

Frondel, Manuel et al.

Research Report

Lignite regions in Germany: An analysis based on current comparative structural data

RWI Projektberichte

Provided in Cooperation with:

RWI – Leibniz-Institut für Wirtschaftsforschung, Essen

Suggested Citation: Frondel, Manuel et al. (2018) : Lignite regions in Germany: An analysis based on current comparative structural data, RWI Projektberichte, RWI - Leibniz-Institut für Wirtschaftsforschung, Essen

This Version is available at:

<https://hdl.handle.net/10419/195938>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



RWI Report

RWI – Leibniz Institute for Economic Research

**Lignite Regions in Germany:
an Analysis Based on Current Comparative
Structural Data**

**Project Report for the Federal Ministry for
Economic Affairs and Energy (BMWi)**

Project Number: I C 4 - 25/17

Final Report – Summary – January 2018



Imprint

Publisher

RWI – Leibniz Institute for Economic Research

Hohenzollernstr. 1-3 | 45128 Essen, Germany
Phone: +49 201-81 49-0 | E-Mail: rwi@rwi-essen.de
www.rwi-essen.de

Board of Directors

Prof. Dr. Christoph M. Schmidt (President)
Prof. Dr. Thomas K. Bauer (Vice President)
Dr. Stefan Rumpf (Administrative Board Member)

© RWI 2018

Reprint and further distribution—including excerpts—with complete reference and with permission by RWI only.

RWI Report

Editor: Prof. Dr. Christoph M. Schmidt
Layout and design: Julica Bracht, Claudia Lohkamp, Daniela Schwindt

Lignite Regions in Germany: an Analysis Based on Current Comparative Structural Data

Project Report for the Federal Ministry for Economic Affairs and Energy (BMWi)
Project Number: I C 4 - 25/17
Final Report – Summary – January 2018

Project team

Prof. Manuel Frondel (Leader), Rüdiger Budde, Dr. Jochen Dehio (Co-Leader),
Ronald Janßen-Timmen, Dr. Michael Rothgang, Dr. Torsten Schmidt (Co-Leader)

The project team thanks Dimitri Bogonos und Svenja Elsner for their support and implementation during the project. Daniela Schwindt and Sarah Rühl are gratefully acknowledged for their support in preparing the report.

RWI – Leibniz Institute for Economic Research

**Lignite Regions in Germany:
an Analysis Based on Current Comparative
Structural Data**

**Project Report for the Federal Ministry for
Economic Affairs and Energy (BMWi)**

Project Number: I C 4 - 25/17

Final Report – Summary – January 2018

Content

1.	Purpose of the project	5
2.	Study design	7
2.1	Demarcation of lignite mining regions.....	7
2.2	System of indicators and data	8
2.3	Multiplier analysis	8
2.4	Shift-share analysis	9
2.5	Analysis of the demographic structure.....	9
3.	Central results	11
3.1	Location of the lignite mining regions.....	11
3.2	Economic significance of the lignite mining sector for employment.....	11
3.3	Economic strength of the lignite mining regions.....	12
3.4	Ability to innovate.....	14
3.5	Skill composition of the labor force.....	17
3.6	Sectoral structure.....	18
3.7	Location effects	19
3.8	Population development.....	21
4.	Summary and overall assessment	25

Tables

Table 3.2.1 Distribution of employment in the lignite mining regions in Germany.....12

Table 3.2.2 Importance of direct, indirect and induced employment effects in the lignite mining regions.....12

Table 3.3.1 GDP and per capita income in the four lignite regions.....13

Table 3.3.2 Gross value added in the lignite mining regions.....13

Table 3.3.3 Employment in the lignite mining regions14

Table 3.4.1 Research intensity in the lignite mining regions.....15

Table 3.4.2 R&D-personnel intensity in the lignite mining regions.....15

Table 3.5.1 Indicators of the skilled worker situation in the lignite mining regions.....17

Table 3.5.2 Job vacancies and unemployment rate in the lignite mining regions18

Table 3.6.1 Location coefficients for the lignite mining regions.....19

Table 3.8.1 Population projections for the lignite mining regions..... 22

Graphs

Graph 2.1.1 Localization of lignite mining regions in Germany 7

Graph 3.4.1 Indicators of innovation intensity in the lignite mining regions compared to the federal average.....16

Graph 3.7.1 Shift-share analysis of employment in the lignite mining regions compared with the federal level 20

Graph 3.7.2 Shift-share analysis of gross value added in the lignite mining regions compared with the federal level..... 20

Graph 3.7.3 Shift-share analysis of employment in the lignite mining regions compared with the states.....21

Graph 3.7.4 Shift-share analysis of gross value added in the lignite mining regions compared with the state level.....21

1. Purpose of the project

The phase-out of nuclear energy, the extraction of coal and lignite-fired power generation as well as the simultaneous expansion of renewable energies is dominating the discourse about the energy policy in Germany. While the phase-out pathway for nuclear energy and hard coal production are already predetermined, a corresponding decision for lignite-based power electricity production, however, has not been made yet. The lignite mining regions in Germany are in the focus in respect to climate protection and structural change. Against this background, the Federal Government adopted the so-called "Klimaschutzplan 2050" (climate protection plan 2050) on November 14th 2016. This plan aims to support lignite regions in managing the induced structural change by combining climate with regional economic objectives.

Part of the agreed climate protection plan is to create a commission called "economic growth, structural change and regional development", that is supposed to start its work in 2018. The commission will include representatives from municipalities and federal states, labor unions and employers, stakeholders from the regions and representatives from the federal ministries. The mission of the commission is to assess the development of lignite mining regions and to propose suitable measures to foster socially acceptable structural change.

This study is intended to prepare or support the work of this commission. For this reason, we present central socio-economic indicators for each German lignite mining region and compare them with state and national averages. On the basis of these results, the further structural change should be designed. The indicators reflect the different problems, will inform future policies and enable policy makers to tailor specific responses to the coming challenges and work out the already initiated or foreseeable structural developments of the respective regions.

Based on the quantitative and qualitative findings regional profiles are derived for the regions of the four German lignite mining regions. These regional profiles show the development or the current situation of the regions with regard to the associated challenges and structural developments. On this basis, perspectives and potentials were derived with regard to the future economic and innovative development of the lignite mining regions. For the classification of the developments in the individual districts and regions these were compared with those in the respective federal states and in Germany altogether.

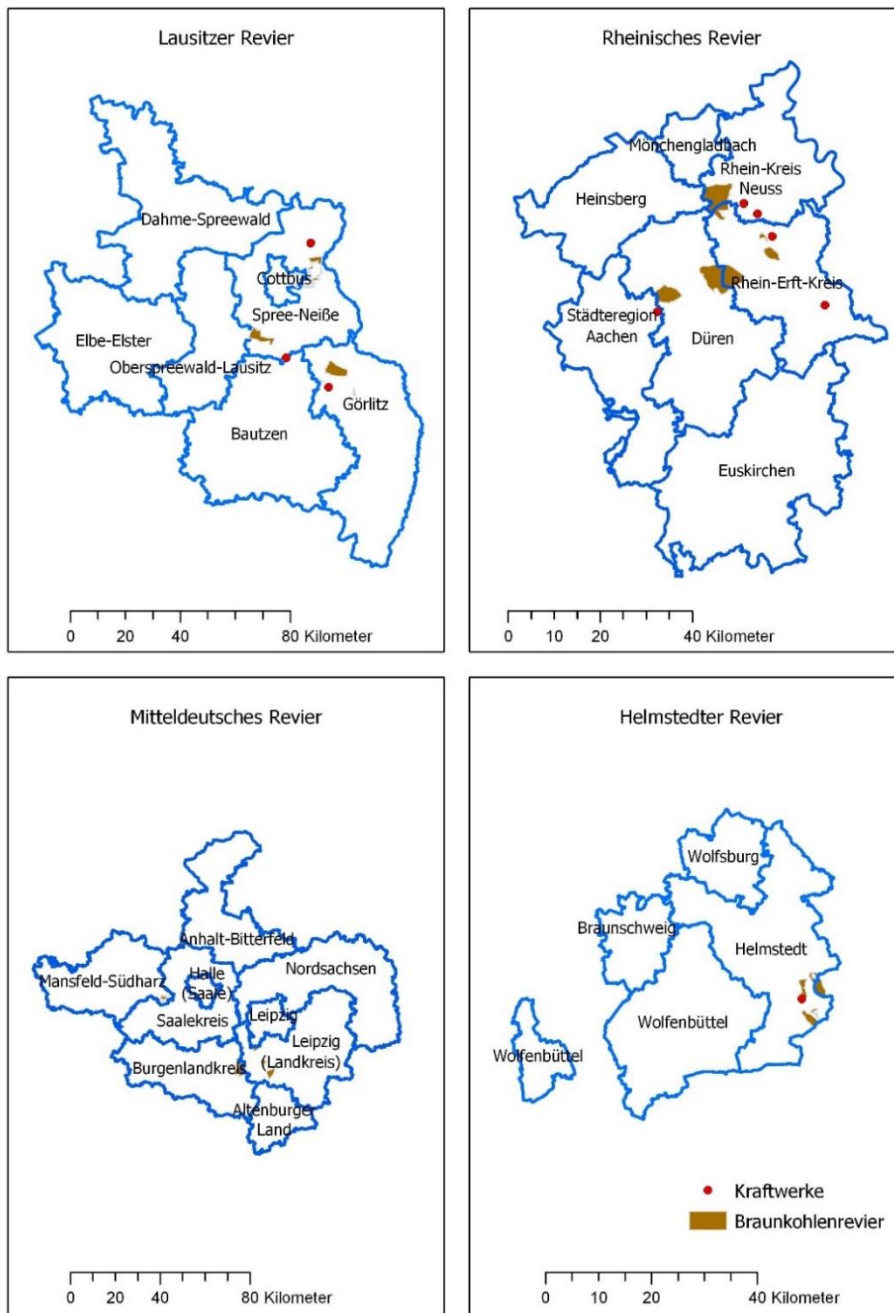
This summary presents the main results of the extended version of the study. Section 2 describes the study design. Section 3 presents the main results for the lignite mining regions and Section 4 concludes with an overall assessment.

2. Study design

2.1 Demarcation of lignite mining regions

This study analyses the four lignite mining regions in Germany. The demarcation of these regions took place at the district level (NUTS 3) and was coordinated with the respective federal state. Graph 2.1.1 shows the administrative districts and autonomous cities that surround the locations of opencast lignite mines and the lignite power plants.

Graph 2.1.1
Localization of lignite mining regions in Germany



Source: Own diagram.

The districts or cities are located around the lignite mines and the sites of the lignite power plants. The region of the Lausitzer Revier includes six districts and one city from two federal states, the Rheinische Revier five districts and two cities from one federal state, the Mitteldeutsches Revier seven districts and two cities from three federal states and the Helmstedter Revier two districts and two cities from a federal state.

2.2 System of indicators and data

As a basis for the investigations in the context of this study an evaluation of the literature and the available studies was made. The insights and data gained from these desktop analyzes then served as a basis for the indicator system, which refers to the development of key structural data related to mapping the growth and innovation potential of the four lignite mining regions. We therefore selected spatial, economic as well as innovativeness indicators, which all allow comparisons with other regions and levels of the federal system. The set of indicators aims to paint a comprehensive picture of the living conditions in the lignite mining regions. The period of observation usually covers ten years (usually from 2005 to 2015, but in some cases goes back to 2000) in order to show the development of the lignite mining regions. To fill the publication lag, we also extended the sample in some cases to 2018 based on the economic forecast or the demographic projection. Our main sources include the official as well as non-official statistics. Moreover, we used results from other empirical studies. Primary surveys were not conducted.

Indicators for the regional and demographic structure: Economic prospects of a region depends, among others, on the centrality and the ability to be reached by public and private transport. We therefore select indicators of the settlement structure, transport connection, public infrastructure and demographic development. The settlement structure indicator distinguishes between urban and rural areas. Moreover, we measure accessibility by the number of residents and commuter flows. The indicator “Ländlichkeit” bundles several information including settlement density, the share of agricultural and forest land, the share of single- and two family houses and the accessibility of centers. The accessibility of highways, railway stations and airports serve as indicators of the connectivity of a region. Finally, we present some indicators about the demographic structure such as the number of residents as well as the age distribution. To assess the perspective of the regions we also make use of demographic projection.

Indicators of economic strength and the economic structure: Indicators of economic strength are taken from the National Accounts of the federal states. We use GDP per capita as well as labor productivity. As a measure for purchasing power we use disposable income per capita and the unemployment rate. Indicators for the economic structure in the administrative districts are gross value added and the number of employees in manufacturing as well as in the service sector. Moreover, we report the number of employees in the lignite production sector. Finally, we report indicators for the local government finance, in particular the debt level as well as revenues of major taxes.

Indicators of innovativeness: Innovations are an important driver of economic growth at the regional as well as at the national level. In this study we report indicators of the R&D-intensity, R&D-personnel intensity, patent intensity, (hightech) start up intensity, digital infrastructure, and the skill composition of the labor force.

2.3 Multiplier analysis

In this project we use input-output analysis to derive employment multiplier in order to predict indirect and induced employment effects of a reduction of employment in the lignite sector. Therefore, we need information about intermediate inputs, wages and investments in the lignite production sector. Based on this information, we can estimate the impact of a changing lignite production

on primary product manufacturers as well as on investment and consumer goods producers. Starting point for these calculations is the number of employees in the surface mining, the lignite-fired power plants and upgrading facilities in the German lignite regions. Indirect and induced employment effects are estimated using employment multipliers calculated from Energy Environment Forecast Analysis (EEFA) for the year 2009. However, we adjust these employment multipliers to conditions of the year 2016 by using plausibility checks. We conduct the employment analysis for the economy as a whole and at the regional level.

2.4 Shift-share analysis

To evaluate the economic impact on the lignite mining regions we use a shift-share analysis, which is a standard tool in regional economics. Specifically, the shift-share analysis compares the development in a specific region to the dynamics in a broader area like their respective federal state or Germany as a whole. The technique allows to decompose the overall effect into the three following components: The business cycle, the structural and the regional component. The business cycle component captures the effect of the overall economic activity on the region. Therefore, the component isolates the change in employment or gross value added that is due to the overall state of the business cycle. The structural component captures differences in the economic structure between the region and the broader area. This component is calculated by assuming that the region would have had the same economic structure as the broader area. The regional component is a residual. It is calculated as the difference between the actual change in the variable of interest and the business cycle component and the structural component. Therefore, a positive regional component indicates that the region performs better than the broader region given its economic structure. A negative regional component signals the opposite. In this study we perform the shift-share analysis for the administrative districts in the lignite mining regions using employment and value added as variables of interest. We use data for the official statistics for the years 2000 to 2016 and forecasts from the RWI business cycle forecast for the years 2017 and 2018. We employ a linear regression model to forecast values for the regional level conditional on the forecast for the federal level. We compare the regions with the federal level and the state level.

2.5 Analysis of the demographic structure

To better assess the economic perspectives in the lignite regions, we also report the demographic projections of age cohorts for each administrative district in Germany until 2035. This projection is based on assumptions about fertility rates and mortality rates as well as immigration and emigration figures for each of the 402 administrative districts in Germany. The employed model guarantees that net migration within Germany is consistently projected. Immigration from foreign countries in contrast is set exogenously, based on the assumption of a net migration to Germany of 200'000 each year. Net migration to Germany, however, is particularly uncertain. For this reason, demographic projections often differ in their assumptions about overall net migration to Germany. Although the BBSR projection uses a bottom-up approach, i.e. demographic developments are projected for the administrative districts and then aggregated to the state and the national level, net migration from foreign countries also does not take regional specificities into account. However, our impression is that the assumption about net migration from the BBSR projection is reasonable. An additional challenge for the recent projection are the adjustments caused by the results of the Census 2011. The Census 2011 results generated considerable structural breaks in the age-cohort time series. For this reason, the projection cannot be based on the historical relationship between demographic variables. To overcome these problems adjustment coefficients were used when necessary. In the internal migration model, additional adjustments were necessary. Despite these problems, the projections are overall informative for the demographic developments in the lignite regions in Germany. An area of special interest is the development of the labor force.

3. Central results

3.1 Location of the lignite mining regions

The cartographic illustration of the location of the four lignite mining regions in Germany reveals some important differences. First of all, the size of both East German mining regions is much larger than of the West German regions. With regard to centrality and the ability to be reached by public and private transport, the Lausitzer Revier is the only region without a major regional center. The administrative district Dahme-Spreewald neighbors Berlin but the distances are too great to generate positive spillovers. The situation is different in the other lignite mining regions. All of them have at least two major regional centers.

There are additional important differences between the four regions with regard to centrality and settlement structure. The region Lausitzer Revier only consists of administrative districts that are classified as peripheral with the sole exception being Dahme-Spreewald. In addition, the eastern part of this region borders Poland and the Czech Republic. Moreover, all districts are classified as rural (even Cottbus). At the other extreme the region Rheinisches Revier is classified as central and urban. In the region Mitteldeutsches Revier one third of the districts are classified as urban. In addition, four of these nine districts are classified as central. In the region Helmstedter Revier all districts are classified as central and all are classified as urban except the Helmstedt district.

Centrality and settlement structure are important to assess the economic perspectives of a region because there is a direct link between the level of urbanizations and the proximity to agglomerations on the one hand and the ability to innovate and develop on the other. The more rural or peripheral a region is, the less attractive it is for business startups. This disadvantage cannot be compensated by cost advantages. Moreover, these regions are seldom able to attract skilled workers.

3.2 Economic significance of the lignite mining sector for employment

The four regions also show considerable differences with respect to the importance of lignite mining for the regional economy. The contribution of lignite to electricity generation was 23% in the year 2016 (2000: 26%). 42% of employees in the lignite sector are working in the region Lausitzer Revier (36% lignite production), 45% in the region Rheinisches Revier (53% lignite production), 12% in the region Mitteldeutsches Revier (10% lignite production), and 1% in the region Helmstedter Revier (less than 1% lignite production). Table 3.2.1 shows the number of employees subject to social security contribution in opencast lignite mining, in lignite-fired power plants and in refinement production in the four lignite mining regions. In addition, it shows the contribution of employees to total employment subject to social security. These figures confirm the importance of lignite mining in particular for the region Lausitzer Revier, followed by the region Rheinisches Revier and the region Mitteldeutsches Revier. In the Helmstedter Revier lignite production was abandoned in 2017.

Based on assumptions we calculated the indirect and induced employment effects from changes in economic activity in the lignite production sector. The lignite sector is linked with intermediate goods, investment goods and consumer goods industries in the region and other parts of the country. Table 3.2.2 shows the total employment that is directly or indirectly related to the lignite sector. Taken together, nationwide 56 thousand persons are directly employed in the lignite mining sector, are working in mining-dependent areas or their employment is induced by the mining sector. Accordingly, 1,8 persons in the wholesale, consumer goods and capital goods industry are employed per directly employed person in the lignite industry nationwide. In 2016 0,2% of all employees were subject to social security contribution (in the region Lausitzer Revier 3,3%, in Rheinisches Revier 1,8% and in Mitteldeutsches Revier 0,5%) as were 0,8% of the employees in the industry. These jobs mainly concern industrial sectors or business-related services.

Table 3.2.1
Distribution of employment in the lignite mining regions in Germany

Region	2005	2016	2005	2016
	Employees in the lignite sector		Share of employees in the lignite sector subject to social security contribution in %	
Lausitzer Revier	8.881	8.278	2,5	2,0
Rheinisches Revier	11.105	8.961	1,7	1,2
Mitteldeutsches Revier	2.642	2.414	0,4	0,3
Helmstedter Revier	665	199	0,3	0,1
Total	21.210	19.852	1,3	0,9

Source: Own calculations, based on data of the coal industry.

Table 3.2.2
Importance of direct, indirect and induced employment effects in the lignite mining regions 2016

Revier	Direct, indirect and induced employment of the lignite sector	all in %	Share of the employees industry in %	popu lation in %
Lausitzer Revier	13.245	3,27	17,5	1,1
Rheinisches Revier	14.338	1,84	10,2	0,6
Mitteldeutsches Revier	3.862	0,52	3,5	0,2
Helmstedter Revier	329	0,11	0,3	0,03
Reviere total	31.774	1,43	8,0	0,5
Germany	55.586	0,18	0,8	0,07

Source: Own calculations.

3.3 Economic strength of the lignite mining regions

The economic development in the four lignite mining regions differs (Table 3.3.1): In the two East-German lignite mining regions, annual GDP growth was half a percentage point higher than in the West-German lignite mining regions. Per-capita income growth in the region Lausitz was even 1 ½ percentage points and in the region Mitteldeutsches Revier one percentage point higher than in the West-German regions. One explanation for this unequal growth in per-capita income is the difference in the demographic development in the regions—the decrease in population in the East-German lignite regions was much stronger than in the West-German regions. However, the level of per-capita personal income is still much higher in the West-German regions. In 2015, the level of per-capita income in the region Rheinisches Revier was 10% lower than the federal average and the level of per-capita income in the East-German regions was 20% below the federal average.

Table 3.3.2 and 3.3.3 show the development of gross value added and employment in the manufacturing industry and the service sector. The growth rates of gross value added in the manufacturing industries was considerably higher in the East-German lignite mining regions than in the western regions; however, the increase in employment was only slightly higher. Moreover, the growth rate of value added in the service sector similar in all regions but the increase in employment was higher in the West-German regions.

Table 3.3.1
GDP and per capita income in the four lignite regions

Region	GDP			Per capita income		
	in mill. €		in % p.a.	€ per resident		in % p.a.
	2005	2015	2005-15	2005	2015	2005-15
Lausitzer Revier	22.988	31.426	3,2	17.815	26.983	4,2
Rheinisches Revier	61.188	79.303	2,6	25.351	32.769	2,6
Mitteldeutsches Revier	40.932	55.619	3,1	19.618	27.640	3,5
Helmstedter Revier	21.960	28.156	2,5	37.598	48.114	2,5
Brandenburg	48.716	66.350	3,1	19.239	26.848	3,8
Sachsen	84.653	113.549	3,0	20.044	27.899	3,7
Nordrhein-Westfalen	508.544	648.714	2,5	28.497	36.544	2,8
Sachsen-Anhalt	45.864	57.868	2,4	18.689	25.828	3,7
Thüringen	43.147	58.793	3,1	18.629	27.172	4,3
Niedersachsen	195.794	256.705	2,7	24.816	32.591	3,1
Germany	2.300.860	3.032.820	2,8	28.288	37.128	3,1

Source: Own calculations, based on data of SNA of the Federal States.

Table 3.3.2
Gross value added in the lignite mining regions

Region	Gross value added in Manufacturing			Gross value added in Services		
	in mill. €		% p.a.	in thousand		% p.a.
	2005	2015	2005-15	2005	2015	2005-15
Lausitzer Revier	6.020	9.367	4,5	14.515	18.638	2,5
Rheinisches Revier	16.753	22.209	2,9	38.359	48.875	2,5
Mitteldeutsches Revier	9.783	14.947	4,3	26.831	34.708	2,6
Helmstedter Revier	9.618	11.053	1,4	10.182	14.200	3,4
Brandenburg	10.880	16.229	4,1	32.476	42.752	2,8
Sachsen	22.462	32.772	3,8	53.438	68.799	2,6
Nordrhein-Westfalen	133.221	162.503	2,0	325.014	419.088	2,6
Sachsen-Anhalt	12.463	17.084	3,2	28.386	34.225	1,9
Thüringen	12.460	17.936	3,7	26.068	34.471	2,8
Niedersachsen	55.426	70.959	2,5	119.025	156.744	2,8
Germany	612.083	832.214	3,1	1.454.205	1.880.097	2,6

Source: Own calculations, based on data of SNA of the Federal States.

Table 3.3.3
Employment in the lignite mining regions

Region	Employment in manufacturing			Employment in services		
	in thousand		% p.a.	in thousand		% p.a.
	2005	2015	2005-15	2005	2015	2005-15
Lausitzer Revier	139	148	0,6	370	369	0,0
Rheinisches Revier	250	251	0,0	765	861	1,2
Mitteldeutsches Revier	203	221	0,9	685	722	0,5
Helmstedter Revier	104	112	0,7	210	242	1,4
Brandenburg	229	245	0,7	764	807	0,5
Sachsen	509	544	0,7	1.371	1.440	0,5
Nordrhein-Westfalen	2.115	2.104	-0,1	6.292	7.005	1,1
Sachsen-Anhalt	245	262	0,7	730	721	-0,1
Thüringen	296	311	0,5	694	711	0,2
Niedersachsen	875	937	0,7	2.587	2.913	1,2
Germany	10.095	10.517	0,4	28.563	31.903	1,1

Source: Own calculations, based on data of SNA of the Federal States.

The different pace in value added growth between East- and West-German regions is part of the economic convergence in living conditions and can be derived from economic growth theory. These economic growth models predict that factor income between economic regions converges in the long run. GDP of a region is a function of technological progress, labor, capital as well as productivity of these two factors. In modern models of endogenous growth also the importance of human capital is stressed.

The predicted convergence process of these models fits the observations in the lignite mining regions. As we have seen before, labor productivity is still low in the eastern compared to the western regions. In addition, the relatively low capital stock in the eastern regions leads to a high capital productivity. For this reason, investment in machinery and equipment is profitable, while additional employment might not be. However, given the demographic development and the level of technology, a complete economic convergence between the regions remains uncertain.

3.4 Ability to innovate

Indicators of innovation show a mixed picture, but in general, the indicators imply a lower innovation potential in East-German regions. For instance, the research intensity measured as the ratio of R&D expenditure to GDP exhibits much higher levels in the West-German regions. The research intensity in the region Rheinisches Revier is below the level of Nordrhein-Westfalen and therefore considerably below the German average. However, research intensities in both eastern regions are even lower (table 3.4.1). One reason is the lack of big corporations, at least in the rural areas, and the long distance to universities and other research facilities. This is particularly true for the region Lausitzer Revier.

The personnel intensity in the R&D sector shows the same picture (Table 3.4.2). This indicator is calculated as the share of employees in the R&D sector in total employment and measures the intensity of knowledge transfer into the region. From this point of view, low values for the East-German lignite mining regions are a constraint for the future economic development in both regions.

Table 3.4.1
Research intensity in the lignite mining regions

Region	R&D-expenditures in thousand €		Research intensity in % of GDP		Change in % p.a.
	2005	2015	2005	2015	2005-2015
	Lausitzer Revier	55.621	156.061	0,24	0,50
Rheinisches Revier	736.831	822.325	1,20	1,04	-1,5
Mitteldeutsches Revier	120.574	192.495	0,29	0,35	1,6
Helmstedter Revier	1.638.645	4.593.323	3,61	8,09	8,4
Brandenburg	140.000	397.000	0,29	0,60	7,6
Sachsen	915.000	1.346.000	1,08	1,19	0,9
Nordrhein-Westfalen	5.376.000	7.352.000	1,06	1,13	0,7
Sachsen-Anhalt	161.000	212.000	0,35	0,37	0,4
Thüringen	424.000	569.000	0,98	0,97	-0,1
Niedersachsen	2.871.000	6.504.000	1,47	2,53	5,6
Germany	38.651.000	60.952.000	1,68	2,01	1,8

Source: Own calculations, based on data of the SV Wissenschaftsstatistik (R&D statistics). – Mitteldeutsches Revier without the administrative districts Anhalt-Bitterfeld und Altenburger Land. – For reasons of security, the R&D-data of the region Helmstedter Revier is published for the administrative district Braunschweig only.

Table 3.4.2
R&D-personnel intensity in the lignite mining regions

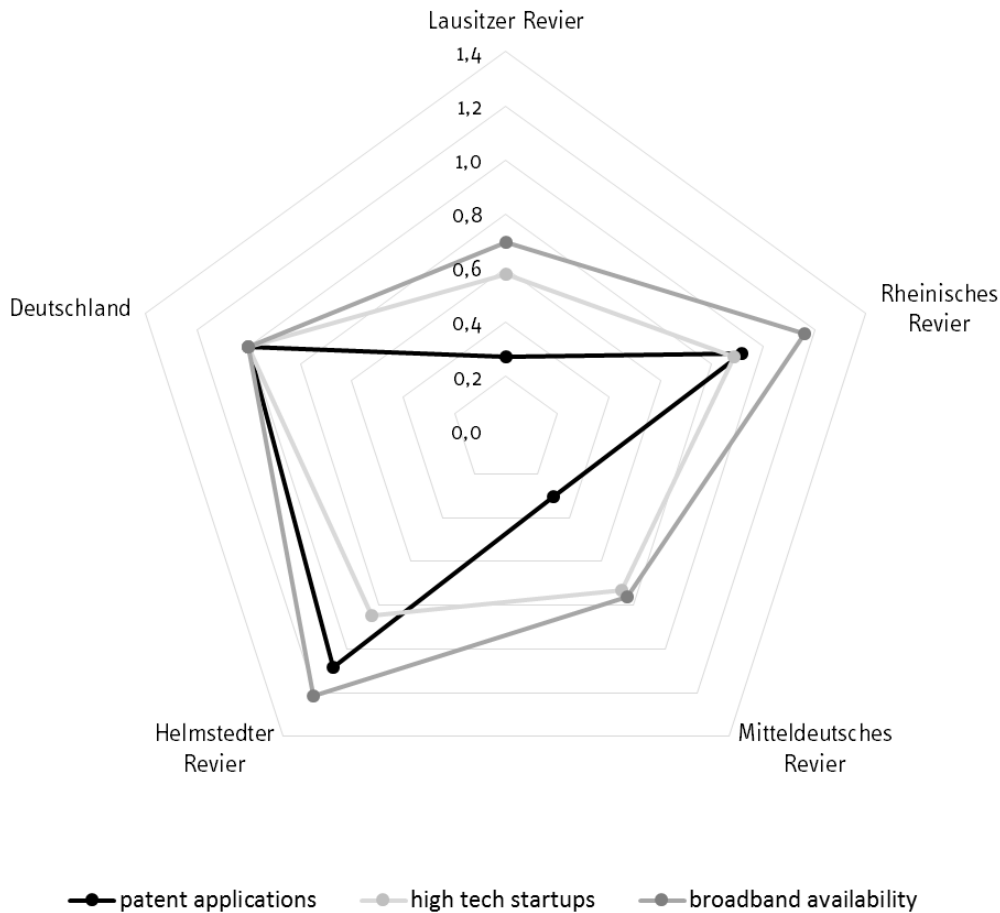
Region	R&D-personnel		R&D-personnel-intensity in %		Change in % p.a.
	2005	2015	2005	2015	2005-2015
	Lausitzer Revier	771	1.369	0,22	0,34
Rheinisches Revier	5.112	6.583	0,88	0,86	-0,1
Mitteldeutsches Revier	1.532	2.384	0,25	0,33	2,5
Helmstedter Revier	11.727	18.008	2,93	2,92	0,0
Brandenburg	1.620	3.667	0,23	0,45	7,0
Sachsen	9.393	12.294	0,71	0,80	1,3
Nordrhein-Westfalen	41.968	56.694	0,76	0,88	1,6
Sachsen-Anhalt	1.991	2.378	0,28	0,31	1,0
Thüringen	4.873	5.360	0,69	0,68	-0,1
Niedersachsen	22.461	32.254	0,97	1,16	1,7
Germany	304.503	404.767	1,17	1,32	1,2

Source: Own calculations, based on data of the SV Wissenschaftsstatistik (R&D statistics). – Mitteldeutsches Revier without the administrative districts Anhalt-Bitterfeld und Altenburger Land. – For reasons of security, the R&D-data of the region Helmstedter Revier is published for the administrative district Braunschweig only.

Research intensities in the public sector paint a different picture. The R&D intensity measure (in expenditure terms) for universities and the public sector as a whole is much higher in eastern Germany and close to the German average in the western lignite mining regions. This finding points to the public policy goal of compensating the lack of large companies in eastern Germany. However, we find a quite dense public financed research infrastructure in the region Rheinische Revier und Mitteldeutsches Revier and a lower density in the region Lausitzer and Helmstedter Revier.

The comparison of research intensity measures for the four lignite mining regions highlight the above mentioned deficits (Graph 3.4.1). The figures for patent applications, high tech startups as well as broadband availability highlight the backwardness of the East-German lignite mining regions compared to the West-German regions as well as to the German average. This is clearly a locational handicap in particular of the East-German regions.

Graph 3.4.1
Indicators of innovation intensity in the lignite mining regions compared to the federal average
 Germany (average) = 1



Source: Own graph. Patent intensity = high-tech patent applications at the European Patent Office (EPO) per 10.000 residents; Start-up intensity = number of high-tech startups per 10.000 persons of the work force. Broadband availability = Share of households that have an internet connection with at least 50 Mbit/s end of 2016.

3.5 Skill composition of the labor force

Table 3.5.1 presents some important indicators for the skill composition of the labor force. The number of employees in MINT occupations (Mathematics, Information technology, Natural science and Technology) as a share of all employees is of particular interest because a high number is important for innovation and development of a region. With the exception of the region Mitteldeutsches Revier all regions show figures above the German average. However, in the region Lausitz Revier the share of employees with an academic degree is below average. Moreover, in the region Lausitz the share of employees with an academic degree above the age 55 is quite high. It is crucial that firms are able to find adequate substitutes, once these people retire.

Table 3.5.1

Indicators of the skilled worker situation in the lignite mining regions

Region	Number der MINT-employees per thousand employees in 2013	Share of MINT-employees over 55 in 2013 in %	Share of employees with an academic degree in Juni 2016 in %	Share of school leavers with an university entrance qualification 2011-2013 in %
Lausitzer Revier	37	22,5	12,1	31,1
Rheinisches Revier	45	18,4	13,1	48,1
Mitteldeut. Revier	31	19,6	16,0	29,4
Helmstedter Revier	79	17,3	19,3	38,0
Brandenburg	27	22,5	12,7	41,5
Sachsen	34	19,3	16,6	28,7
Nordrhein-Westf.	33	18,4	13,9	39,2
Sachsen-Anhalt	25	21,4	12,3	26,9
Thüringen	28	21,0	12,9	31,9
Niedersachsen	34	17,1	11,8	33,8
Germany	37	17,6	15,0	35,3

Source: Own calculations, based on data of IW Köln. – MINT = Mathematics, Computer Science, Natural Sciences and Technology.

However, in particular in East-German lignite regions, young people continuously left the mining regions and therefore reduced the supply of skilled labor in these regions. Moreover, the lower share of apprentices in particular in the region Lausitzer Revier (3%) compared with the federal average (4,2%) as well as the lower share of employees with an academic degree point in the same direction. Thus, in the future, recruitment needs in the East-German regions might be hard to cover. In contrast, the West-German regions could be seen as more attractive locations for skilled employees. Moreover, the share of registered vacancies relative to the unemployment rate highlight a substantial mismatch between needed and existing skills in the East-German regions (Table 3.5.2), given that both rates are relatively high.

Table 3.5.2
Job vacancies and unemployment rate in the lignite mining regions
 in %

Region	Share of job vacancies	Unemployment rate²
Lausitzer Revier	2,5	9,4
Rheinisches Revier	2,6	7,8
Mitteldeut. Revier	2,5	9,9
Helmstedter Revier	1,6	6,0
Brandenburg	2,5	8,7
Sachsen	2,4	8,2
Nordrhein-Westfalen	2,4	8,0
Sachsen-Anhalt	2,4	10,2
Thüringen	3,1	7,4
Niedersachsen	2,4	6,1
Germany	2,4	6,4

Source: Own calculations, based on data from the Federal Labor Agency and the SNA of the states. – ¹ Share of registered job vacancies in August 2017. ² 2015.

3.6 Sectoral structure

Table 3.6.1 shows the location coefficients to describe the sectoral specialization of the lignite mining regions. The coefficient indicates whether the share of employees in a sector in a particular region is above or below the federal average.

The coefficient of the sector „Mining, electricity, gas, steam and air conditioning supply, water supply” that contains the employees in lignite mining production and lignite-firing power plants is below one in the region Helmstedt. This indicates that the share of employees in this sector is below the federal average. In the other lignite mining regions the coefficients are considerably larger than one. Moreover, the share of employees in the agricultural sector is substantially larger than one in the East-German regions. This is an additional indication that these regions are rural areas.

The level of industrialization in all regions is below average, indicated by a coefficient for manufacturing smaller than one. The only exception is the region Helmstedt where the coefficient is above one. The end of lignite extraction worsens this situation. In addition, for important service sectors the coefficients in these regions are also below the federal averages.

Table 3.6.1
Location coefficients for the lignite mining regions
2016

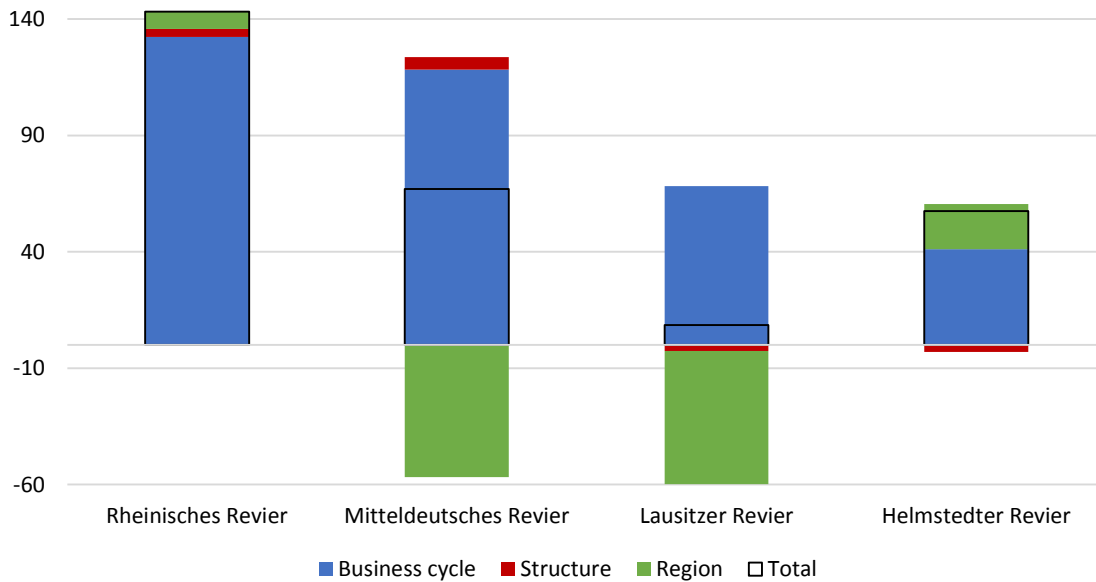
Industry sectors (CPA) ¹	Germany	Lausitzer Revier	Rheinisches Revier	Mittel-deutsch. Revier	Helmstedter Revier
Agriculture, forestry and fishing	1.00	2.97	0.60	1.80	0.31
Mining, electricity, gas, steam and air conditioning supply, water supply	1.00	2.34	1.66	1.61	0.92
Manufacturing industry	1.00	0.88	0.84	0.70	1.56
- Manufacture of consumer goods	1.00	1.26	0.95	0.87	0.53
- Metals and Electronical equipment	1.00	0.70	0.65	0.58	0.49
- Manufacture of intermediate goods	1.00	1.12	1.45	0.97	0.22
Services					
- Construction and construction works	1.00	1.41	0.99	1.21	0.58
- Wholesale and retail trade and repair of motor vehicles and motorcycles	1.00	0.88	1.20	0.91	0.75
- Transportation and Storage	1.00	1.26	1.18	1.40	0.67
- Accommodation and Food	1.00	1.02	0.74	0.95	0.71
- Information and Communication	1.00	0.32	0.79	0.96	0.73
- Financial services and Insurance	1.00	0.41	0.88	0.59	0.50
- Real estate activities, professional scientific and technical services	1.00	0.57	0.95	0.84	1.42
- Administrative and support service	1.00	1.09	1.00	1.41	1.17
- Public administration and defense; compulsory social security	1.00	1.34	0.91	1.10	0.87
- Education	1.00	0.95	0.99	1.34	0.97
- Human health	1.00	0.98	1.07	1.05	0.77
- Residential care and social work	1.00	1.31	1.14	1.05	0.79
- Other services and activities of households	1.00	0.97	1.02	0.96	0.79

Source: Own calculations, based on data of the Federal Labor Office (Bundesagentur für Arbeit). Locational coefficient: ratio of employees subject to social insurance contributions in a sector in a region to all employees subject to social insurance contributions in that sector in the total economy. ¹CPA = *Classification of Products by Activity*.

3.7 Location effects

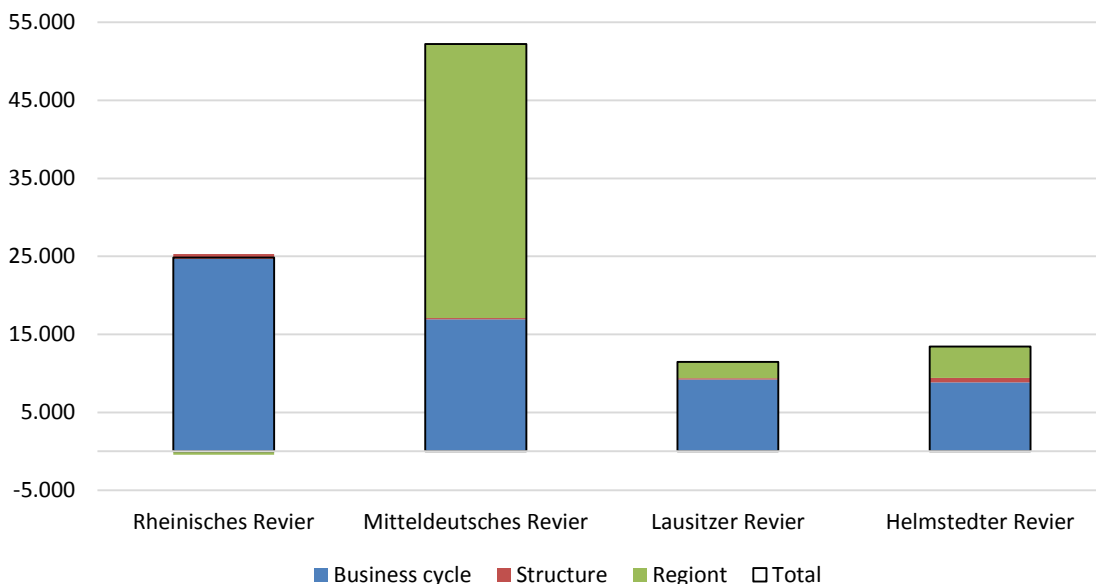
In this section we use a shift-share analysis to decompose the development of employment and value added in the four regions into three components. For this analysis, we use official data for the time period 2003 to 2016 and extend the dataset for the years 2017 and 2018 based on the RWI business cycle forecast. For this period, we compare the economic development in the four lignite mining regions with the economic development at the federal level (Graph 3.7.1 and 3.7.2) as well as at the state level (Graph 3.7.3 and 3.7.4) respectively.

Graph 3.7.1
Shift-share analysis of employment in the lignite mining regions compared with the federal level
 2003 to 2018; in thousand



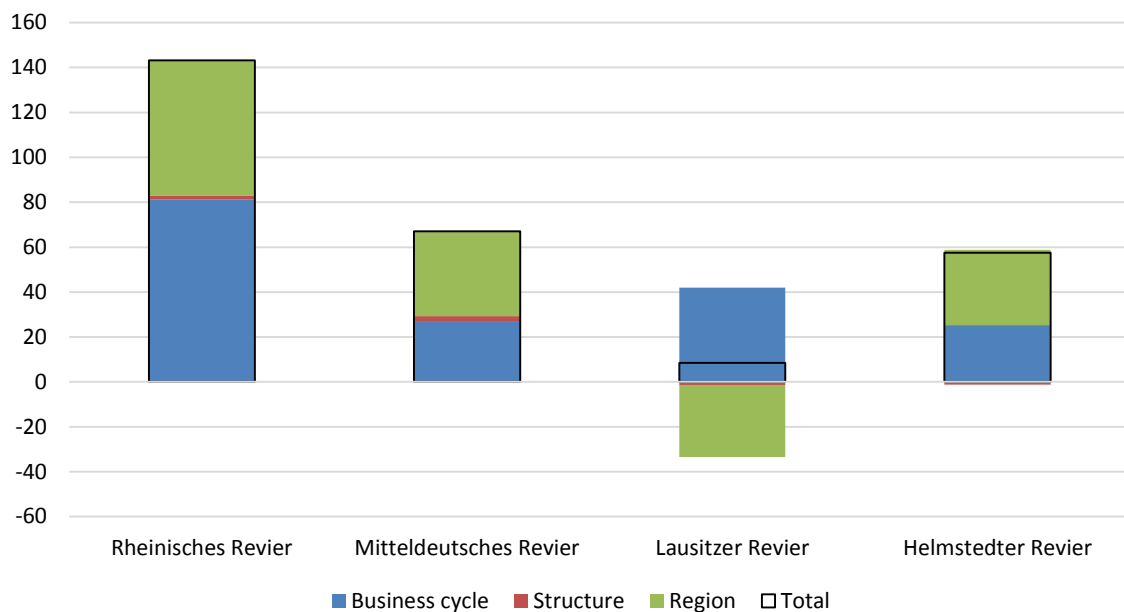
Source: Own calculations, based on data of SNA of the Federal States.

Graph 3.7.2
Shift-share analysis of gross value added in the lignite mining regions compared with the federal level
 2003 to 2018; in thousand



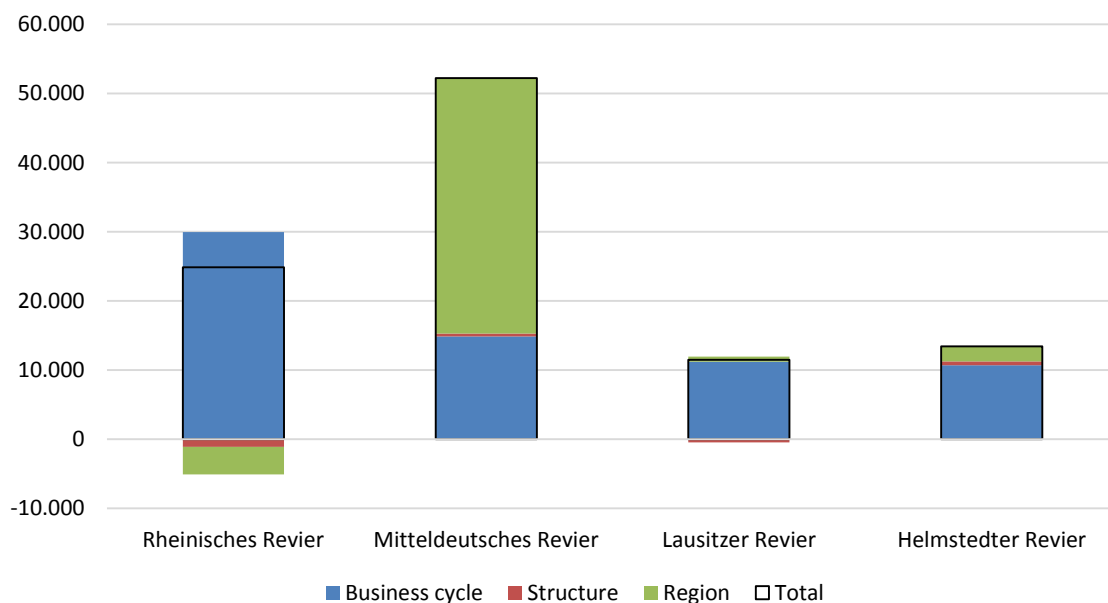
Source: Own calculations, based on data of SNA of the Federal States.

Graph 3.7.3
Shift-share analysis of employment in the lignite mining regions compared with the states
 2003 to 2018; in thousand



Source: Own calculations, based on data of SNA of the Federal States.

Graph 3.7.4
Shift-share analysis of gross value added in the lignite mining regions compared with the state level
 2003 to 2018; in thousand



Source: Own calculations, based on data of SNA of the Federal States.

The results reveal that there are no substantial sectoral differences between the lignite mining regions, the national economy as well as the economy at the state level. From this point of view the regional component is most important since it indicates regional deviations from nationwide or state level economic developments. However, this component is calculated as a residual that has no

straightforward economic interpretation. With regard to the development of employment, the decomposition reveals a negative regional component for the East-German regions and a slightly positive component for both West-German regions.

Looking at the results for gross value added, a different picture arises which shows a slightly positive regional component for the region Lausitz and a considerable positive component for the region Mitteldeutsches Revier. These differences in the development of employment and value added is in line with the convergence hypothesis between East- and West-German regions. However, the negative regional coefficient in Graph 3.8.3 for the region Lausitz shows that this convergence process is slower than in other parts of the East-German states. The positive regional coefficient for the region Mitteldeutsches Revier as an indicator for a faster convergence is in line with this interpretation. With regard to the region Rheinisches Revier it is noticeable that the performance is better than in overall Nordrhein-Westfalen.

3.8 Population development

Table 3.8.1 summarizes the results of the demographic projection calculated by BBSR up to 2035.

Table 3.8.1
Population projections for the lignite mining regions
2016 to 2035

	Number in thousand		Change % p.a. 2016-2035	Share total population in %	
	2016	2035		2016	2035
Lausitzer Revier					
Up to 20 years old	175	128	-1,6	14	14
20-60 years old	561	380	-2,0	49	41
More than 60 years old	402	424	0,3	35	45
total	1.138	932	-1,0		
Rheinisches Revier					
Up to 20 years old	439	417	-0,3	18	17
20-60 years old	1.312	1.161	-0,6	54	48
More than 60 years old	666	843	1,2	28	35
total	2.417	2.421	0,0		
Mitteldeutsches Revier					
Up to 20 years old	306	257	-0,9	16	15
20-60 years old	1.011	777	-1,4	42	46
More than 60 years old	640	669	0,2	33	39
total	1.957	1.703	-0,7		
Helmstedter Revier					
Up to 20 years old	97	85	-0,7	17	16
20-60 years old	315	261	-1,0	55	49
More than 60 years old	165	189	0,7	29	35
total	577	535	-0,4		
Germany					
Up to 20 years old	14.316	13.015	-0,5	18	17
20-60 years old	43.875	37.180	-0,9	54	48
More than 60 years old	22.828	28.053	1,1	28	36
total	81.019	78.248	-0,2		

Source: Own calculations, based on data of BBSR.

For the economic prospects of a region, the expected number of future residents and their age structure are crucial determinants. The results of the population projections point to a rather stable or even slightly increasing population in cities up to the year 2035. In contrast, rural population is likely to shrink further. Looking at age groups, the size of younger cohorts is expected to decline, while the number of senior citizens will increase in the future. This development is expected to be more pronounced in the East-German regions in particular in the region Lausitzer Revier.

4. Summary and overall assessment

The total number of employees that depend directly, indirectly or are induced by economic activity in the lignite mining sector is relatively small compared to total employment in Germany (56 thousand or 0,2% of total employment and 0,8% of the employment in the industry). However, in the lignite mining regions their importance is with 3,3% of total employment and up to 17,5% of total manufacturing employment considerably higher. At the regional level, the lignite mining sector is economically important, especially since the respective regions are in general economically underdeveloped. In 2015 two third of the employees in the lignite mining sector were older than 45. For this reason, a gradual phase-out of lignite production would be socially more responsible. Nevertheless, a retreat of the lignite sector in view of the relatively low levels of industrialization, especially in the regions of the eastern German areas, would be of considerable regional economic importance, with correspondingly **great challenges with regard to the associated structural change**.

The economic perspectives of the affected regions, however, are considerably different, which becomes obvious if one looks at the **regional structure of these areas**. The region Lausitzer Revier is rural, peripheral and Cottbus is the only larger city. In contrast, the region Rheinisches Revier is classified as urban, central and has two major regional centers. The two other regions, Helmstedter and Mitteldeutsches Revier, are located between these two extremes, but both also have two major regional centers.

Both eastern lignite mining regions lag behind the West-German regions as well as the federal average in terms of **value added, per capita income and employment rates**. However, in the past, both regions were able to reduce the gap to their western counterparts. Considering this convergence, it is likely that the catch-up process will continue in the future, which also is in line with the observed productivity improvements in the East German regions. These improvements will foster competitiveness. This is also indicated by the results of the shift-share analysis: the locational factors for the development of value added in the East German lignite mining regions are – in contrast to employment – positive compared to the national level, which has increased their productivity and thus their economic competitiveness.

However, it is not ensured that this process will lead to a complete equalization of living conditions between the East and West-German regions. One reason is that the level of industrialization in the eastern regions is relatively low. It is therefore necessary for the eastern regions to attract new firms, which, however, is particularly challenging because the fastest growing business sectors are underrepresented in the East-German lignite mining regions. An additional reason is, that the values of **innovation intensity** are much lower in the eastern regions. The values for the research or patent intensity reach only about a quarter of the national average. Finally, the demographic development is unfavorable compared to the situation in the western regions. For example, in the region Lausitzer Revier the labor force potential, that is the population aged 20 to 60 years old, is according to the population forecast almost a third lower by 2035. The decrease is more than twofold the projected decrease in Germany as a whole. This will impede covering the need for skilled workers in the future.

In view of the upcoming withdrawal of lignite, the above-mentioned aspects limit the potential for economic development especially of the eastern regions. It is therefore necessary to accompany the structural change in these economically backward regions. This is most important in the East-German regions and especially in the region of the Lausitzer Revier. **Support for structural change** is essential to ensure a continuation of the adjustment process, especially in the East-German lignite mining regions. For this purpose, the classical regional economic support instruments should be used, but also targeted structural policy measures are reasonable. These include, for example, im-

proving the regional infrastructure (e.g. in terms of digital infrastructure and transport infrastructure). In addition, strengthening the public higher education and research landscape could improve the knowledge and technology transfer within the regions, which is an opportunity to promote innovations by companies and thus improve their competitiveness.



Leibniz Institute for
Economic Research

RWI is funded by the Federal Government and
the federal state of North Rhine-Westphalia.

