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Abstract

Regional economic policy faces the challenge of two competing policy goals - reducing regional economic disparities vs. promoting economic growth. The allocation of public funds has to weigh these goals particularly under the restriction of scarce financial resources. If, however, some region turns out to be a regional growth pole with positive spillovers to its disadvantaged periphery, regional policies could be designed to reconcile the conflicting targets. In this case, peripheral regions could indirectly participate in the economic development of their growing cores.

We start our investigation by defining and identifying such growth poles among German regions on the NUTS 3 administrative level based on spatial and sectoral effects. Using cluster analysis, we determine significant characteristics for the general identification of growth poles. Patterns in the sectoral change are identified by means of the change in the employment. Finally, we analyze whether and to what extent these growth poles exert spatial spillover effects on neighbouring regions and thus mitigate contradictory interests in regional public policy. For this purpose, we apply a Spatial-Cross-Regressive-Model (SCR-Model) including the change in the secondary sector which allows to consider functional economic relations on the administrative level chosen (NUTS 3).

Keywords: Size and Spatial Distributions of Regional Economic Activity; Cross-Sectional Models; Spatial Models; Treatment Effect Models; Regional, Urban, and Rural Analyses

JEL-classification: R12, C21, O18

Zusammenfassung

Die Regionalpolitik ist heute im Spannungsfeld zwischen zwei politischen Zielen gefangen, erstens dem Abbau regionaler Disparitäten und zweitens der Initiierung von Wachstumsimpulsen. Die Fördermittelpolitik muss diesen beiden Zielen vor dem Hintergrund enger werdender haushaltspolitischer Spielräume gerecht werden. Wenn stark wachsende Regionen in benachbarte Regionen abstrahlen, dann ist eine Fokussierung der öffentlichen Hilfen auf Wachstumspole sinnvoll. Periphere Regionen partizipieren in diesem Fall indirekt von dem stärkeren Wachstum in den wirtschaftlichen Zentren.

Wir identifizieren zunächst auf NUTS 3 Ebene Wachstumsregionen in der Bundesrepublik Deutschland. Mit Hilfe der Clusteranalyse weisen wir nach, dass sich in Wachstumsregionen besondere Muster des Strukturwandels erkennen lassen. Der Strukturwandel wird mit Hilfe von Veränderungen in der Beschäftigungsstruktur analysiert. Zum Schluss wird unter Anwendung eines Spatial-Cross-Regressive-Modells (SCR-Modell) gezeigt, welche Abstrahlwirkungen von den Regionen ausgehen.

Schlüsselwörter: Stärke und räumliche Verteilung regionaler ökonomischer Aktivität; Cross-Sectional-Modelle; Räumliche Modelle; Treatment-Effect-Modelle; Regionale, urbane und ländliche Analysen

Spillover Effects of Spatial Growth Poles – a Reconciliation of Conflicting Policy Targets?

1. Introduction

Article 72 (2) Grundgesetz (basic constitutional law) obliges the Federal Government to "create equal conditions of life within the Federal territory" (aim of distribution). Restriction of scarce financial resources, reduced government aid (e.g. European Regional Development Funds (ERDF)) as well as the ongoing discussion about the financial compensation between the Federal States are the motivation for the necessity to adjust the German regional policy fundamentally.

Most often, a conflict is assumed between the aim of distribution and the aim of growth (Art. 104a Grundgesetz), as the funds used for economically weak regions are not available for strongly growing regions – even more, they have to be financed by tax revenues from growth poles. So far, a high importance has been attributed to the distribution target, but it has been discussed since to concentrate government aid on so-called growth poles (see for this particularly the results of the discussion round Gesprächskreis Ost, Dohnanyi/Most 2004). With this, the aim of growth would be attributed a higher weight at the expense of the distribution target. This conflict eases (at least partly) when spillover effects of neighbouring regions apply. The following example illustrates this idea.

The kind of policy which is applied theses days is (mainly) based on the principle of equal treatment, i. e. the government aid is distributed evenly to possible growth poles and periphery regions. Still, government aid can also be distributed selectively (regional, sectoral). We assume that the subsidisation effect depends on the economic structure. Advantages of agglomeration can increase growth in a specific industrial sector as well. In a possible scenario, the total sum of government aid is focussed on strongly growing industrial sectors in the stringly growing region. Here, the strongly growing industrial sectors have a larger share than in the slowly growing region. Therefore the structural subsidisation effect in the strongly growing region is larger than in slowly growing region. There is an additional growth impulse on the respective region because of spillover effects from neighbouring regions. The total growth of both regions results from the growth of the structural subsidisation effect of the own region and the interdependence between the regions. An exclusive government aid to the strongly growing industrial sector in in the strongly growing region does not lead to direct growth in the neighbouring region. However, a possible spatial effect lets this region participate in the Strengthened growth of the strongly growing region. The gain in growth in the strongly growing region might even overcompensate the loss in the neighbouring region, i. e. the

total growth in both regions exceeds the total growth in the case of equally distributed unspecific government aid. Here, economic policy is focussed on the growth target. But we did not give up the distribution target totally. The slowly growing region receives an additional impulse by the spillover effect from the neighbouring region. This described form of government aid is applied by the government of the state of Brandenburg at the grant of investment contribution within the federal project (Gemeinschaftsaufgabe der Verbesserung der regionalen Wirtschaftsstruktur, GA) for the improvement of regional economical structure. Therein, companies in highly growing industrial sectors in regions with a large share of strongly growing industrial sectors, receive a so-called government aid of potentials (addition to the basic government aid) (cf. MW 2006).

The paper is structured as follows (see box 1). At first we will determine strongly growing regions.

Box 1:
Assumptions and procedural method

Assumption 1: The trade-off between the distribution target and the growth target can be reconciled if the government aid is focused on strongly growing industrial sectors in strongly growing regions. Neighbouring regions can enjoy the spillover effects from these regions identified before.

Assumption 2 (derived from assumption 1): The economic growth in small-area regions is influenced by the industrial sector and the spillover effects from neighbouring regions. → **focus of the paper**

Procedural method:

1. Definition of growth poles – analysis of the change in the gross value added per capita in the 439 NUTS 3-regions in Germany, 1999 to 2004
2. Identification of the structural change in these regions
   a Determination of the relative share of dependent employment relationships in the 60 industry branches (NACE-classification) → Classification of regions similar in the structural change, cluster analysis
   → Are there clusters represented by a high level of high-growing regions?
   b Classification of regions growing at high level (5%, 10%, 25% and 50% quantiles) → Which industry branches represent these "growing-classes"?
   → Which patterns can be identified in the several "growing-classes"?
3. Proof of the influence of these patterns to the regional growth, spatial-cross-regressive model (SCR Model) → Which influence do these patterns have on the growth of small area regions?
4. Forecast to research activities to furnish proof of assumption 1
   → Which task do we have to deal with?

Secondly, these growth poles are examined considering similarities and differences to non-growth poles. The question in mind is whether agglomeration effects or the structural change plays a role for growth poles. The observation, that companies of similar or also different branches are often concentrated at certain locations should be analysed as well (cf. Marshall 1952 pp. 267-277; Porter 1990 and Krugman 1991). The structural change is displayed in the changes of new and old industrial sector focusses. Our paper searches for industrial sector focusses in regions with a similar cluster structure. Thirdly,

these characteristics should be examined with respect to their influence on the total growth of NUTS-3 regions.[1] At the same time, a proof of spatial effects becomes necessary for the dissolution of the trade-off. Finally we conclude our results and we will give an outlook to new fields of research resulting from our work.

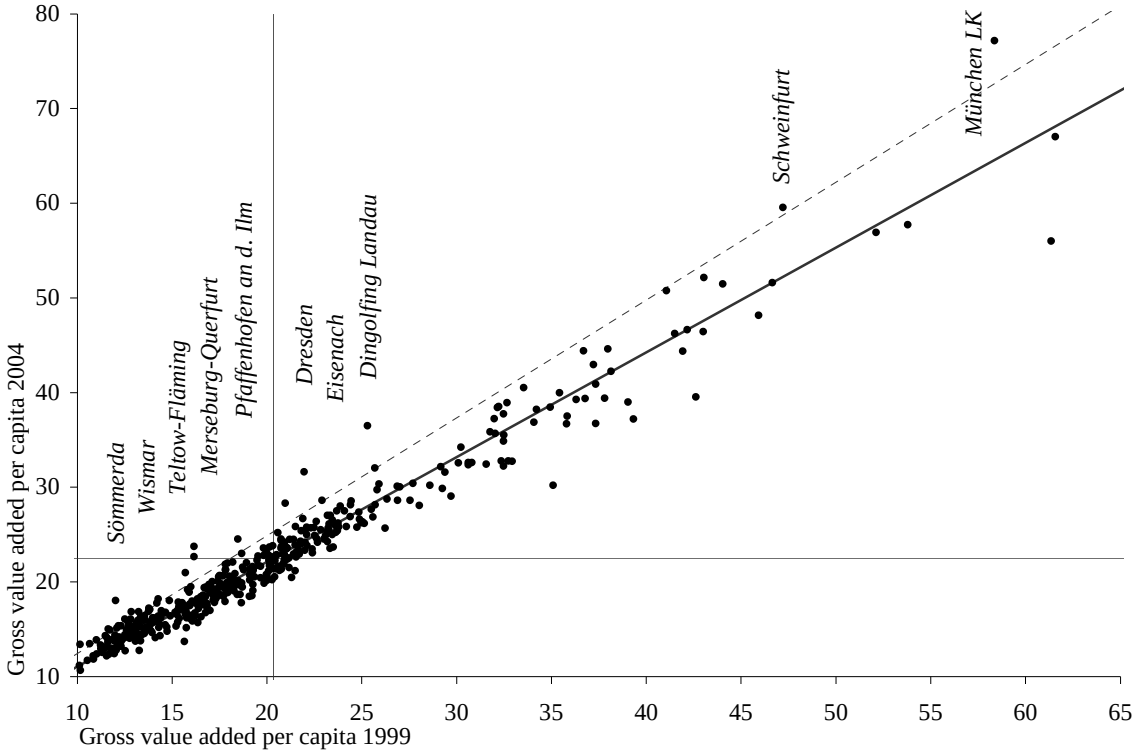
This paper shows a strong influence of the structural change with a high share of industrial sectors of the secondary sector on the growth of small-area regions. In a second step, determinants of growth within a regional production function were analysed. In this function a sectoral component and spatial effects were considered.

1 NUTS (Nomenclature des Unités Territoriales Statistiques, Germany): Districts, distict-free cities and federal states Berlin and Hamburg.

2. Determination of growth poles

In fig. 2.1, the growth of the 439 German NUTS-3 regions, measured by the gross value added (GVA) per capita, becomes evident.

Figure 2.1:
Growth of the gross value added in 1 000 Euro per per capita (NUTS-3, 1999-2004)



Source: National Accounting, own presentation.

The x-axis shows the gross value added per capita in the year 1999, while the y-axis contains the corresponding values in the year 2004. The horizontal and vertical lines describe the average values in the years 1999 and 2004. The point of origin as well as the intersection of average gross value added per capita describe the fixed points of the diagonal (solid black line) and result in the average growth within Germany. All regions above the diagonal show growth above average in comparison from 1999 to 2004.

Which regions can be identified as strongly growing regions in a simple way? The larger above average the growth of a region is, the higher above the diagonal the region can be found in fig. 2.1. A counter clockwise rotation of the diagonal limits the number of

groth poles. The regions with the highest growth rates are situated above the dashed line. There are shown different “growth classes” in table 2.1.

Table 2.1:
Classification of growth

Regions with growth	Growth	Classification
above average	< 5 % quantile	growth pole
	5 % - 10 % quantile	strong growth
	10 % - 25 % quantile	growth
	25 % - 50 % quantile	weak growth
below average	positive	substandard growth
	negative	negative growth

Source: Own presentation.

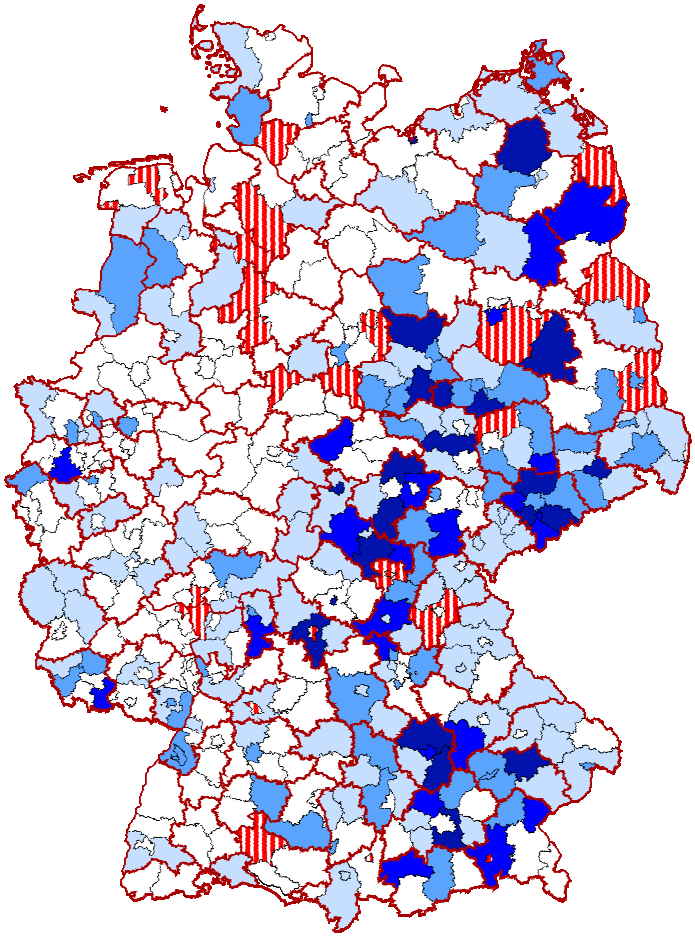
The regional distribution of growth within Germany in the examined time period can be gathered from fig. 2.2. Growth, measured by the change in gross value added per inhabitant from 1999 to 2004, concentrates on selected East German and Bavarian NUTS-3 regions. In the examined areas, we also find regions with a substandard or a negative growth.

The top 5 % of the strongly growing regions are marked as growth poles. We speak of a strong growth when considering the upper 5 to 10 % of the strongly growing regions. The following class characterizes the upper 10 to 25 % of the areas. Regions showing an above-average growth, which do not belong to the mentioned groups are classified as weak growth.

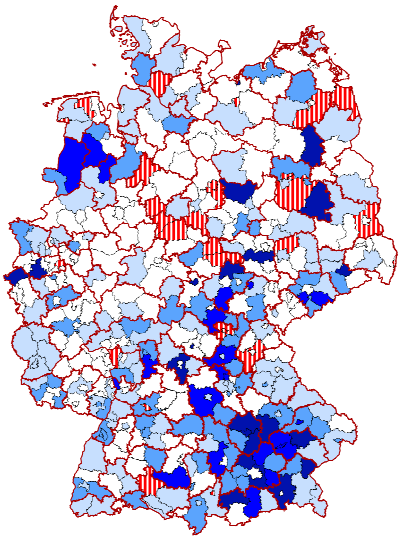
Besides, two further groups are displayed – regions corresponding a negative growth and other regions showing substandard growth. The aim is now to search for determinants of growth of the regions. The size of agglomeration, the structural change or the spatial-functional connections could play a role in this context. Forthermore we have to consider strong government aid in East-Germany (cf. Ragnitz et al. 2006). The supposed determinants are analysed descriptively in the following chapters and, based on this analysis, inserted to a neoclassical growth function.

Fig. 2.2:
Growth poles (1999-2004)

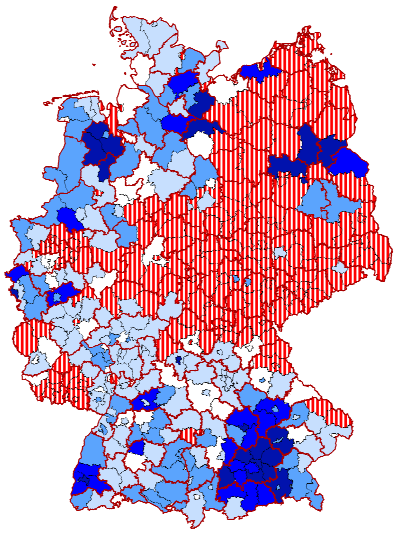
Percentage change of GVA per inhabitant 1999-2004



Percentage change of GVA 1999-2004



Percentage change of inhabitants 1999-2004



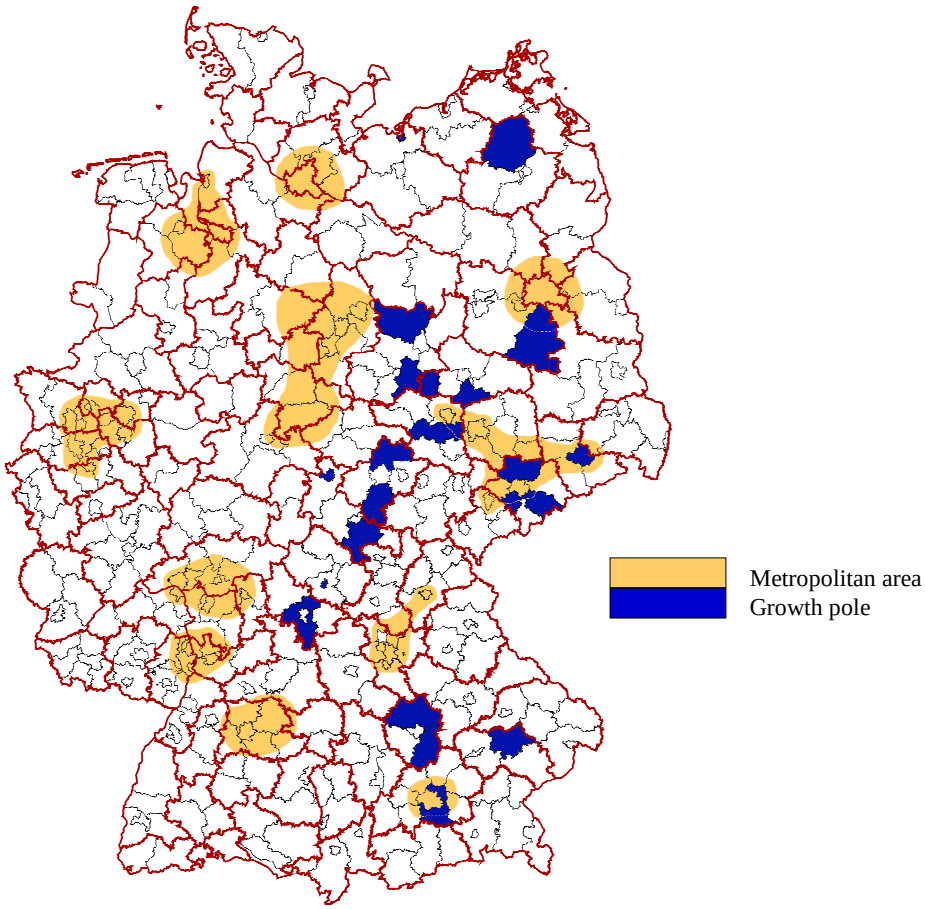
Regions with growth	Growth between quantiles	Classification
above average	< 5 %	growth pole
	5 % - 10 %	strong growth
	10 % - 25 %	growth
	25 % - 50 %	weak growth
below average	positive	substandard growth
	negative	negative growth

Source: own presentation.

3. Agglomeration effects

Fig. 3.1 shows the German metropolitan areas as well as the 22 strongest growth poles. The current German/European definition of metropolitan areas is, they are “engines of economical, social and cultural development...” (cf. MKRO 1995, p. 87). For the political definition of metropolitan areas, assets (potential of inhabitants, economic power) as well as functional criteria play a crucial role (cf. Heimpold 2006, p. 61). Metropolitan areas represent highly agglomerative, strongly connected areas. In this case we should see a high correlation between agglomeration and growth. There are only a few overlaps between the metropolitan regions politically defined and the growth poles identified above. A further simple measure to describe the relation between growth and agglomeration size is the number of inhabitants per hectare. The correlation between the examined growth and the agglomeration size of the regions in the year 2004 does not speak for a linear relation (R^2 = 0.013). Therefore it will not be a part of our growth function we will use in chapter 5.

Fig. 3.1:
Growth poles and metropolitan areas



Source: MKRO, own presentation.

4. Structural change

For a more detailed analysis of the influence of structural change on growth, NUTS-3 regions are examined, considering the employment (L) in the 60 industrial sectors (two digit numerical NACE-code, cf. Federal Statistical Office Germany (2002)). The aim is to determine the sectoral growth engines of the economic development in the region. In this context, the share of employment is understood as a proxy for total output and the resulting level of welfare.[2] According to equation 4.1, we analyse the total change of the share of employment in a certain industrial sector (i) in a respective region (j) on the total employment in region j from the year 1998 to 2004. This leads us to the information, if a certain industrial sector becomes more or less important in its respective region.

$$L_{(i,j),04-98} = \left(\frac{L_{(i,j),2004}}{\sum_{i=1}^{60} L_{(i,j),2004}} \right) - \left(\frac{L_{(i,j),1998}}{\sum_{i=1}^{60} L_{(i,j),1998}} \right) \tag{4.1}$$

The analysis of structural change is carried out in two steps. In the first step, the considered regions are clustered, based on their structural change. In this procedure, areas with comparable economical structure are assigned into the same group (see box 2 for a description of the clustering procedure). It is of special interest whether main areas of growth accumulate in certain clusters and which patterns can be shown by this procedure. In this first step of our analysis, increases and decreases in the structural change are considered. In the second step, all regions with a certain growth structure have been investigated to find out whether particularities concerning the change of employment in industrial sectors show up.

Box 2:
Cluster analysis

The cluster analysis requires non-correlated variables. The given NUTS-3 regions are assigned to disjoint groups (subsets) so that the clusters are as similar as possible concerning their structure and well-differentiated from the regions in other clusters.

A great variety of potential cluster approaches are applied within the analyses of hierarchical-agglomerative procedures. As a measure for distance, the squared euclidian distance is applied. By means of the single linkage procedure the regions are examined for outlies considering the given structure. For the further course of the analysis, the WARD-procedure is applied,as it leads to “robust” classes of approximately the same size. The outlies are assigned to the clusters with Fisher-Discriminant-Criteria before the interpretion of the clusters. The squared residuals in the WARD-linkage as well as the dendrogram refer to an optimal number of 4 clusters.

The distribution of growth regions within the clusters is shown in the following table 4.1.

[2] For NUTS-3 regions, the official statistics do not supply any informations about gross value added in the 60 industrial sectors (two digit numerical NACE-code).

Tab. 4.1:
Growth poles and structural change
- absolute (relative) -

Cluster	Average growth	N	Weak growth		Growth		Strong growth		Growth Pole	
1	0.09	76	31	(0.41)	17	(0.22)	6	(0.08)	2	(0.03)
2	0.09	258	109	(0.42)	40	(0.16)	13	(0.05)	5	(0.02)
3	0.15	54	42	(0.78)	27	(0.50)	15	(0.28)	9	(0.17)
4	0.14	51	37	(0.73)	26	(0.51)	10	(0.20)	6	(0.12)
Germany	0.10	439								

Source: Own calculation.

In this table, the allocation of the growth clusters becomes obvious. In general, the regions inclosed in cluster 3 and 4 have the highest average total growth in the examined time period from the year 1998 to 2004. For the argumentation of appropriate growth clusters, we refer to the class of "growth" (25%-quantil, see table 2.1). This quantile covers 25% of the regions with the strongest growth. The classification in the 4 clusters shows that approximately 50% of the regions contained in cluster 3 and 4 are regions belonging to the class of "growth".

Table 4.2 shows the highest changes in the share of employment in all clusters in comparison to the structural change in Germany. We can denote a remarkable correspondence in the industrial sectors with the highest increase or decrease. There are industrial sectors (two digit numerical NACE-code, bold numbers in table 4.2), which are different from the growing industrial sectors in the whole of Germany. Specifically, the German increases are mainly based on the industrial sectors of 'Other business activities (74)', 'Health and social work (85)', 'Education (80)', 'Supporting and auxiliary transport and activities of travel agencies (63)' as well as 'Computer and related activities (72)'. On the other hand, the strong structural change in Germany is shown in the strong decreases of dependent employment relationships in the industrial secotrs of 'Construction (45)', 'Public administration and defence (75)', 'Manufacture of furniture, manufacturing n.e.c. (36)', 'Manufacture of other non-metallic mineral products (26)' as well as 'Manufacture of textiles (17)'. In general, the growth clusters 3 and 4 reflect these processes for the whole of Germany or even press ahead with the structural change.

Of special interest are these industrial sectors, which represent the differences. Growth cluster 3 is determined by a strong increase in importance concerning the level of employment in the industrial sectors 'Hotels and restaurants (55)' and above all in 'Manufacture of fabricated metal products, except machinery and equipment (28)'. The second represents an industrial sector of the secondary sector.

Table 4.2:
Average (proportional) change in employment by industrial sectorsa, b

Cluster	Average growth	Industrial sectors denoted by the highest increase	Industrial sectors denoted by the highest decrease
1	0.09	• Other business activities (74) • Health and social work (85) • Computer and related activities (72) • **Manuf. of motor vehicles (34)** • Supporting and auxiliary transport (63)	• Construction (45) • **Manuf. of machinery & equip. (29)** • **Wholesale trade (51)** • **Retail trade (52)** • Manufacture of chemicals (24)
2	0.09	• Health and social work (85) • Other business activities (74) • Supporting and auxiliary transport (63) • Computer and related activities (72) • Education (80)	• Construction (45) • Manufacture of furniture (36) • Manuf. of o. non-metall. min. prod. (26) • **Manufacture of wood (20)** • Manufacture of textiles (17)
3	0.15	• Health and social work (85) • Other business activities (74) • **Manuf. of fabricated metal prod. (28)** • **Hotels and restaurants (55)** • Supporting and auxiliary transport (63)	• Construction (45) • Public administration and defence (75) • **Agriculture (01)** • **Activ. of membership organiz. (91)** • Manufacture of furniture (36)
4	0.14	• Education (80) • Health and social work (85) • Other business activities (74) • **Manufacture of motor vehicles (34)** • Supporting and auxiliary transport (63)	• Construction (45) • Public administration and defence (75) • **Manuf. of other transport equip. (35)** • **Sewage and refuse disposal (90)** • **Agriculture (01)**
Germany	0.10	• Other business activities (74) • Health and social work (85) • Education (80) • Supporting and auxiliary transport (63) • Computer and related activities (72)	• Construction (45) • Public administration and defence (75) • Manufacture of furniture (36) • Manuf .of o. non-metall. min. prod. (26) • Manufacture of textiles (17)

[a] NACE-Classification – [b] Bold faces : Industrial sectors which differ from the structural change in Germany.

Source: Own calculation.

The ‘Agricultural sector (01)’ as well as ‘Activities of membership organizations n.e.c. (91)’ have decreased above-average regarding their importance in these areas.

Growth cluster 4 reflects the German development as well as an above-average increase in importance of the industrial sector of ‘Manufacture of motor vehicles, trailers and semi-trailers (34)’. In this sector, also the ‘Manufacture of other transport equipment (35)’ decreased above-average. Industrial sector 34 is characterized by a high degree of linkages with a variety of suppliers. The regions of cluster 4 show an extraordinary decrease in the ‘agricultural sector (01)’, which means a strong structural importance. Besides this, there is clearly less employment in ‘Sewage and refuse disposal, sanitation

and similar activities (90)'. The industrial sectors 91 and 90 as a part of public services can be connected with the trend towards privatization in the public sector.

Regarding the regional characteristics of the clusters, in table 4.3 is shown hat in the growth clusters, mainly regions from East Germany are represented. Also the share of district-free cities is below the German average in cluster 3 and above-average in cluster 4.

Table 4.3:
Regional characteristics of the clusters

Cluster	Average growth	Share of district-free cities	Share of regions from East Germany
1	0.09	53.9 %	6.6 %
2	0.09	19.4 %	7.0 %
3	0.15	14.8 %	85.2 %
4	0.14	35.4 %	84.3 %
Germany	0.10	26.4 %	25.5 %

Source: Own calculation.

The following table 4.4 shows a larger share of regions with a decrease of inhabitants in comparison to Germany for both growth clusters.

Table 4.4:
Population in the clusters

Cluster	Average growth	Regions with a decrease of inhabitants	Average change of inhabitants
1	0.09	32.9 %	3 209
2	0.09	28.3 %	2 665
3	0.15	79.6 %	- 2 989
4	0.14	86.3 %	- 5 838
Germany	0.10	42.1 %	1 076

Source: Own calculation.

The (few) regions with an increase of inhabitants in the growth clusters do not compensate the loss of inhabitants in other regions of the cluster, as the average number of inhabitants of one representative region in these two clusters is decreasing.

The next table illustrates that approximately ¾ of all German regions are characterized by a decrease of the level of employment. The number of the regions with a decrease in the growth clusters is even higher. The rate of employment in a region in Germany is decreasing approximately with 1.2 % points. The average decrease is even higher for the regions of both growth clusters.

Table 4.5:
Dependent employment relationship in the clusters

Cluster	Average growth	Regions with a decrease of the rate of dependent employment relationship	Average decrease of the rate of dependent employment relationship
1	0.09	59.2 %	0.1 % - point
2	0.09	74.4 %	0.9 % - point
3	0.15	94.4 %	2.8 % - point
4	0.14	82.4 %	2.4 % - point
Germany	0.10	75.2 %	1.2 % - point

Source: Own calculation.

Finally we can summarize that growth clusters are very strongly dominated by East German regions. In these regions, the average number of inhabitants show a decrease. The migration effect from East to West Germany is reflected in this process (cf. Kubis 2005). The decrease in the lavel of employment at the same time means a loss of jobs. This reflects the policy in the Eastern Federal States of Germany, which mainly aims at modernization of the stock of capital by granting investment subsidy (tax benefit) and investment grants (government aid) – investment subsidy act and federal project for the improvement of the regional economical structure.

In the following discriminant analysis we show the multivariate discriminatory power of the 4 clusters (cf. Backhaus 2003, pp. 187). Table 4.6 presents the industrial sectors having the greatest multivariate discriminatory power. As it is shown in table 4.6 the discriminatory power is dominated by industrial sectors with declining economical impact (from the year 1998 to 2004 in the industrial sectors ‘Construction (45)’ and ‘Public administration and defence (75)’. Furthermore, we can also see several strong growing industrial sectors (e. g. ‘Manufacture of motor vehicles, trailers and semi-trailers (34)’), which contribute to the discriminatory power.

Table 4.6:
Multivariate discriminatory power[a]

No.	Industrial sector (two digit numerical NACE-code)	Description	multivariate discriminatory power	cum. multivariate discriminatory power
1	45	Construction	5.95 %	5.95 %
2	75	Public administration and defence	4.48 %	10.43 %
3	02	Forestry	3.61 %	14.04 %
4	35	Manuf. of other transport equipment	3.50 %	17.54 %
5	**52**	**Retail trade**	3.49 %	21.03 %
6	**90**	**Sewage and refuse disposal**	3.28 %	24.31 %
7	**80**	**Education**	2.95 %	27.27 %
8	70	Real estate activities	2.84 %	30.11 %
9	**51**	**Wholesale trade**	2.71 %	32.81 %
10	64	Post and telecommunications	2.63 %	35.45 %
11	**34**	**Manufacture of motor vehicles**	2.61 %	38.05 %
12	**91**	**Activities of membership organiz. n.e.c.**	2.51 %	40.57 %
13	**29**	**Manuf. of machinery & equip. n.e.c.**	2.35 %	42.92 %
14	**01**	**Agriculture**	2.34 %	45.26 %
15	61	Water transport	2.34 %	47.60 %
16	85	Health and social work	2.27 %	49.86 %
17	40	Electr., gas, steam and hot water supply	2.18 %	52.04 %

[a] Bold face: Industrial sectors which are denoted by a high loss respectively a high gain in importance. See also table 4.2.

Source: Own calculation.

In the second step of the structural change analysis, we examine the influence on the regionally distinguishable growth structure. In this step, the change of employment in several industrial sectors w.r.t. growth pole classes (regional differentiation) will be investigated. The central results are summarized in table 4.7. Particularly for the closely defined term of strong growing regions (5% and 10% quantile), the clear increase in employment in the areas of ‘Manufacture of motor vehicles, trailers and semi-trailers (34’) as well as ‘Manufacture of fabricated metal products, except machinery and equipment (28)’ becomes obvious. There are several industrial sectors (bold numbers in table 4.7), which differ from the strongly growing industrial sectors in Germany.

Table 4.7:
Change of employment according to industrial sectors due to economical structure[a]

Quantile	Growth class	Average growth	Industrial sectors denoted by the highest increase	Industrial sectors denoted by the highest increase
5%	Growth Pole	0.28	• Health and social work (85) • Other business activities (74) • **Manuf. of motor vehicles (34)** • Education (80) • **Manuf. of fabricated metal prod. (28)**	• Construction (45) • Public administration and defence (75) • **Agriculture (01)** • **Manuf. of machinery & equip. (29)** • Manufacture of furniture (36)
10%	Strong growth	0.24	• Health and social work (85) • Other business activities (74) • **Manuf. of motor vehicles (34)** • **Manuf. of fabricated metal prod. (28)** • Education (80)	• Construction (45) • Public administration and defence (75) • **Agriculture (01)** • Manufacture of furniture (36) • Manuf. of o. non-metall. min. prod. (26)
25%	Growth	0.19	• Other business activities (74) • Health and social work (85) • Education (80) • Supporting and auxiliary transport (63) • **Manuf. of motor vehicles (34)**	• Construction (45) • Public administration and defence (75) • **Agriculture (01)** • Manufacture of furniture (36) • **Financial intermediation (65)**
50%	Weak growth	0.15	• Health and social work (85) • Other business activities (74) • Education (80) • Supporting and auxiliary transport (63) • **Manuf. of motor vehicles (34)**	• Construction (45) • Public administration and defence (75) • Manuf. of o. non-metall. min. prod. (26) • Manufacture of furniture (36) • **Agriculture (01)**
Germany		0.10	• Other business activities (74) • Health and social work (85) • Education (80) • Supporting and auxiliary transport (63) • Computer and related activities (72)	• Construction (45) • Public administration and defence (75) • Manufacture of furniture (36) • Manuf .of o. non-metall. min. prod. (26) • Manufacture of textiles (17)

[a] NACE-Classification.

Source: Own calculation.

The regional specifics displayed in table 4.8 show an increasing percentage of East German cities the closer the classification covers the growth regions. Despite the increase, these percentages are even lower than the percentage of East German cities in the examined growth clusters. The percentage of district-free cities is lower than the Federal average.

Table 4.8:
Regional characteristics of growth clusters

Quantile	Growth classes	Average growth	Share of district-free cities	Share of regions in East Germany
5 %	Growth Pole	0.28	18.2 %	72.7 %
10 %	Strong growth	0.24	13.6 %	61.4 %
25 %	Growth	0.19	28.2 %	49.1 %
50 %	Weak growth	0.15	21.9 %	38.8 %
	Germany	0.10	26.4 %	25.5 %

Source: Own calculation.

In general, an above-average decrease of population in all growth classes can be observed. The results we have shown in the first step (see table 4.4 and 4.5) have been shown in the second step, too (cf. Tab. A.1 and A.2 in the Appendix). Summarizing this process it can be said, that a certain pattern for growth regions exists. For sectoral change, selected economical focusses seem to exist. There is a relative increase in the level of employment in certain industrial sectors of the secondary sector. This seems to be necessary for the strong growth in the service sector. Based on these facts, we reflect the increase of employment in the secondary sector into the neo-classical growth function. These specific determinants of growth are analyzed in the fifth section, considering their spatial effects. The distinction of regional spillover effects between corresponding regions plays an elementary role.

5. Regional production function

At first, we formulate a regional production function for the determination of the growth of a region on a regional level (NUTS 3). In contrast to Eckey et al. (2007), we use a component specific to the regional sector.

$$Y = F\left(K, L, X_q\right) \tag{5.1}$$

The welfare level *Y* is approximated by the gross value added per capita.[3] As an exogenous variable for the capital stock *K*, we utilize the following proxy. We assume that the capital stock varies regionally and sectorally. The stock of capital on NUTS-1 level presented by the German Federal Statistical Office is distributed on the according sectors and is presented as an aggregated total amount on the NUTS-3 level. As a proxy for the level of labour supply *L* of a region, we implement the employment per capita of a region. In the foregoing chapter, we use further regional components X_q in the regional production function. The growth of a region depends on the individual industrial sectors, which, as basic sectors of the regional economy, leads towards the growth. In order to consider this regional fact, we would like to describe the modification of the secondary sector of a region *L2* in the production function. For the description of the human capital *H* of a region, we use the employment register. Here, each person working in a scientifical-technical profession can be determined (ISCO-88 COM group 2 or 3). Therefore, we can determine the intensity of human capital as a share of the inhabitants of the examined regions and use it in the model as an exogenous variable. A dummy for East German Nuts-3 regions, having the value one if the concerned region is situated in East Germany, zero otherwise, proved to be insignificant for the explanation of growth differences in the period of examination.

The formulation of the production function with regional components is made in analogy to the Cobb-Douglas-production function (cf. Mankiw et al. 1992).

$$Y = c \cdot K^{\alpha_1} \cdot L^{\alpha_2} \cdot \prod_{q=3}^{Q} x_q^{\alpha_q} \cdot \varepsilon \tag{5.2}$$

Regional differences are modelled w.r.t. the exogenous variables capital stock *K*, the level of employment *L* and further regional components x_q. The growth rate of the welfare level *Y* can be approximately described as follows.

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3 We decided to measure welfare level – general accepted – as Gross value added per inhabitant. We did not use producitivity (Gross value added per dependent employment relationship). The correlation between the change in inhabitants and the change in the dependent employment relationships is very strong ($R^2 = 0.751$). Furthermore, in our model we do not consider a commuter-effect separately because of its small-sized correlation between the change in inhabitants and in commuters ($R^2 = 0.092$). Nevertheless we absorb this effect in our model due the spatial-compent.

(5.3) $$\hat{Y} = \frac{\dot{Y}}{Y} = \frac{Y_{04} - Y_{99}}{Y_{99}} \approx \ln\left(Y_{04} / Y_{99}\right)$$

Therefore we can describe the log of the regional production function as follows.

(5.4) $$\ln\left(Y_{04} / Y_{99}\right) = \alpha_0 \cdot c + \alpha_1 \cdot \ln\left(K_{03} / K_{99}\right) + \alpha_2 \cdot \ln\left(L_{04} / L_{99}\right) + \alpha_3 \cdot \ln\left(L2_{04} / L2_{99}\right) + \alpha_2 \cdot \ln\left(H_{04} / H_{99}\right) + \varepsilon$$

We denote the growth rate of the welfare of a region by *Y*. *K* stands for be the modification of the capital stock, *L* for the modification of the total labour supply, an *L2* for the modification in the secondary sector. The modification of the size of the human resources is denoted by *H*. The estimated function corresponds to a decomposition of growth, while the different growth variables can be examined with regard to their significant share of explanation.

The variables employment *L* and employment of the secondary sector *L2*, however, show multicollinearity. The multicollinearity problem might be solved in a simple way, by the following auxilliary calculation.

(5.5) $$\ln\left(L2_{04} / L2_{99}\right) = \gamma_1 \cdot \ln\left(L_{04} / L_{99}\right) + u_{L2}$$

In a „direct regression“ of the concerned parameters for *L2* and *L*, the whole information which cannot be explained by *L* moves to the residual. u_{L2} forms a structural change of the own region – towards a higher level of employment in the secondary sector. This residual has been assessed and placed in the model instead of the original variable. It could be interpreted as a pure industrialization effect.

(5.6) $$\ln\left(Y_{04} / Y_{99}\right) = \alpha_0 \cdot c + \alpha_1 \cdot \ln\left(K_{03} / K_{99}\right) + \alpha_2 \cdot \ln\left(L_{04} / L_{99}\right) + \alpha_3 \cdot \left(u_{L2,04} / u_{L2,99}\right) + \alpha_2 \cdot \ln\left(H_{04} / H_{99}\right) + \varepsilon$$

As another important aspect, the examination and consideration of spatial effects has to be pointed out. We use the matrix W to weight and describe spatial correlations and spatial filtering. The matrix W that has been used, models the distance in minutes between all 439 NUTS-3 regions.[4] The explanatory variables, weighted with W, determine the own level of welfare as “average” level of the exogenous variables of the corresponding regions. We assume that nearby regions have, due to the modelling, a higher weight and therefore a greater influence on the own level of welfare.

This assumption of regional linkages of economy is taken into account by integrating the relation that has been modelled in W into the estimation of a spatial cross regressive model (SCR model) as follows (cf. Eckey et al. 2005, p. 6).

(5.7) $$\hat{Y} = \alpha_0 c + \alpha_1 \hat{K} + \alpha_2 \hat{L} + \alpha_3 \hat{u}_{L2} + \alpha_4 \hat{H} + \beta_1 W\hat{K} + \beta_2 W\hat{L} + \beta_3 W\hat{u}_{L2} + \beta_4 W\hat{H} + \varepsilon$$

4 Own calculation.

The model from equation 5.6 has been estimated accordingly and has been examined for spatial effects. Here as well, the proxy for the human capital turned out not to be significant. However, we leave this variable in the model because of theoretical considerations.

The LM-lag-test confirms a highly significant spatial context, so that its modelling is not only possible but necessary (cf. Anselin 2001, p. 324). Insignificant spatial effects of the examined exogenous variables have been removed by a backward procedure. The results of the regression are presented in table 5.2.

Table 5.2:
Regression growth determinants

Endogenous Variable: Δ gross value added per inhabitant 2004-1999			
Exogenous Variables		Coefficient	t-value
c	constant	0.036	3.246 ***
$\hat{K}$	capital stock	0.637	10.654 ***
$\hat{L}$	labour	0.170	2.244 **
$\hat{u}_{L2}$	labour supply	0.043	2.557 **
$\hat{H}$	human capital	0.009	0.169
$W\hat{u}_{L2}$	spatial labour supply effect	0.197	1.760 *
$W\hat{H}$	spatial human capital effect	0.378	2.044 **
	Signif. codes	0.010 ***, 0.050 **, 0.100 *	
	Adjusted R-squared:	0.295	F-statistic p-value: 0.0000

Source: Own calculation with R.

We can see that the stock of capital exerts strong influence on the growth of a certain region. The change in the stock of labour has significantly positive effects on the growth rate of the level of welfare as well. Besides, the change in the degree of industrialization has also significantly positive consequences. With the assumption of constant productivity, a growth of employment in the secondary sector results in a higher total growth. The spatial effects turn out to be significant for the exogenous examined variables degree of industrialization as well as human capital and positive in their effective direction. This means, that the growth of the significant variables in the corresponding regions (mainly nearby regions) influences the own growth positively.

We have shown an above-average growth in regions with a high growth in the degree of industrialization, which means a probable growth sector. At the same time we could prove a positive spatial effect for exactly this sector. Due to this, it is possible to compensate, to a certain extent, the loss of direct government aid of a slowly growing region by the increased growth. In combination with the connected increase of the spatial spillover effect, the slowly growing region participates on the strengthened growth of the strongly growing region.

6. Summary and Outlook

From the point of view of government aid that is both regionaly as well as sectoraly focussed within Germany, the question arised whether the contradiction between the legally fixed aim of equality under law and the German aim of growth might be partly reduced by modified government aid.

In this paper we could show that the growth of regions is intensely determined by a sectoral change. This change is based on the increased importance of the service sector. Besides, we could also show within the analysis of economical structure the dependence of the tertiary sector from an (increasing) secondary sector. This important result leads us to an adequate modelling within the regional production function. The significant proof of a positive effect of the increased importance of the secondary sector as well as its positive spillover effect in neighbouring periphery regions leads to the conclusion that a growth pole requires an economic structure with corresponding spillover effects.

From the initial point of rare financial resources and reduced government aid, the question has raised whether it is necessary to change the regional policy in Germany fundamentally. Do we have to focus government aid to high-growing industry branches in areas with high growth? This kind of policy would lead to a welfare-loss in the periphery (slow-growing regions). However, under the conditions of spillover effects from the areas with high growth, the periphery will not loose as much as in the case without these effects.

We showed that there are patterns in the structural change of strongly growing regions and identified certain industrial sectors in the service sector. We also indicated that strongly growing regions are distinguished with a high percentage in the secondary sector. Using a Spatial-Cross-Regressive-Model (SCR Model) we determined that the secondary sector has a great positive influence on the regional economic growth and, in addition to that, this sector initiates high spillover effects to neighbouring regions. Therewith peripheral regions can benefit from government aid which is focussed on strongly growing regions.

Following the above mentioned results of this research so far, the following questions did arise and lead to an ongoing research in this field:

- What is the reason that specific industry branches have a strong importance to the regional growth? Which common attributes do high-growing industry branches in the secondary sector have? Does the level of networking play an important role? How can we measure the level of networking between several firms?
- Which is the optimum level of government aid in a region? How could it be determined?
- Under which circumstances can we notice a total welfare effect to peripheral regions due to the focussing of government aid on regions with a high growth in contrast to the same treatment of all regions?

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Appendix

Table A.1:
Population in the growth classes

Growth classes	Growth classes	Average growth	Regions with a decrease of inhabitants	Average change of inhabitants
5 %	Growth Pole	0.28	68.2%	- 1 003
10 %	Strong growth	0.24	59.1%	- 309
25 %	Growth	0.19	57.3%	- 1 311
50 %	Weak growth	0.15	50.7%	- 155
	Germany	0.10	42.1%	1 076

Source: Own calculation.

Table A.2:
Dependent employment relationship in the growth clusters

Growth classes	Growth classes	Average growth	Regions with a decrease of the rate of employment	Average decrease of the rate of employment
5 %	Growth Pole	0.28	68.2 %	1.2 %-point
10 %	Strong growth	0.24	70.5 %	1.2 %-point
25 %	Growth	0.19	69.1 %	1.3 %-point
50 %	Weak growth	0.15	71.7 %	1.3 %-point
	Germany	0.10	75.2 %	1.2 %-point

Source: Own calculation.

Table A.3:
Regional cluster allocation and growth classes by Quantiles

			Quantiles in %							Quantiles in %			
AGS[a)]	REGION	CLUSTER	50	25	10	5	AGS	REGION	CLUSTER	50	25	10	5
1001	Flensburg	1	0	0	0	0	1062	Stormarn	2	0	0	0	0
1002	Kiel	2	0	0	0	0	2000	Hamburg	1	0	0	0	0
1003	Lübeck	1	0	0	0	0	3101	Braunschweig	3	0	0	0	0
1004	Neumünster	1	1	1	0	0	3102	Salzgitter	2	1	1	0	0
1051	Dithmarschen	2	1	1	0	0	3103	Wolfsburg,	1	0	0	0	0
1053	Herzogt.Lauenburg	2	0	0	0	0	3151	Gifhorn, Landkreis	1	0	0	0	0
1054	Nordfriesland	2	1	0	0	0	3152	Göttingen, Landkreis	2	0	0	0	0
1055	Ostholstein	2	0	0	0	0	3153	Goslar, Landkreis	4	0	0	0	0
1056	Pinneberg	2	0	0	0	0	3154	Helmstedt, Landkreis	2	0	0	0	0
1057	Plön	2	0	0	0	0	3155	Northeim, Landkreis	2	0	0	0	0
1058	Rendsb.-Eckernförde	2	0	0	0	0	3156	Osterode am Harz	4	0	0	0	0
1059	Schleswig-Flensburg	2	0	0	0	0	3157	Peine	1	0	0	0	0
1060	Segeberg	1	0	0	0	0	3158	Wolfenbüttel	2	0	0	0	0
1061	Steinburg	2	0	0	0	0	3241	Region Hannover	2	0	0	0	0

AGS[a)]	REGION	CLUSTER	Quantiles in %				AGS	REGION	CLUSTER	Quantiles in %			
			50	25	10	5				50	25	10	5
3251	Diepholz	2	1	0	0	0	5315	Köln	1	0	0	0	0
3252	Hameln-Pyrmont	2	0	0	0	0	5316	Leverkusen	2	1	1	0	0
3254	Hildesheim	2	1	0	0	0	5354	Aachen	1	0	0	0	0
3255	Holzminden	2	0	0	0	0	5358	Düren	2	0	0	0	0
3256	Nienburg (Weser)	2	0	0	0	0	5362	Rhein-Erftkreis	2	1	0	0	0
3257	Schaumburg	2	0	0	0	0	5366	Euskirchen	2	1	0	0	0
3351	Celle	2	0	0	0	0	5370	Heinsberg	2	1	1	0	0
3352	Cuxhaven	2	0	0	0	0	5374	Oberbergischer Kreis	2	0	0	0	0
3353	Harburg	1	1	0	0	0	5378	Rh.-Bergischer Kreis	2	0	0	0	0
3354	Lüchow-Dannenberg	3	0	0	0	0	5382	Rhein-Sieg-Kreis	1	1	0	0	0
3355	Lüneburg	2	0	0	0	0	5512	Bottrop	2	0	0	0	0
3356	Osterholz	2	0	0	0	0	5513	Gelsenkirchen	4	1	1	0	0
3357	Rotenburg (Wümme)	2	0	0	0	0	5515	Münster	1	0	0	0	0
3358	Soltau-Fallingbostel	2	0	0	0	0	5554	Borken	2	0	0	0	0
3359	Stade	2	0	0	0	0	5558	Coesfeld	2	0	0	0	0
3360	Uelzen	1	0	0	0	0	5562	Recklinghausen	2	1	0	0	0
3361	Verden	2	0	0	0	0	5566	Steinfurt	2	0	0	0	0
3401	Delmenhorst	1	0	0	0	0	5570	Warendorf	2	0	0	0	0
3402	Emden	4	0	0	0	0	5711	Bielefeld	2	0	0	0	0
3403	Oldenburg	2	1	0	0	0	5754	Gütersloh	2	0	0	0	0
3404	Osnabrück	1	0	0	0	0	5758	Herford	2	0	0	0	0
3405	Wilhelmshaven	2	0	0	0	0	5762	Höxter	2	0	0	0	0
3451	Ammerland	2	1	0	0	0	5766	Lippe	2	0	0	0	0
3452	Aurich	2	0	0	0	0	5770	Minden-Lübbecke	2	0	0	0	0
3453	Cloppenburg	2	1	1	0	0	5774	Paderborn	1	0	0	0	0
3454	Emsland	1	1	1	0	0	5911	Bochum	2	0	0	0	0
3455	Friesland	1	0	0	0	0	5913	Dortmund	2	1	1	0	0
3456	Grafschaft Bentheim	2	1	0	0	0	5914	Hagen	2	0	0	0	0
3457	Leer	1	1	0	0	0	5915	Hamm	2	0	0	0	0
3458	Oldenburg LK	1	0	0	0	0	5916	Herne	2	0	0	0	0
3459	Osnabrück	2	1	0	0	0	5954	Ennepe-Ruhr-Kreis	2	0	0	0	0
3460	Vechta	2	1	1	0	0	5958	Hochsauerlandkreis	2	0	0	0	0
3461	Wesermarsch	1	0	0	0	0	5962	Märkischer Kreis	1	0	0	0	0
3462	Wittmund	1	0	0	0	0	5966	Olpe	2	1	0	0	0
4011	Bremen	1	1	0	0	0	5970	Siegen-Wittgenstein	2	0	0	0	0
4012	Bremerhaven	2	1	0	0	0	5974	Soest	2	0	0	0	0
5111	Düsseldorf	2	0	0	0	0	5978	Unna	2	0	0	0	0
5112	Duisburg	1	1	1	0	0	6411	Darmstadt	1	0	0	0	0
5113	Essen	2	1	0	0	0	6412	Frankfurt am Main	1	0	0	0	0
5114	Krefeld	1	0	0	0	0	6413	Offenbach	3	0	0	0	0
5116	Mönchengladbach	2	0	0	0	0	6414	Wiesbaden	2	0	0	0	0
5117	Mülheim an der Ruhr	2	1	0	0	0	6431	Bergstraße	2	1	0	0	0
5119	Oberhausen	1	1	0	0	0	6432	Darmstadt-Dieburg	2	1	0	0	0
5120	Remscheid	2	0	0	0	0	6433	Groß-Gerau	1	0	0	0	0
5122	Solingen	2	0	0	0	0	6434	Hochtaunuskreis	1	0	0	0	0
5124	Wuppertal	2	0	0	0	0	6435	Main-Kinzig-Kreis	2	1	0	0	0
5154	Kleve	2	1	0	0	0	6436	Main-Taunus-Kreis	1	0	0	0	0
5158	Mettmann	2	0	0	0	0	6437	Odenwaldkreis	2	0	0	0	0
5162	Rhein-Kreis Neuss	1	1	1	1	0	6438	Offenbach	2	1	0	0	0
5166	Viersen	2	0	0	0	0	6439	Rheing.-Taunus-Kreis	2	0	0	0	0
5170	Wesel	2	0	0	0	0	6440	Wetteraukreis	2	1	1	0	0
5313	Aachen	1	0	0	0	0	6531	Gießen	2	0	0	0	0
5314	Bonn	1	0	0	0	0	6532	Lahn-Dill-Kreis	2	0	0	0	0

AGS[a)]	REGION	CLUSTER	Quantiles in % 50	25	10	5	AGS	REGION	CLUSTER	Quantiles in % 50	25	10	5
6533	Limburg-Weilburg	2	1	0	0	0	8125	Heilbronn	2	1	0	0	0
6534	Marburg-Biedenkopf	2	0	0	0	0	8126	Hohenlohekreis	2	0	0	0	0
6535	Vogelsbergkreis	2	0	0	0	0	8127	Schwäbisch Hall	2	0	0	0	0
6611	Kassel	2	0	0	0	0	8128	Main-Tauber-Kreis	2	0	0	0	0
6631	Fulda	2	1	0	0	0	8135	Heidenheim	2	0	0	0	0
6632	Hersfeld-Rotenburg	2	1	0	0	0	8136	Ostalbkreis	2	1	0	0	0
6633	Kassel	2	0	0	0	0	8211	Baden-Baden	1	1	1	0	0
6634	Schwalm-Eder-Kreis	2	0	0	0	0	8212	Karlsruhe	1	1	0	0	0
6635	Waldeck-Frankenb.	2	1	0	0	0	8215	Karlsruhe	2	0	0	0	0
6636	Werra-Meißner-Kreis	2	1	0	0	0	8216	Rastatt	2	1	1	0	0
7111	Koblenz	1	0	0	0	0	8221	Heidelberg	2	0	0	0	0
7131	Ahrweiler	2	0	0	0	0	8222	Mannheim	2	1	1	0	0
7132	Altenkirchen	2	0	0	0	0	8225	Neckar-Odenw.-Kr.	2	0	0	0	0
7133	Bad Kreuznach	1	0	0	0	0	8226	Rhein-Neckar-Kreis	1	1	0	0	0
7134	Birkenfeld	2	0	0	0	0	8231	Pforzheim	2	0	0	0	0
7135	Cochem-Zell	2	0	0	0	0	8235	Calw	2	0	0	0	0
7137	Mayen-Koblenz	2	1	0	0	0	8236	Enzkreis	2	0	0	0	0
7138	Neuwied	1	0	0	0	0	8237	Freudenstadt	2	0	0	0	0
7140	Rhein-Hunsrück-Kr.	2	0	0	0	0	8311	Freiburg i.Breisgau	2	0	0	0	0
7141	Rhein-Lahn-Kreis	2	1	0	0	0	8315	Br.-Hochschwarzw.	2	1	0	0	0
7143	Westerwaldkreis	2	0	0	0	0	8316	Emmendingen	2	0	0	0	0
7211	Trier	2	0	0	0	0	8317	Ortenaukreis	2	0	0	0	0
7231	Bernkastel-Wittlich	2	1	0	0	0	8325	Rottweil	2	0	0	0	0
7232	Bitburg-Prüm	2	1	0	0	0	8326	Schwarzw.Baar-Kr.	2	0	0	0	0
7233	Daun	4	1	0	0	0	8327	Tuttlingen	2	0	0	0	0
7235	Trier-Saarburg	2	0	0	0	0	8335	Konstanz	2	1	0	0	0
7311	Frankenthal	2	0	0	0	0	8336	Lörrach	2	0	0	0	0
7312	Kaiserslautern	2	0	0	0	0	8337	Waldshut	2	0	0	0	0
7313	Landau i.d.Pfalz	1	1	1	0	0	8415	Reutlingen	2	1	1	0	0
7314	Ludwigshafen	1	0	0	0	0	8416	Tübingen	2	0	0	0	0
7315	Mainz	1	0	0	0	0	8417	Zollernalbkreis	2	0	0	0	0
7316	Neustadt a.d.Weinstr.	1	0	0	0	0	8421	Ulm	1	0	0	0	0
7317	Pirmasens	2	0	0	0	0	8425	Alb-Donau-Kreis	2	0	0	0	0
7318	Speyer	1	0	0	0	0	8426	Biberach	2	1	1	0	0
7319	Worms	2	0	0	0	0	8435	Bodenseekreis	2	0	0	0	0
7320	Zweibrücken	1	0	0	0	0	8436	Ravensburg	2	0	0	0	0
7331	Alzey-Worms	1	0	0	0	0	8437	Sigmaringen	2	0	0	0	0
7332	Bad Dürkheim	2	0	0	0	0	9161	Ingolstadt	1	1	1	1	0
7333	Donnersbergkreis	2	0	0	0	0	9162	München	1	0	0	0	0
7334	Germersheim	4	1	1	0	0	9163	Rosenheim	4	0	0	0	0
7335	Kaiserslautern	1	1	0	0	0	9171	Altötting	2	1	1	1	0
7336	Kusel	1	0	0	0	0	9172	Berchtesg. Land	2	0	0	0	0
7337	Südliche Weinstraße	2	1	0	0	0	9173	Bad Tölz-Wolfratshs.	2	1	1	0	0
7338	Ludwigshafen	2	0	0	0	0	9174	Dachau	2	1	1	1	0
7339	Mainz-Bingen	2	0	0	0	0	9175	Ebersberg	4	1	0	0	0
7340	Südwestpfalz	2	0	0	0	0	9176	Eichstätt	2	1	1	1	1
8111	Stuttgart	1	1	1	0	0	9177	Erding	2	0	0	0	0
8115	Böblingen	1	0	0	0	0	9178	Freising	1	1	1	0	0
8116	Esslingen	2	0	0	0	0	9179	Fürstenfeldbruck	2	1	0	0	0
8117	Göppingen	2	0	0	0	0	9180	Garmisch-Partenk.	2	0	0	0	0
8118	Ludwigsburg	2	1	0	0	0	9181	Landsberg a.Lech	2	0	0	0	0
8119	Rems-Murr-Kreis	2	0	0	0	0	9182	Miesbach	2	0	0	0	0
8121	Heilbronn	2	0	0	0	0	9183	Mühldorf a.Inn	2	1	1	0	0

AGS[a)]	REGION	CLUSTER	Quantiles in % 50	25	10	5	AGS	REGION	CLUSTER	Quantiles in % 50	25	10	5
9184	München	2	1	1	1	1	9577	Weißenb.-Gunzenhs.	2	1	0	0	0
9185	Neub.-Schrobenhs.	2	1	0	0	0	9661	Aschaffenburg	2	1	1	0	0
9186	Pfaffenhofen a.d.Ilm	2	1	1	1	1	9662	Schweinfurt	1	1	1	1	1
9187	Rosenheim	2	1	1	1	0	9663	Würzburg	2	0	0	0	0
9188	Starnberg	2	1	0	0	0	9671	Aschaffenburg	2	1	0	0	0
9189	Traunstein	2	0	0	0	0	9672	Bad Kissingen	2	0	0	0	0
9190	Weilheim-Schongau	2	1	1	1	0	9673	Rhön-Grabfeld	2	1	0	0	0
9261	Landshut	1	1	1	0	0	9674	Haßberge	2	0	0	0	0
9262	Passau	2	1	1	0	0	9675	Kitzingen	2	1	0	0	0
9263	Straubing	2	1	1	0	0	9676	Miltenberg	1	1	1	1	0
9271	Deggendorf	2	1	0	0	0	9677	Main-Spessart	2	1	0	0	0
9272	Freyung-Grafenau	2	0	0	0	0	9678	Schweinfurt	2	0	0	0	0
9273	Kelheim	2	1	1	1	0	9679	Würzburg	3	1	1	1	1
9274	Landshut	3	1	1	0	0	9761	Augsburg	2	0	0	0	0
9275	Passau	2	1	0	0	0	9762	Kaufbeuren	2	0	0	0	0
9276	Regen	3	1	0	0	0	9763	Kempten	1	1	0	0	0
9277	Rottal-Inn	1	1	0	0	0	9764	Memmingen	2	1	1	0	0
9278	Straubing-Bogen	2	1	0	0	0	9771	Aichach-Friedberg	1	1	0	0	0
9279	Dingolfing-Landau	1	1	1	1	1	9772	Augsburg	2	1	1	0	0
9361	Amberg	2	1	0	0	0	9773	Dillingen a.d.Donau	2	1	0	0	0
9362	Regensburg	3	0	0	0	0	9774	Günzburg	2	1	0	0	0
9363	Weiden i.d.OPf.	2	0	0	0	0	9775	Neu-Ulm	2	1	0	0	0
9371	Amberg-Sulzbach	2	1	0	0	0	9776	Lindau	2	0	0	0	0
9372	Cham	3	1	0	0	0	9777	Ostallgäu	2	0	0	0	0
9373	Neumarkt i.d.OPf.	2	0	0	0	0	9778	Unterallgäu	2	0	0	0	0
9374	Neust. a.d.Waldnaab	2	1	0	0	0	9779	Donau-Ries	2	1	1	0	0
9375	Regensburg	2	1	0	0	0	9780	Oberallgäu	2	1	0	0	0
9376	Schwandorf	2	0	0	0	0	10041	Stadtv. Saarbrücken	2	0	0	0	0
9377	Tirschenreuth	2	1	0	0	0	10042	Merzig-Wadern	2	1	0	0	0
9461	Bamberg	1	1	0	0	0	10043	Neunkirchen	2	0	0	0	0
9462	Bayreuth	2	0	0	0	0	10044	Saarlouis	1	1	1	0	0
9463	Coburg	1	0	0	0	0	10045	Saar-Pfalz-Kreis	2	1	1	1	0
9464	Hof	2	0	0	0	0	10046	Sankt Wendel	2	1	1	0	0
9471	Bamberg	2	1	1	1	0	11000	Berlin	1	0	0	0	0
9472	Bayreuth	2	0	0	0	0	12051	Brandenb. a.d.Havel	3	1	1	1	0
9473	Coburg	2	0	0	0	0	12052	Cottbus	4	1	1	0	0
9474	Forchheim	2	1	0	0	0	12053	Frankfurt (Oder)	4	1	1	0	0
9475	Hof	2	1	0	0	0	12054	Potsdam	4	0	0	0	0
9476	Kronach	2	1	1	0	0	12060	Barnim	3	0	0	0	0
9477	Kulmbach	2	1	0	0	0	12061	Dahme-Spreewald	2	0	0	0	0
9478	Lichtenfels	2	1	1	0	0	12062	Elbe-Elster	2	0	0	0	0
9479	Wunsiedel i.Fichtelg.	2	1	0	0	0	12063	Havelland	2	0	0	0	0
9561	Ansbach	2	1	0	0	0	12064	Märkisch-Oderland	2	0	0	0	0
9562	Erlangen	1	1	1	0	0	12065	Oberhavel	4	1	1	1	0
9563	Fürth	1	1	0	0	0	12066	Oberspr.-Lausitz	4	1	1	0	0
9564	Nürnberg	1	0	0	0	0	12067	Oder-Spree	2	1	0	0	0
9565	Schwabach	2	1	1	0	0	12068	Ostprignitz-Ruppin	3	1	0	0	0
9571	Ansbach	2	1	1	0	0	12069	Potsdam-Mittelmark	3	0	0	0	0
9572	Erlangen-Höchstadt	2	1	1	1	0	12070	Prignitz	3	1	1	0	0
9573	Fürth	2	1	0	0	0	12071	Spree-Neiße	1	0	0	0	0
9574	Nürnberger Land	2	1	1	0	0	12072	Teltow-Fläming	3	1	1	1	1
9575	Nstdt./Aisch-Bad W.	2	0	0	0	0	12073	Uckermark	3	1	1	1	0
9576	Roth	2	0	0	0	0	13001	Greifswald	3	1	1	0	0

AGS[a)]	REGION	CLUSTER	Quantiles in %				AGS	REGION	CLUSTER	Quantiles in %			
			50	25	10	5				50	25	10	5
13002	Neubrandenburg	4	1	0	0	0	15151	Anhalt-Zerbst	4	1	0	0	0
13003	Rostock	2	0	0	0	0	15153	Bernburg	2	1	1	1	1
13004	Schwerin	1	0	0	0	0	15154	Bitterfeld	4	1	1	1	1
13005	Stralsund	2	1	0	0	0	15159	Köthen	3	1	1	0	0
13006	Wismar	4	1	1	1	1	15171	Wittenberg	3	1	1	0	0
13051	Bad Doberan	3	1	0	0	0	15202	Halle (Saale)	4	0	0	0	0
13052	Demmin	3	1	1	1	1	15256	Burgenlandkreis	4	1	0	0	0
13053	Güstrow	3	0	0	0	0	15260	Mansfelder Land	4	1	0	0	0
13054	Ludwigslust	3	1	0	0	0	15261	Merseburg-Querfurt	4	1	1	1	1
13055	Mecklenburg-Strelitz	3	0	0	0	0	15265	Saalkreis	3	1	0	0	0
13056	Müritz	3	1	1	0	0	15266	Sangerhausen	4	1	1	0	0
13057	Nordvorpommern	3	1	0	0	0	15268	Weißenfels	4	0	0	0	0
13058	Nordwestmecklenb.	3	0	0	0	0	15303	Magdeburg	4	1	1	0	0
13059	Ostvorpommern	3	1	0	0	0	15352	Aschersleben-Staßfurt	4	1	1	1	1
13060	Parchim	3	0	0	0	0	15355	Bördekreis	4	1	0	0	0
13061	Rügen	4	1	1	0	0	15357	Halberstadt	4	1	0	0	0
13062	Uecker-Randow	4	0	0	0	0	15358	Jerichower Land	4	1	0	0	0
14161	Chemnitz	4	1	1	0	0	15362	Ohre-Kreis	4	1	1	1	1
14166	Plauen	3	1	0	0	0	15363	Stendal	4	0	0	0	0
14167	Zwickau	1	1	0	0	0	15364	Quedlinburg	4	1	1	0	0
14171	Annaberg	4	1	1	1	0	15367	Schönebeck	4	1	1	0	0
14173	Chemnitzer Land	4	1	1	1	0	15369	Wernigerode	4	1	1	0	0
14177	Freiberg	3	1	1	0	0	15370	Altmarkkr. Salzw.	4	1	1	0	0
14178	Vogtlandkreis	3	1	0	0	0	16051	Erfurt	4	0	0	0	0
14181	Mittl. Erzgebirgskr.	4	1	1	1	1	16052	Gera	2	0	0	0	0
14182	Mittweida	2	1	1	1	1	16053	Jena	2	1	1	0	0
14188	Stollberg	3	1	1	1	1	16054	Suhl	4	1	0	0	0
14191	Aue-Schwarzenb.	3	1	0	0	0	16055	Weimar	4	0	0	0	0
14193	Zwickauer Land	2	1	0	0	0	16056	Eisenach	3	1	1	1	1
14262	Dresden	3	1	1	1	1	16061	Eichsfeld	3	1	1	1	0
14263	Görlitz	4	0	0	0	0	16062	Nordhausen	3	0	0	0	0
14264	Hoyerswerda	4	1	1	0	0	16063	Wartburgkreis	3	1	0	0	0
14272	Bautzen	3	1	1	0	0	16064	Unstrut-Hainich-Kr.	2	0	0	0	0
14280	Meißen	3	1	0	0	0	16065	Kyffhäuserkreis	3	0	0	0	0
14284	Niederschles. Oberl.kr.	2	1	0	0	0	16066	Schmalkalden-Mein.	4	1	1	1	0
14285	Riesa-Großenhain	3	1	1	0	0	16067	Gotha	2	1	0	0	0
14286	Löbau-Zittau	2	1	0	0	0	16068	Sömmerda	3	1	1	1	1
14287	Sächsische Schweiz	2	1	0	0	0	16069	Hildburghausen	3	1	1	1	1
14290	Weißeritzkreis	4	1	1	0	0	16070	Ilm-Kreis	3	1	1	1	1
14292	Kamenz	2	1	0	0	0	16071	Weimarer Land	3	1	1	1	0
14365	Leipzig	4	0	0	0	0	16072	Sonneberg	1	1	1	1	0
14374	Delitzsch	4	0	0	0	0	16073	Saalfeld-Rudolstadt	3	1	1	0	0
14375	Döbeln	3	1	1	1	0	16074	Saale-Holzland-Kreis	3	1	0	0	0
14379	Leipziger Land	1	1	1	0	0	16075	Saale-Orla-Kreis	3	1	1	1	0
14383	Muldentalkreis	3	1	0	0	0	16076	Greiz	4	1	0	0	0
14389	Torgau-Oschatz	3	1	1	0	0	16077	Altenburger Land	3	1	1	0	0
15101	Dessau	4	1	1	0	0							

[a] AGS: Allgemeiner Gemeindeschlüssel, German Regional Code

Source: Own calculation.