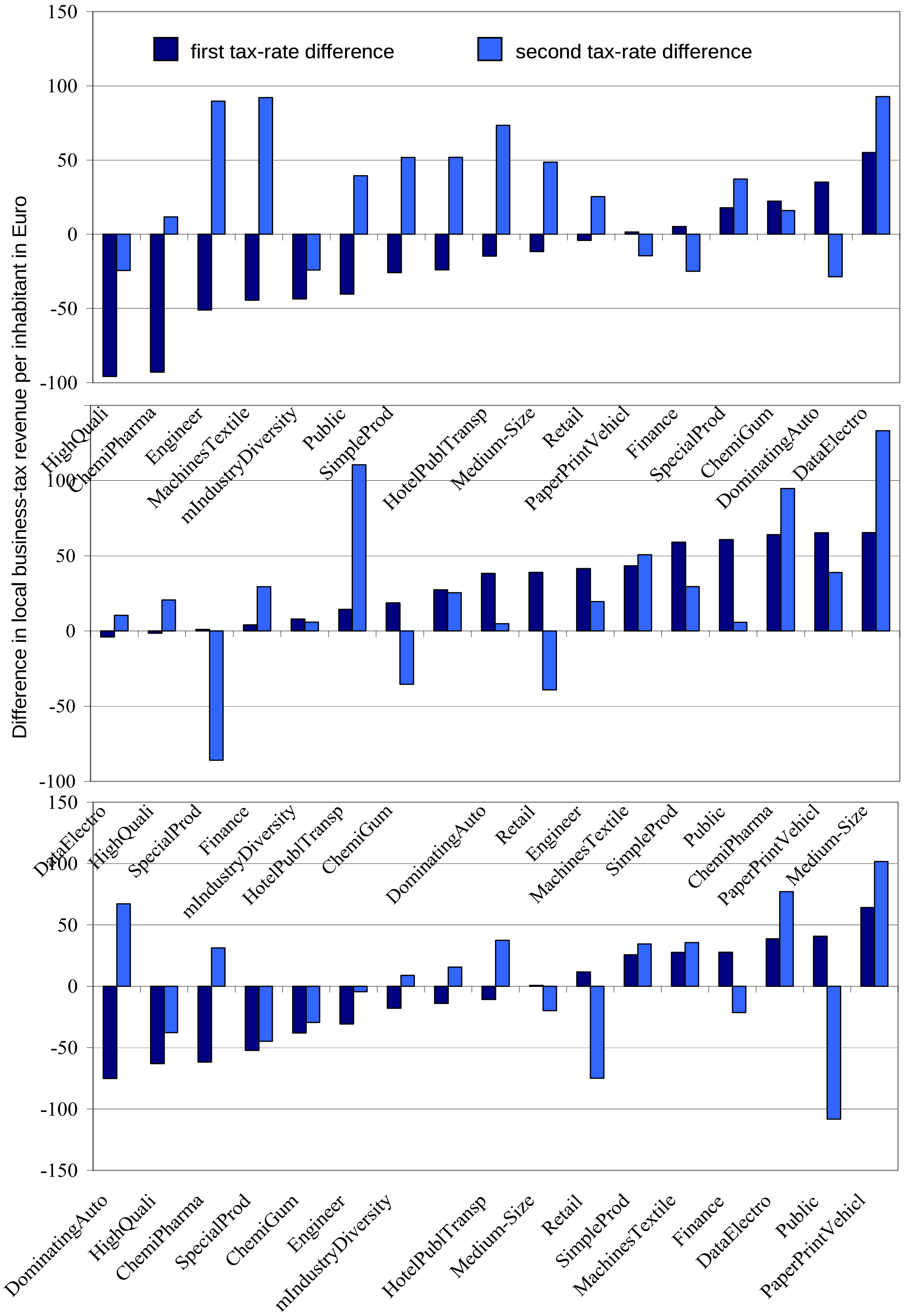
Source: Own figure based on results from the multi-level model estimated with SAS, PROC Mixed

Obviously, two different types of agglomeration-effects are measured by observing commuters on one side and the effect of tax-rates on the other. It is among municipalities with a negative commuter-balance that a high tax-rate is often associated with higher tax-revenues per inhabitant. Obviously among these municipalities there exist some with a specialised local labour force or other unobserved advantages, which are able to attract certain firms more than other municipalities with a negative commuter-balance. This holds especially true where hotel- and restaurant industry is important and where information-services as well as the production of electronic equipment and clothes dominate. In the same figure the low revenues with medium tax-rates confirm an expectation formulated in chapter 2: Among the low potential municipalities with negative commuter-balance there are some municipalities that are characterised by extremely immobile industries precisely because their development lacks any dynamic. Here, the tax-rate is set relatively high even though tax revenue is very low. Besides this effect we can conclude for urban municipalities in a rather peripheric position with a negative commuter balance that in most cases their relative situation is best depicted by the agglomeration effect: There are many with very low revenues and a low tax rate and a few with rather high revenues and a high tax-rate.

This pattern is different among urban municipalities in a rather peripheric position with a *positive* commuter-balance (bottom figure in figure 3). The majority of them show a negative relation between tax-rate and tax revenue. This means that their more dynamic development depends on the decisions of firms with a higher (exit-)mobility. Due to the positive relation between new settlement and exit-mobility municipalities with the most positive dynamic decide for the lowest tax-rate. The figure shows that this does not only hold true in relative terms but also in absolute terms: According to estimation results among urban municipalities with a positive commuter-balance in rather peripheric position, business-tax revenues are highest if the business-structure is characterised by engineering-services and the local tax-rate is low. Obviously, among these municipalities there is at the same time a higher potential for convergence due to the high mobility of firms than among those types of municipalities that are characterised by those agglomeration-effects that are indicated by a positive relation between tax-rate and tax-revenue. This negative relationship among the municipalities with negative commuter-balance in the top figure in contrast hints on immobile location-factors that raise the relative competitiveness of some of them. Therefore it would be wrong to expect that all municipalities have the same potential to profit from certain industry-structures even if they are of the same type in terms of remoteness and settlement character.

Results may be presented differently in order to underline the argument (figure 4).

Figure 4: Effect of the first and second raise of the tax-rate in urban municipalities with a negative commuter-balance in rather peripheric, rural, and central position



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

Here the difference in tax-revenues between the medium tax-rate and the lowest tax-rate and between the highest tax-rate and the medium tax-rate as shown in figures 3 are isolated for urban municipalities with a negative commuter-balance in rather peripheric, “rural”, and central relative position (from top to bottom). Obviously, the pattern that the first difference in tax-rate relates negatively to tax-revenue while the second difference relates positively to it, which corresponds to the low-revenue situation with a medium tax-rate, is typical for peripheric regions with their generally low economic dynamic. Only here makes tax-revenue maximization via tax-rate maximization by taking advantage of the immobility of the remaining few firms sense. If we compare the relation between higher tax-rates and differences in tax-revenues for relatively “rural” and “central” municipalities it is clarified by figure 4 that the dominance of agglomeration effects as described by a positive relation between tax-rate and tax-revenue is more prevalent among municipalities of rather “rural” position, while the dominance of the competition effect as described by a negative relation between tax-rate and tax-revenue is more prevalent among municipalities of rather “central” position. There are some industry-structures for which the competition-effects seems to dominate in all geographical positions, such like the high-qualification dimension. Others have a heterogeneous impact upon the competition between similar locations such as information services and production of electronic equipment (“DataElectro”), which causes a dominating agglomeration effect among peripheric and central municipalities but not so among “rural” communities.

4 Conclusions

It was our goal to isolate systematically differing small-scale agglomeration-patterns, which indicate different types of competition between localities. We applied a technique of indirect closure based on the differing observed relation between local business tax-rate and tax-revenue and used a mixed multi-level model in order to cope with local dependencies on different scales. Thereby it was shown that small-scale agglomeration effects, i.e. differing development potentials of similar municipalities, are at least partially determined by settlement characteristics, geographical relative position and industry structure. Since these influences interact in various ways the observed patterns are very complex. It is due to small-scale “agglomeration-effects”, defined here as a positive observed relation between tax-rate and tax-revenue, that municipalities of the same type may nevertheless have different potentials in economic development. On the other hand, a high mobility of firms in a dynamic environment strengthens the competition-effect as indicated by a negative relation between tax-rate and tax-revenue. Under such circumstances municipalities will strive for convergence. In empirical studies comparing regional developments on various geographical scales these heterogeneous relations will have to be taken into account in order to reach generalisable conclusions. Regional economic policy cannot apply identical concepts independently of the wider economic environment. Instead it has to react to the differing endogenous potentials of localities for economic development.

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