Accompanying evaluation of the Coal Regions Investment Act and the Federal Government's STARK programme

– Interim report –

Halle (Saale) and Essen, 30 June 2023

Report prepared for the Federal Ministry for Economic Affairs and Climate Action

Authors:
Matthias Brachert [a]
Katja Heinisch [a]
Oliver Holtemöller [acd]
Florian Kirsch [b]
Uwe Neumann [b]
Michael Rothgang [b]
Torsten Schmidt [b]
Christoph Schult [a]
Anna Solms [a]
Mirko Titze [ac]

[a] Halle Institute for Economic Research (IWH)

[b] RWI – Leibniz Institute for Economic Research

[c] Martin Luther University Halle-Wittenberg

[d] Contact. Contact information: Halle Institute for Economic Research (IWH), Kleine Märkerstraße 8, 06108 Halle (Saale), Email: oliver.holtemöller@iwh-halle.de, telephone: +49 345 7753-800.

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List of abbreviations

BA	Federal Employment Agency (Bundesagentur für Arbeit)
BAFA	Federal Office for Economic Affairs and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle
BB	Brandenburg
BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development (Bundesinstitut für Bau-, Stadt- und Raumforschung)
BDE	Federal Association oft he German Disposal, Water and Circular Economy (Bundesverband der Deutschen Entsorgungs-, Wasser- und Kreislaufwirtschaft e. V.)
BHO	Federal Budget Code (Bundeshaushaltsordnung)
BLKG	Coordination Body of the Federal Government and the Federal-State Governments (Bund-Länder-Koordinierungsgremium)
BMBF	Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung)
BMF	Federal Ministry of Finance (Bundesministerium der Finanzen)
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz)
BMWi	Federal Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie)
BMWK	Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz)
bn	Billion
cf.	„conferatur" – compare; see
DEBRIV	German Lignite Coal Industry Association (Deutscher Braunkohlen-Industrie-Verein)
Destatis	Federal Statistical Office (Statistisches Bundesamt)
DLR	German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt)
ed.	Editor
eds.	Editors
EIA	Energy Information Administration
et al.	„et alia"; and others
EUR	Euro
Fig.	Figure
GDP	Gross Domestic Product

GFS	All-German System for the Promotion of Structurally Weak Regions (Gesamtdeutsches System zur Förderung strukturschwacher Regionen)
GRW	Joint Federal/Länder programme for improving regional economic structures (Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur")
GVA	Gross value added
IB	Investitionsbank Sachsen-Anhalt
ILB	Investitionsbank des Landes Brandenburg
InvKG	Coal Regions Investment Act (Investitionsgesetz Kohleregionen)
IOM	Input Output Model
IUC	Innovation Center University Medicine Cottbus (Innovationszentrum Universitätsmedizin Cottbus)
IW	German Economic Institute (Institut der deutschen Wirtschaft Köln)
IWH	Halle Institute for Economic Research (IWH)
JTF	Just Transition Fund
KldB	Classification of occupations of the Federal Employment Agency (Klassifikation der Berufe)
KoMoNa	Municipal Model Projects for the Implementation of Ecological Sustainability Goals in Structural Change Regions (Municipal Model Projects for the Implementation of Ecological Sustainability Goals in Structural Change Regions)
KSG	Federal Climate Change Act (Bundes-Klimaschutzgesetz)
KVBG	Coal-fired Power Generation Termination Act (Kohleverstromungsbeendigungsgesetz)
LSP	Lausitz Science Park
LVwA	Federal state administration office (Landesverwaltungsamt)
m	Million
MWIDE	Ministry of Economic Affairs, Innovation, Digitalisation and Energy of the State of North Rhine-Westphalia (Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen)
MWIKE	Ministry of Economic Affairs, Industry, Climate Action and Energy of the State of North Rhine-Westphalia (Ministerium für Wirtschaft, Industrie, Klimaschutz und Energie des Landes Nordrhein-Westfalen)
NASA	Saxony-Anhalt public transport service (Nahverkehrsservice Sachsen-Anhalt)
NRW	North Rhine-Westphalia
p.	Page
p.a.	Per annum

PC	Process costs
R&D	Research and development
RMM	Regional Macroeconomic Model
RWI	Leibniz Institute for Economic Research
SAB	Sächsische Aufbaubank – Förderbank
SAS	Sächsische Agentur für Strukturentwicklung GmbH
sec.	section
SF	Immediate Action Programme (Sofortprogramm)
SN	Saxony
ST	Saxony-Anhalt
STARK	Strengthening the transformation dynamic and departure in the coal mining areas and at coal-fired power plant sites (Stärkung der Transformationsdynamik und Aufbruch in den Revieren und an den Kohlekraftwerkstandorten)
StStG	Act on Structural Change in Coal Mining Areas (Strukturstärkungsgesetz Kohleregionen)
SV	Science Statistics Founder Association (Wissenschaftsstatistik Stifterverband)
SVB	Employees subject to social security contributions (Sozialversicherungspflichtig Beschäftigte)
TFP	Total Factor Productivity
TWh	Terrawatt hour
UBA	German Environment Agency (Umweltbundesamt)
VGR	National Accounts (Volkswirtschaftliche Gesamtrechnungen)
VGRdL	National Accounts of the federal states (Volkswirtschaftliche Gesamtrechnungen der Länder)
VP	Transport projects
WRL	Wirtschaftsregion Lausitz GmbH
WWCLEG	What Works Centre for Local Economic Growth
WZ	German Classification of Economic Activities (Klassifikation der Wirtschaftszweige)
ZKI	Centre for Artificial Intelligence in Public Health Research (Zentrum für Künstliche Intelligenz in der Public Health-Forschung)
ZV	Grant volume (Zuwendungsvolumen)

Executive Summary

(1) In order to achieve the statutory climate protection targets, industry and society must drastically reduce their greenhouse gas emissions. The energy industry is particularly important in this context, as it is responsible for a large part of the emissions of climate-damaging gases. This is essentially due to the fact that heat and electricity are still largely generated using coal and especially lignite coal. Thermal utilisation of lignite coal is associated with particularly high emissions of greenhouse gases. Phasing out this type of energy production would hence make a substantial contribution to achieving Germany's climate protection goals.

(2) However, putting an end to the thermal utilisation of (lignite) coal entails economic and social adjustment processes. Considering Germany as a whole, (lignite) coal-based industries account for only a small fraction in production and employment. Given that energy supply security remains guaranteed, no substantial macroeconomic effects are thus to be expected from the coal phase-out. However, this does not apply at the regional level: Due to geological and technological characteristics – economically efficient thermal utilisation of lignite coal is only possible in close proximity to the deposits – German's lignite coal sector is regionally concentrated. And it is particularly in the Lusatian mining area where the lignite coal industry and the related economic sectors are relatively important for regional income and employment. With the Coal Regions Structural Strengthening Act (*Strukturstärkungsgesetz Kohleregionen*), the Federal Government has created an instrument to cushion the negative economic and social consequences of the coal phase-out in the affected regions. The Federal Government has earmarked a budget of EUR 41.09bn for this purpose until 2038.

(3) What the regions affected by the coal phase-out have in common is the fact that they face enormous structural economic challenges even without a stop to the thermal utilisation of (lignite) coal. With very few exceptions, the entire assisted area of the Coal Regions Investment Act (InvKG, *Investitionsgesetz Kohleregionen*) is located within the assisted area of the Federal Funding System for Structural Development Regions (GFS, Gesamtdeutsches Fördersystem für strukturschwache Regionen). Among the determinants of economic growth, it is above all a shortage of labour supply – driven by demographic change – that slows down economic growth in these regions. The transformation of the regional economy due to the coal phase-out is now adding to the already difficult conditions for sustainable growth. The instrument of the Coal Regions Investment Act calls for tailor-made solutions to these specific conditions.

(4) A special feature of the Coal Regions Investment Act is that it consists of a whole bundle of different measures, ranging from the construction and upgrading of business-related infrastructures to the improvement of transport connections and the strengthening of regional education and research and development. These measures are subject to delays with regard to decision-making, implementation and their impacts. Furthermore, relevant data to adequately map these processes are often only available after some time. It will therefore take some time before credible impact evaluation is possible.

(5)   Evidence-based evaluation of the (causal) impacts of the measures of the Coal Regions Investment Act requires, as a first step, that the diverse funding lines of this programme are grouped according to economic criteria in such a way that a theoretically sound relationship to the determinants of economic growth can be established. In the present case, a total of eight categories are suitable for this purpose, i.e.,   1: accessibility,   2: education,   3: culture,   4: health,   5: business locations,   6: research and development, 7: climate and sustainability, 8: social capital. Each of these categories addresses a specific impact channel in the relationship between funding and its target outcomes and suggests initial impacts in different time horizons.

(6)   A descriptive analysis of the projects earmarked for funding so far shows that up to now only a relatively small part of the total budget has reached the assisted regions even though many projects are in the pipeline. This is not surprising since the administrative processes take time. In order to ensure formally correct use of funding, the granting authorities must develop a corresponding set of guidelines and then implement these in a rule-compliant way. In this respect, the processes under the Coal Regions Investment Act do not differ significantly from those of other funding programmes. The time aspect could be an obstacle in the implementation of the Coal Regions Investment Act if expenditure is strictly tied to (tightly scheduled) funding periods. This would involve a risk of inefficiencies if projects that are not actually worthy of funding are approved simply in order to fully exhaust the budget. Loosening these spending margins – for instance, by using an 'n+' rule that is already applied in EU funding – could be an effective solution to this problem.

(7)   The evaluation of the projects earmarked for funding so far further reveals that funding is predominantly provided in the following categories 1: accessibility, 2: education, 5: business locations and 6: research and development, although the weighting of these categories differs in the various assisted regions. Against the background that economic literature sees relatively high contributions to regional economic growth specifically in categories 1, 2 and 6, funding has so far been mostly channelled into growth-promoting uses. In future, however, the focus should be more on the question as to whether proposed projects contribute to strengthening the regional labour force potential. The availability of labour already hampers growth in the regions of the assisted area. The measures should cover the entire range of possible areas of action, i.e., from improving (pre-)school education to vocational training and improving local conditions for highly qualified employees. This also includes measures to improve the physical accessibility of the areas in order to reach a larger population potential as well as measures to raise previously unused labour force potential. At the same time, the need for more immigration of skilled labour from abroad is an issue that deserves increased efforts. The latter, in particular, requires a 'welcoming culture' in the assisted areas.

(8)   Finally, from a regional point of view, funding under the Coal Regions Investment Act is found to be concentrated in some areas. Since this programme is largely a demand-driven funding instrument, this observation is not unexpected. Funds hence flow into areas that have sufficient absorptive capacities. Equal distribution of the budget over the entire assisted area cannot be the goal of political action; instead, funding should be used where the highest impacts on the target outcomes can be expected.

(9)   In order to determine the impacts of the measures of the Coal Regions Investment Act, the question must be answered as to what would have happened without funding. Comparing the actual development of the assisted area with this counterfactual scenario allows conclusions to be drawn as to whether there is a causal relationship between use of funds under the Coal Regions Investment Act and the achievement of certain targets of economic policy. Counterfactual impact analyses can provide a methodological approach towards answering this question. With regard to the development of employment, it can be seen that so far there is no difference between the counties that belong to the assisted area under the Coal Regions Investment Act and counties with similar economic structural characteristics, i.e., similar structural weakness. Put in positive terms, the feared reduction in employment has so far failed to materialise. These findings do not suggest any cause-effect relationships at this stage. The coal phase-out (negative shock) and the measures of the Coal Regions Investment Act (positive shock) run parallel, and future analyses must attempt to isolate these two effects from each other in order to enable reliable statements on the impacts of the funding programme. In addition, the launch of the funding programme coincides exactly with the Covid-19 pandemic. A final assessment of the impacts of the funding programme is hence not possible at this point in time – also and especially against the background of the relatively low outflow of funding.

(10) Transformation poses major challenges for all stakeholders, especially when the need for change, i.e., the phasing out thermal utilisation of (lignite) coal, is a result of considerations of economic policy that do not affect all parts of Germany equally. The local population must feel that the compensation measures under the Coal Regions Investment Act are fair, that the support programme truly helps them and that opportunities for change are opening up. It hence appears to be all the more important to provide a clear and transparent description of the funding process, the economic and social challenges (keywords: labour mobilisation, immigration) and the actual impacts of the programme, and to raise realistic expectations. It is also important in this context that the (interim) results of the accompanying scientific evaluation and the underlying data are published without any delay.

1 Introduction

The Federal Climate Change Act (KSG, *Klimaschutzgesetz*) envisages a 65 percent reduction in German greenhouse gas emissions by 2030 compared to 1990 emissions. Phasing out thermal utilisation of coal (especially lignite coal) will make a substantial contribution to achieving these goals. However, the coal phase-out poses structural challenges for the lignite coal mining areas (and the locations of the hard coal-fired power plants).

In order to actively shape structural change in these regions, the German Bundestag passed the Act on Structural Change in Coal Mining Areas (StStG, *Strukturstärkungsgesetz Kohleregionen*) in August 2020 with the approval of the Bundesrat.[1] With this law, the Federal Government will provide financial assistance of EUR 41.09bn until 2038. The policy measures focus on a range of goals, above all macroeconomic (value creation, growth, tax revenue), competitive (productivity), labour market policy (employment, employment structures), distribution policy (regional disparities) and climate policy (greenhouse gas reduction, sustainability). The structural policy interventions provided for in the Act on Structural Change in Coal Mining Areas comprise a wide range of measures.

The Act also regulates the Federal Government's reporting obligations to the Bundestag and the Bundesrat, including, in particular, the obligation to perform a scientific evaluation of the law in a two-year cycle. This report[2] is the first document in this series. The current report specifically focuses on the measures planned under the Coal Regions Investment Act and the federal STARK programme[3] as well as the preliminary assessment of their potential impacts. Considering that the programme started in 2020 and an almost twenty-year term, the report can at best reflect an initial interim status. Many measures have not yet or have only just started. The empirical analyses presented here are based on data as per 31 December 2022. It is planned to update and expand the report on an annual basis.

The report is structured as follows: Chapter 2 looks at the subject of the evaluation, i.e., the Coal Regions Investment Act, from a general legal perspective. It mainly elaborates on who decides where which funding under the Coal Regions Investment Act is used.

Chapter 3 illustrates the overall economic development of the assisted areas up to the de facto start of the Coal Regions Investment Act. This chapter additionally provides a description of the development of the lignite coal economy.

Chapter 4 deals with the characteristics of measures under the Coal Regions Investment Act. It works out which impacts can be expected and when. This chapter finally presents a proposal on how to categorise the very diverse measures under the Coal Regions Investment Act in order to make evaluation possible in the first place. These more conceptual steps in the study are based on relevant economic literature.

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[1] The law formally came into force on 14 August 2020.
[2] This report expands on the analyses which the authors submitted to BMWK in a brief expert report on 15 December 2022.
[3] The federal STARK programme is part of the Coal Regions Investment Act pursuant to its section 15.

Chapter 5 evaluates the lists of projects intended for funding. In view of the fact that the analyses in this report cover a period of around two years (data as per 31 December 2022), this chapter focuses not only on projects that are being implemented but also on those that are still in the pipeline. It also addresses the question as to how much funding has actually already been spent on the approved measures. The formal incidence is described along the structure of the Coal Regions Investment Act.

Chapter 6 presents a scenario of how the assisted areas under the Coal Regions Investment Act would have developed had there been no coal phase-out and no funding measures under the Act. These results provide indications of the trends taking place in the regions in general.

These results, for their part, are important for the comparisons in Chapter 7 of the development of the Coal Regions Investment Act regions not just in terms of time in the context of a before-and-after comparison, but also in the context of a comparison with a control group of regions that are not the subject of funding under the Act.

Against the background of the analytical steps taken so far, Chapter 8 examines whether – and, if so, where – there is a need for adjustment in the administrative implementation of the Coal Regions Investment Act and the orientation of its content.

Chapter 9 wraps up the results of the report and gives an outlook on the next steps of the study.

2 Legal basis

Structural assistance for the regions affected by the coal phase-out is the result of an intensive political discussion process that ended in a compromise negotiated with the involvement of large groups of society in order to achieve socially fair and economically compatible climate protection. Section 2.1 describes the genesis of the regulatory framework for phasing out the thermal utilisation of (lignite) coal. Section 2.2 addresses the concrete design of the legal framework. Section 2.3 deals with the layout of the assisted area. Section 2.4 elaborates on the processes for selecting funded projects.

2.1 Economic policy discussions around the coal phase-out

The discussion on the thermal utilisation of (lignite) coal begins with the realisation that carbon dioxide emissions must be rigorously reduced in order to limit global warming to a tolerable level. A number of (voluntary) commitments exist for this at multilateral and national level. Germany has defined its reduction targets at the following sectoral levels: *energy*, *buildings*, *transport*, *industry* and *agriculture*. Among the sectors mentioned, it is predominantly the *energy industry* that covers a substantial share of its primary energy demand from the raw material (lignite) coal[4], which goes hand in hand with comparatively high carbon dioxide emissions. Without phasing out the thermal utilisation of (lignite) coal, this sector will not be able to meet its reduction targets (Commission on Growth, Structural Change and Employment 2019, section 3.1 and the literature cited there; Federal Climate Change Act).

However, achieving climate protection goals on the one hand compromises social and economic goals on the other. This aspect is particularly important because of the coal industry's high regional concentration. The share of this sector in employment and income is very low. The situation is different at mining county level, especially in the Lusatian mining area where the coal sector is very important for the regional economy, especially in areas that are already affected by structural economic challenges (see, for instance, Holtemöller and Schult 2019).

In order to negotiate the conflicting goals in the areas affected by the coal phase-out into a consensus on a broad social basis, the Federal Government set up the 'Commission on Growth, Structural Change and Employment' in June 2018. In concrete terms, the Commission's work involved exploring sustainable employment perspectives for citizens living in the coal regions whilst at the same time guaranteeing security of electricity and heat supply for citizens. From the beginning, the commission was keen to listen to and weigh the different perspectives of those affected.

To this end, for instance, the Commission held hearings with experts from different sectors of society (representatives of various federal and federal-state ministries, stakeholders from business, trade unions, academia and civil society). The Commission also made site visits. Based on these impressions, it drew up recommendations and submitted its final report to the Federal Government in 2019 (Commission on Growth, Structural Change and Employment 2019, especially section 2).

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[4] According to the Federal Statistical Office, coal accounted for around one-third of gross electricity generation in Germany in 2022, of which lignite coal accounted for the majority (see Destatis 2023, Gross electricity generation in Germany for 2019 to 2022, https://www.destatis.de/DE/Themen/Branchen-Unternehmen/Energie/Erzeugung/Tabellen/brutto stromerzeugung.html, accessed 30 May 2023).

The Federal Government used this as a basis to draft two laws, i.e., the Coal-fired Power Generation Termination Act (KVBG, *Kohleverstromungsbeendigungsgesetz*) and the Act on Structural Change in Coal Mining Areas (StStG, *Strukturstärkungsgesetz Kohleregionen*), and introduced them into the parliamentary process. Both laws were passed by the Bundestag in August 2020, the latter with the Bundesrat's approval. The Coal-fired Power Generation Termination Act provides for the gradual decommissioning of power plant capacities for power generation based on lignite and hard coal. This statutory phase-out of coal-fired power generation ultimately provides the justification for the use of structural strengthening funds under the Act on Structural Change in Coal Mining Areas.

2.2 Overview of the Act on Structural Change in Coal Mining Areas and the Coal Regions Investment Act

This report focuses on the Act on Structural Change in Coal Mining Areas (hereinafter: StStG) as the legal regulation that deals with cushioning the social and economic impacts of the coal phase-out. However, it should be noted that the Coal-fired Power Generation Termination Act (hereinafter: KVBG) also contains regulations that are intended to compensate for the social and economic impacts on the affected stakeholders (see also Annex 1).[5]

The StStG is a so-called omnibus law. Its individual articles represent laws in their own right or amendments to existing laws (see Fig. 2-1). The subject of the evaluation is Article 1 StStG, which includes the Coal Regions Investment Act (hereinafter: InvKG). The InvKG itself is again divided into five chapters. The first two chapters regulate financial assistance provided by the Federal Government to the federal states of North Rhine-Westphalia, Brandenburg, Saxony, and Saxony-Anhalt (Chapter 1) and to Lower Saxony, Mecklenburg-Western Pomerania, Saarland and again North Rhine-Westphalia (Chapter 2) in order to equalise differing economic power and to promote economic growth (Basic Law (GG, *Grundgesetz*) Article 104 (1)(1) and (2)). The federal states are responsible for deciding on the funds available in Chapter 1 (with a financial volume of EUR 14bn) and Chapter 2 (with a financial volume of EUR 1.09bn).

Chapters 3 and 4 concern measures (with a financial volume of EUR 26bn) with which the Federal Government can take direct action in the area covered by the InvKG, whereby the federal states have a right of proposal. These projects can only be implemented in the regions mentioned in Chapter 1, with the exception of the federal STARK programme (sec. 15 InvKG), which is also open to Chapter 2 areas.

Chapter 5 finally deals with common regulations and principles in the application of the InvKG. The measures under Chapters 1 and 2 are also referred to as 'Pillar 1', those under Chapters 3 and 4 also as 'Pillar 2'.

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[5] For example, the operators of lignite coal-fired power plants receive compensation payments under section 44 of the KVBG: RWE Power AG EUR 2.6bn (with plants in North Rhine-Westphalia) and LEAG EUR 1.75bn (with plants in Brandenburg and Saxony). In addition, employees who are at least aged 58 years and leave the labour force receive for a maximum of five years an adjustment allowance as a bridging allowance until they receive a statutory old-age pension (section 57 KVBG).

Articles 2 to 4 of the StStG concern amendments to laws with which the authorities implement infrastructure projects on a larger scale (in terms of planning) law. These facts are not the subject of the current evaluation.

Fig. 2-1: Overview about the legal situation regarding the InvKG

Source: Own presentation.
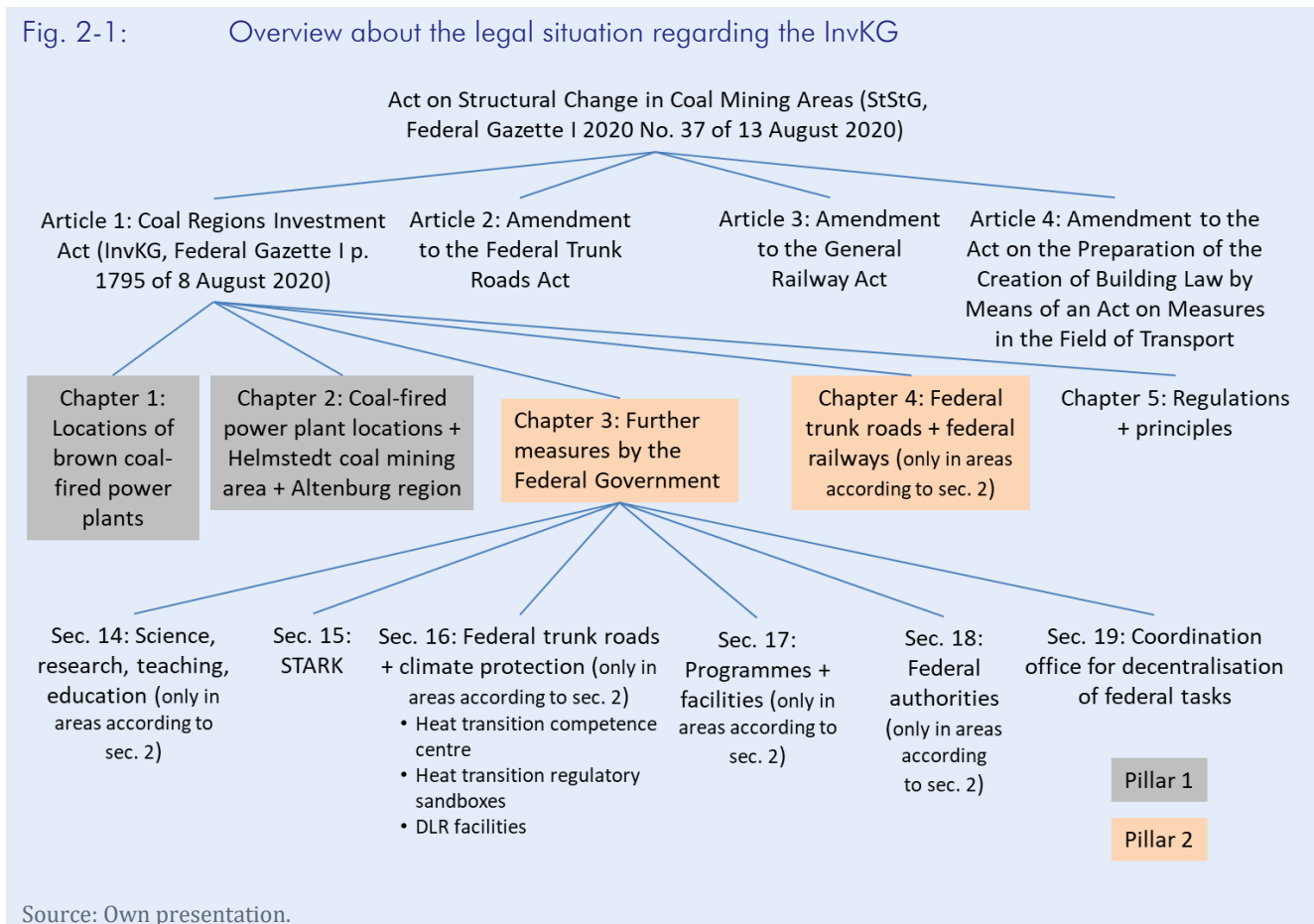
2.3 Demarcation of assisted areas and control group considerations

The special feature of the InvKG is that it is only applied in selected regions in Germany – i.e., in 34 of currently 400 counties and county-free cities (as per 31 December 2021). Of these, 22 counties fall within the assisted area of Chapter 1 InvKG (Lusatian, Central German [excluding Altenburger Land] and Rhenish mining areas). The remaining twelve counties (Altenburger Land, Helmstedt mining area and the sites of the hard coal fired power plants) belong to the assisted category of Chapter 2 InvKG. The InvKG-assisted area was demarcated during the legislative process. The relevant economic literature discusses such interventions under the headline of "place-based policies" (Neumark and Simpson 2015).

Fig. 2-2 presents a map of the assisted areas. It provides two additional pieces of information that need to be considered for further analyses. *First,* it maps the assisted area within the joint Federal/Länder programme for improving regional economic structures (GRW, *Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur"*) – a) as it existed at the time of the decision on the InvKG-assisted areas (i.e., in 2020) and b) as valid since 1 January 2022. The GRW programme provides investment grants for establishments and municipalities in structurally weak regions. The demarcation of the GRW-assisted area[6] is based on a structural weakness indicator.[7] The map shows that – with very few exceptions – all InvKG regions are located in the GRW-assisted area, which means that they have unfavourable structural conditions anyway. InvKG funding in these areas is thus granted in addition to GRW funding and the other programmes of the Federal Funding System for Structural Development Regions (GFS, *Gesamtdeutsches System zur Förderung strukturschwacher Regionen*).

Secondly, map c) includes a category indicating whether employment in a municipality is specialised (measured by place of residence) in coal industries (industry code 05200 Lignite (coal) mining and 09900 Mining support services). Specialisation is deemed to be given if the localisation coefficient[8] of employment in coal industries exceeds 1 and at least five employees from coal industries live in the respective municipality. This indicator provides raw measure as to the extent to which phasing out of the coal industry would in fact affect the regional economy. The reference time frame is 2019, i.e., the year before the InvKG came into force. The map shows that the InvKG-assisted areas are generously demarcated. The InvKG-assisted area also includes municipalities that are located at a larger distance from areas with specialisation in coal industries. In a few cases, there are also regions with specialisation in coal industries, but which do not belong to the InvKG-assisted area.

These considerations now lead to the question as to how the development of the assisted area is to be evaluated from a comparative perspective. For this purpose, it is necessary to define a suitable control group for the InvKG-assisted areas. A credible control group is essential for evaluating the outcomes. The aim here is to isolate the impact (for instance, on employment growth in the counties of the assisted area) that can be attributed to the InvKG programme. The idea behind this approach is that the regions of the InvKG-assisted area and those of the control group are similar in terms of the relevant characteristics that could simultaneously influence both the probability of belonging to the InvKG and the target variable of interest (such as employment growth).

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[6] Since 1 January 2020, other place-based federal programmes have been effective - combined under the umbrella of the 'Federal Funding System for Structural Development Regions' (GFS). These programmes also rely on the map of GRW assisted areas. In terms of expenditures, the GRW is the most important programme in the GFS.

[7] The specific composition of the structural weakness indicators valid for the respective funding period is described in detail in the respective coordination frameworks for the GRW programme.

[8] The localisation coefficient (LQ) is calculated according to the formula: $LQ_{ir} = (L_{ir}/L_r)/(L_i/L)$ where i represents the sector, r the region and L the number of employees. The numerator of the LQ thus indicates the share that employment in sector i in region r has in total employment in region r. The denominator of the LQ represents the share of employment i in employment in the total area. Values above 1 indicate that the share of employment in a sector is more pronounced in a region than in the area as a whole. In this case, literature speaks of (minimum) specialisation of the region in this sector.

Fig. 2-2: Assisted areas of the InvKG

a) GRW-assisted areas until 31 December 2021

b) GRW-assisted areas from 1 January 2022

c) Specialisation of employment (measured by place of residence) in coal industries 2019
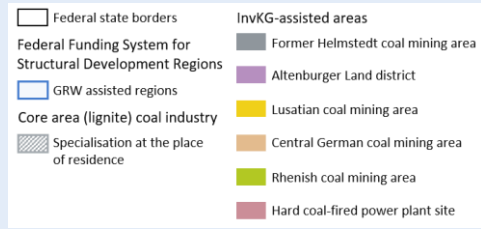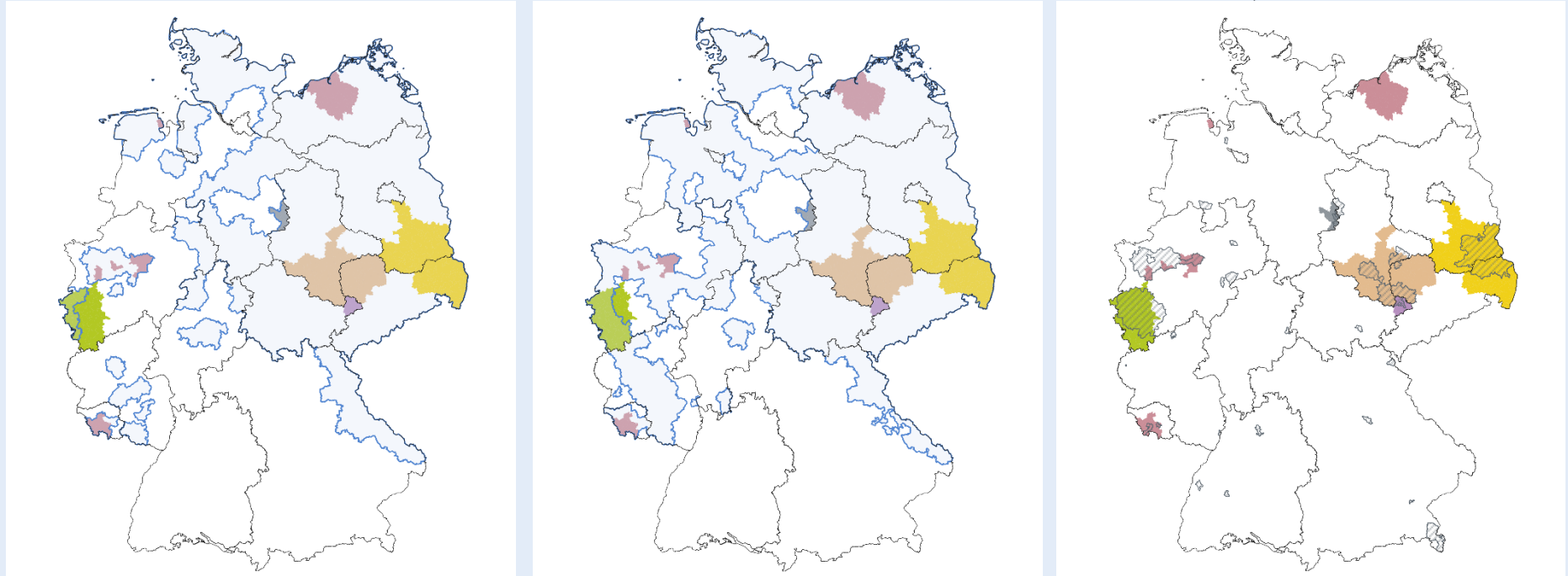
Legend:

- Federal state borders
- **Federal Funding System for Structural Development Regions**
  - GRW assisted regions
- **Core area (lignite) coal industry**
  - Specialisation at the place of residence

InvKG-assisted areas
- Former Helmstedt coal mining area
- Altenburger Land district
- Lusatian coal mining area
- Central German coal mining area
- Rhenish coal mining area
- Hard coal-fired power plant site

Notes: The Lusatian, Central German (excluding Altenburger Land) and Rhenish mining areas comprise regions that fall under the funding category of Chapter 1 InvKG. – The Helmstedt mining area, the Altenburger Land and the sites of the hard coal-fired power plants fall under the funding category of Chapter 2 InvKG. – With this demarcation, municipalities with a coal specialisation are those with more than five employees (measured by place of residence) in coal industries (economic sectors 05200 Lignite mining and 09900 Mining support services) and a localisation coefficient of employment in coal industries of > 1. – Specialisation outside the InvKG-assisted area is due to the relatively broad industry classification.

Source: Raw data: IAB, coordination framework; map: GRW and InvKG demarcation: Own presentation; specialisation: Brachert, Kubis and Titze 2021.

In other words: When selecting a suitable control group for the InvKG-assisted area, several factors must be taken into account to ensure adequate comparability between the two.

One important determinant is that the socio-economic conditions of the selected control regions are similar to those of the InvKG regions. It makes sense here to analyse regions with a similar structural weakness indicator according to the GRW-programme.[9] The GRW regions are particularly well suited as a basis for selecting control regions because the InvKG and GRW-assisted areas overlap almost completely. Around 90 percent of the InvKG counties are also eligible to apply under the GRW programme (see Table 2-1). This share is even somewhat higher with the GRW-assisted area demarcation in effect since 1 January 2022.

Table 2-1: Overlaps between GRW and InvKG-assisted areas

| Map of InvKG-assisted areas | Map of GRW-assisted areas [d] | | | | |
| | Until 31 December 2021 | | From 1 January 2022 | | |
	Not eligible	Eligible	Not eligible	Eligible	Total
Not eligible	226	140	208	158	365
Eligible	4	30	2	32	34
of which:					
Chapter 1 regions	4 [b]	18	2 [c]	20	22
Chapter 2 regions	0	12	0	12	12
Total	230	170	210	190	400 [a]

Notes: [a] The GRW-assisted areas are ultimately defined at municipal level. In certain counties only selected municipalities are eligible. In such cases, this study treats the entire county as eligible within the GRW framework. – [b] This concerns the counties of Euskirchen, Rhein-Kreis Neuss, Rhein-Erft-Kreis and Düren. – [c] This concerns the counties of Rhein-Kreis Neuss and Rhein-Erft-Kreis.

Source: Own presentation based on the respective coordination frameworks and the InvKG.

A next step further narrows down the possible control group. Only those GRW regions that were continuously eligible for GRW funding in both funding periods remain in the donor pool (see Table 2-2). This applies to 163 of the 400 German counties and county-free cities. Aspects of geographical proximity are additionally included in the selection. Accordingly, it seems necessary to select as control regions only those GRW counties which are geographically similar to the coal regions or neighbouring (but do not represent contiguous border regions). This approach accounts for specific regional characteristics

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[9] The GRW regional indicator is calculated at the level of labour market regions. All counties in a labour market region are given the same indicator value. The labour market regions, which are geographically defined on the basis of commuter flows, are ranked using a scoring model starting with the structurally or economically weakest labour market region to the structurally or economically strongest labour market region. The overall indicator is in principle decisive for the distribution of the inhabitants of the assisted area and the determination of the assisted areas. It is composed of the following regional indicators for the funding period starting 1 January 2022: Regional productivity (gross domestic product per person employed 2018), weighting: 37.5 percent; average underemployment rate 2017 to 2019: 37.5 percent; development of the number of persons of working age 2017 to 2040: 17.5 percent; infrastructure indicator: 7.5 percent. In the 2014-2020 funding period, the structural weakness indicator included the following variables: average unemployment rate from 2009 to 2012: 45 percent; gross annual wage per employee in a job requiring compulsory social-insurance contributions in 2010: 40 percent; employment projection 2011 to 2018: 7.5 percent; infrastructure indicator (as per: 30 September 2012): 7.5 percent.

on the one hand but also avoids possible distortions due to spillover effects by excluding direct neighbouring regions on the other. This can be the case, for example, if inter-regional displacement occurs due to labour mobility. One example of this would be if a worker who was newly hired in the InvKG-assisted area leaves his/her job in the neighbouring county (GRW eligible; not an InvKG-assisted area). In the presence of such spillover effects, the effects to be determined in Chapter 7 would be distorted and with them the interpretation of the impact of funding. For this reason, counties directly bordering InvKG-assisted areas are excluded from the donor pool from further consideration.

Finally, the analysis focuses only on the 22 counties from Chapter 1 of the InvKG at this stage. So far, it does not seem to make much sense to include the 12 Chapter 2 regions in the study, on the one hand because the planned funding intensity is significantly lower there anyway (see Table 5-1). In addition, there has been a quasi-non-existent outflow of funds in this funding line on the other. Future reports will also integrate these regions into the analyses. The number of the regions that are considered in our study as a result of this procedure thus comprises 118 counties. This includes the 22 InvKG counties from Chapter 1 and 96 counties of the GRW-assisted area which serve as a control group (see Fig. 2-3). This is included in the analyses in Chapters 3 and 7. It is important to note that the control group serves as a benchmark for the average mining county. Both, within the mining areas and within the control group, there are sometimes clearly different developments, so that it does not make sense to compare the development of the control group with individual mining areas.

Table 2-2:   Number of eligible counties (as per 31 December 2021) according to GRW demarcation

Until 2021 \ From 2022	Not eligible	Eligible	Total
Not eligible	203	27	230
Eligible	7	163	170
Total	210	190	400

Notes: The demarcation of the GRW areas is not entirely precise to the county. In some counties, only selected municipalities (or parts thereof) are eligible. This study treats a county as eligible if it includes at least one municipality that is part of the GRW-assisted area.

Source: Own presentation based on the respective coordination frameworks.

Fig. 2-3:   Selection of counties for the control group
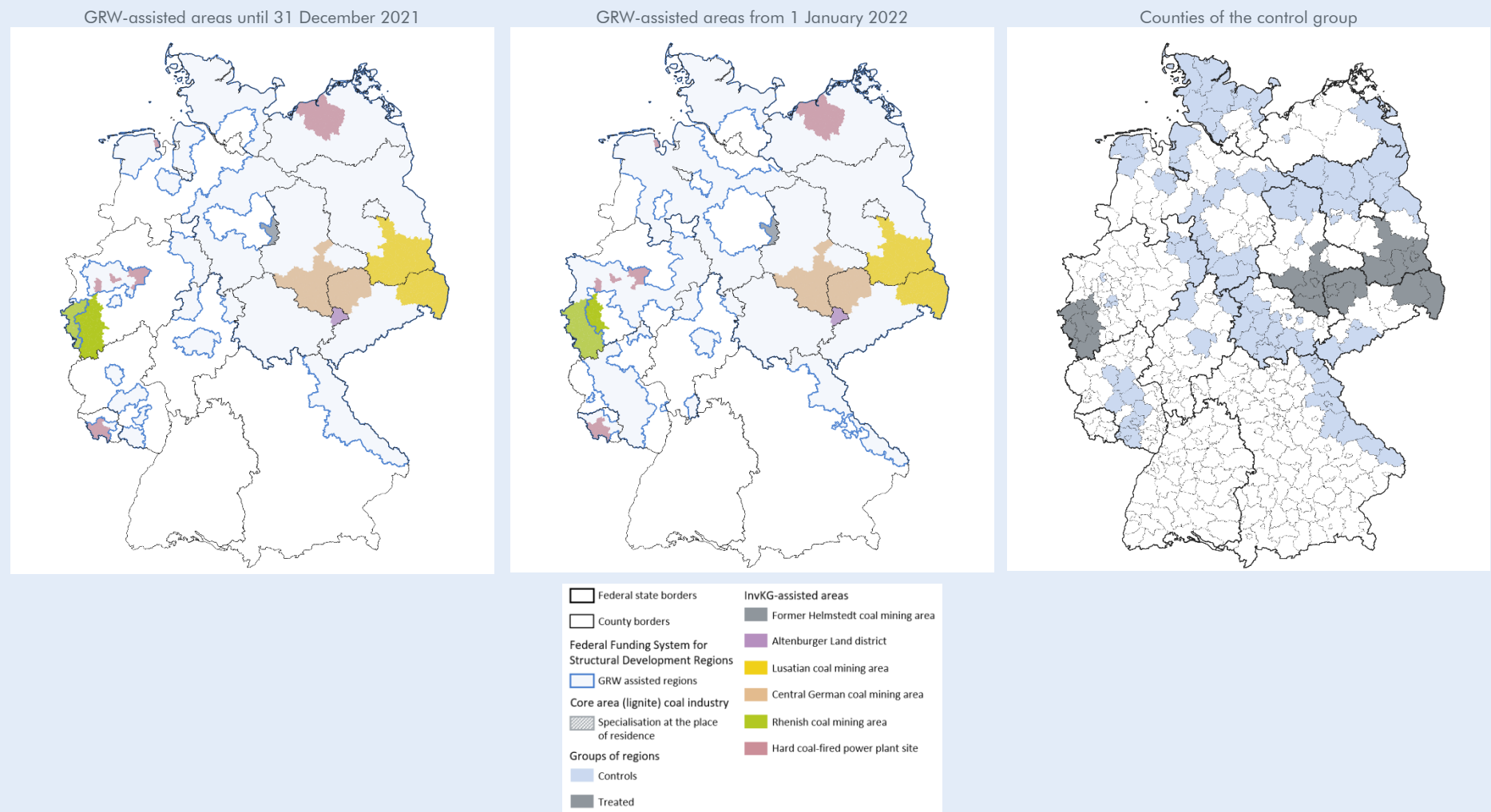
GRW-assisted areas until 31 December 2021   GRW-assisted areas from 1 January 2022   Counties of the control group

Federal state borders | InvKG-assisted areas
County borders
Federal Funding System for Structural Development Regions | Former Helmstedt coal mining area
GRW assisted regions | Altenburger Land district
Core area (lignite) coal industry | Lusatian coal mining area
Specialisation at the place of residence | Central German coal mining area
Groups of regions | Rhenish coal mining area
Controls | Hard coal-fired power plant site
Treated

Notes: The Lusatian, Central German (excluding Altenburger Land) and Rhenish mining areas comprise regions that fall under the funding category of Chapter 1 InvKG.
             – The Helmstedt mining area, the Altenburger Land and the sites of the hard coal-fired power plants fall under the funding category of Chapter 2 InvKG.

Source: Raw data: IAB, coordination framework; map: Brachert, Kubis and Titze 2021.

2.4 Processes for selecting projects to be funded

Selecting the projects to be funded is an important process. The first step usually is to check whether the formal eligibility requirements are met. These projects, which are in principle eligible for funding, then undergo further review with regard to whether they qualify for funding. In this step, the approval authorities assess whether and, if so, to what extent the project proposals contribute to fulfilling the goals of the InvKG. Given the structure of the InvKG, different authorities are involved in the selection process, which may result in procedural differences. In the following, the selection processes are described along the structure of the Act, i.e., according to the funding categories which the federal states implement under their own responsibility (Pillar 1, section 2.4.1) and those funding categories that are the responsibility of the Federal Government (Pillar 2, section 2.4.2).

2.4.1 Approval processes of Pillar 1

The regulations in Chapter 1 and 2 InvKG are the subject of Pillar 1. Given that Chapter 1 areas account for approximately 93% of the budget under the responsibility of the federal states, this section initially focuses on describing the selection processes in precisely those regions. This decision is also justified because at present there is only one project in the Chapter 2 regions, namely in Lower Saxony. In future reports, the approval processes in the other regions of the InvKG-assisted area will also undergo more in-depth scrutiny.

Pursuant to sec. 1 (3) InvKG, the federal states in which the Chapter 1 regions are located were obliged to develop guiding principles. In these guiding principles, contained in Annexes 1 to 3 of the InvKG, the federal states describe how they intend to use federal financial assistance in concrete terms to achieve the funding goals of the InvKG. The federal states have developed these guiding principles into concepts that describe the concrete process of project selection.[10] The legally binding guidelines were then drawn up on the basis of these concepts. A key feature of the federal states' concepts is that projects are selected on the basis of a combination of top-down and bottom-up approaches.

Another feature that all the concepts have in common concerns the extensive counselling and support provided for project ideas prior to formal application. The Federal Office for Economic Affairs and Export Control (BAFA) is also involved in the processes, performing parallel checks to ensure that the projects are of the type specified in the InvKG and that they are suitable for contributing to the realisation of the funding goals.

Finally, the federal states have developed routines to provide financial resources outside the InvKG to municipalities that are unable to meet their own contribution. The reason for this is that the InvKG provides for a maximum funding rate of 90 percent of eligible costs. Especially in the case of projects involving large financial volumes, a co-payment of 10 percent may – in absolute terms – mean a high contribution and thus place a heavy burden on smaller and/or financially constrained municipalities

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[10] Federal state of *Brandenburg* (no year given): Das Lausitzprogramm 2038. Prozesspapier zum Aufbau von Entscheidungs- und Begleitstrukturen im Transformationsprozess. Federal state of *Saxony* (no year given): Handlungsprogramm zur Umsetzung des Strukturstärkungsgesetzes Kohleregionen des Bundes in den sächsischen Braunkohlerevieren. Federal state of Saxony-Anhalt (2021): Strukturentwicklungsprogramm Mitteldeutsches Revier Sachsen-Anhalt.

and in extreme cases may even prevent funding at all. The federal states are therefore trying to effectively counter this problem with additional funds from their own budgets.

In detail, the project selection process at federal state level can be outlined as follows:

- The first point of contact in the federal state of *Brandenburg* is Wirtschaftsregion Lausitz GmbH (WRL). This is an economic development agency funded by the federal state of Brandenburg, the counties of Spree-Neiße, Dahme-Spreewald, Elbe-Elster, Oberspreewald-Lausitz and the county-free city of Cottbus. The applicants submit a (low-threshold) project fact sheet. Project ideas with development potential are passed on to a 'qualification process' which ends with a recommendation (or rejection) regarding the project's eligibility. An interministerial working group then decides whether project ideas found to be worthy of funding are to be passed on to the formal application process, which from this point onwards is accompanied by Investitionsbank des Landes Brandenburg (ILB). Regional stakeholders are involved in all decisions throughout the entire process. Compared to the other federal states, Brandenburg pursues a more top-down oriented project selection process.

- The project selection process in the Free State of *Saxony* is similar. Sächsische Agentur für Strukturentwicklung GmbH (SAS) is responsible for supervising the project executing organisation. Similar to WRL in Brandenburg, SAS is a publicly owned company (established by the Saxon state government together with Sächsische Aufbaubank – Förderbank [SAB]). Following a preliminary technical assessment involving the county commissioner's offices concerned and the Saxon State Directorate, SAS evaluates the project proposal using an indicator-based scoring system. This assessment is used by an interministerial working group to prepare a statement that forms the basis for the final funding recommendation to the meetings of the regional monitoring committees. The audit by BAFA takes place parallel. This is followed by the formal application process with SAB taking the lead. Compared to the other federal states, the number of bottom-up and top-down elements in the project selection process tends to be rather similar in the Free State of Saxony.

- The federal state of *Saxony-Anhalt* has developed three 'funding lines': *Firstly,* approvals can be made within the framework of 'regular funding'. The approach in this funding line differs somewhat from that of the federal states of Brandenburg and Saxony. The project executing organisations are supported by 'funding pilots' (formal employees of Investitionsbank Sachsen-Anhalt [IB]) as well as regional business promotion agents from the territorial authorities of the Saxony-Anhalt assisted area. Eligibility is assessed at the level of the territorial authorities involved (such as county or municipal councils). If a project is found to be worthy of funding, the formal application process begins, which includes checking its eligibility. Depending on the funding area, either IB or the federal state administration office (LVwA, *Landesverwaltungsamt*) or Nahverkehrsservice Sachsen-Anhalt GmbH (NASA) is involved.[11] The federal state government bundles the approval decisions and sends them to BAFA for review. If there are no objections, the responsible approval authority issues the funding approval notice. The *second* funding line, i.e., 'funding calls', enables the federal state government to specifically address individual applicants on focal topics. Regional stakeholders are

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[11] This division of tasks has grown historically in other funding programmes, which is why the Saxony-Anhalt state government has decided to adhere to this procedure also in implementing the InvKG.

involved in this decision-making process. The funding call is brought about by a cabinet decision. The final funding decision is made by the responsible department of the federal state government. With the *third* funding line, i.e., 'Investments by the federal state', the federal state government has the opportunity to initiate its own projects. The project selection process essentially follows that of the 'funding calls' line. Compared to the other federal states, Saxony-Anhalt pursues a more bottom-up oriented project selection process.

- In *North Rhine-Westphalia*, Zukunftsagentur Rheinisches Revier GmbH assumes the regional steering and coordination function, whilst the Rhenish Mining Area Structural Change Unit (*Stabsstelle Strukturwandel Rheinisches Revier*) at the Ministry of Economic Affairs, Industry, Climate Action and Energy (MWIKE) is responsible at federal state level and has overall responsibility for regional economics and funding. Supported by the Jülich project executing organisation, Zukunftsagentur Rheinisches Revier GmbH accompanies the preparation of the project applications. In addition to a preliminary technical assessment – especially of the fit with the economic and structural programme – this includes identifying appropriate access to funding. As part of the project selection process, the supervisory board of Zukunftsagentur Rheinisches Revier GmbH, in which the federal state and the region are represented, determines the 'regional consensus' in accordance with the mining area agreement concluded between the federal state and the region represented by Zukunftsagentur Rheinisches Revier GmbH. This is a prerequisite for the further approval procedure. The federal state government then decides upon the projects and the applications are forwarded to the competent granting authority which is the Cologne county government in the case of the federal state components for the Rhenish mining area.

2.4.2 Approval processes of Pillar 2

Unlike project selection in Pillar 1, there is no 'single' approval process for Pillar 2. Instead, the funding measures are selected as part of the responsible department's general business. This ranges from decisions on the placing of public (federal) authorities and the expansion of existing programmes to major infrastructure projects. In general, the federal states can introduce proposals to the BLKG. This is usually preceded by a decision by the federal state cabinet.

The federal STARK programme (sec. 15 InvKG) has a special role to play for which a dedicated guideline has been developed. BAFA acts as the granting authority and coordinates the entire application process. Even though the selection of projects is designed as a process at federal level, the federal states are nevertheless institutionally involved in this process. For example, the responsible federal state ministries and, to a certain extent, regional agencies are involved in the preparation of the STARK projects. As a rule, no project is submitted to BAFA that has not already undergone a qualification process at federal state level during which other options for accessing funding is examined, for example. Once a project has then been submitted to BAFA, the federal states give an opinion on the eligibility of each individual project application, which BAFA takes into account in its funding decision.

3 Development of the assisted area and the coal sector

This chapter deals with the development of the coal regions until the adoption of the KVBG and the StStG. It first addresses the question of the macroeconomic development of the counties of the InvKG-assisted area (section 3.1). The production function is the theoretical framework for these analyses. Section 3.2 looks at the development of the coal sector. Section 3.3 addresses the special characteristics of the early coal phase-out in the federal state of North Rhine-Westphalia. Finally, section 3.4 presents an overview of the current state of studies.

3.1 Overall economic situation in the assisted areas

3.1.1 Data and methodology

The initial economic situation in the assisted areas is presented on the basis of indicators that have been identified in literature as important variables in the context of economic growth and structural change (Table 3-1).

Table 3-1: Data

Variable	Source	Unit	Period	Region
Gross value added	VGRdL	In euro at current prices	1992-2020	Counties/ federal states
Gross value added	VGRdL	In euro at constant 2015 prices	1992-2020	Federal states
Gross domestic product	VGRdL	In euro at current prices	1992-2020	Federal states
Capital stock	VGRdL	In euro at current prices/in euro at constant 2015 prices	1991-2019	Federal states
Working population	VGRdL	In thousand persons	1992-2020	Counties
Employees	VGRdL	In thousand persons	2000-2020	Counties
Total number of unemployed	Federal Employment Agency	In thousand persons	1995-2020	Counties
Working age population	VGRdL	In thousand persons	1995-2020	Counties
Total population	VGRdL	In thousand persons	1995-2020	Counties
Wages	VGRdL	In euro at current prices	2000-2020	Counties
Standard volume of work	VGRdL	In working hours	2000-2020	Counties
Disposable income	VGRdL	In euro at current prices	1995-2020	Counties
Population projection	Eurostat	In thousand persons	2019-2040	Counties
Population by age group	Eurostat	In thousand persons	2013-2019	Counties
Share of school leavers with higher education entrance qualification	Regionalatlas	in percent	2006-2021	Counties
Employees subject to social security contributions after graduation	Federal Employment Agency	In thousand persons	2013-2021	Counties

Source: Own presentation.

This includes, in particular, data on labour and capital as the production factors and on productivity. The regions considered in the following include the lignite coal assisted areas according to InvKG Chapter 1 sec. 2, and the hard coal assisted areas according to InvKG Chapter 2 sec. 12. The non-InvKG-assisted areas include all counties in Germany that are not among those mentioned in the Coal Regions Investment Act. The control group described in section 2.3 is also included in the group of non-InvKG-assisted areas since the control group consists exclusively of non-assisted areas.

The growth break-down at county and/or mining area level is based on a Cobb-Douglas production function with constant returns to scale, which takes the following form:

$$Y_t = A_t \cdot L_t^{(1-\alpha)} \cdot K_t^{\alpha} . \tag{1}$$

where index t denotes the respective year, Y production, A total factor productivity (TFP), L the hours worked, and K capital stock. The TFP is estimated as a Solow residual (Solow 1957), so that an increase in production that cannot be attributed to the 'capital' or 'labour' factors is assigned to productivity growth.

The statistical offices publish data for gross fixed assets (capital) exclusively at federal state level, so that capital stock at county level must be estimated. For this purpose, capital intensity in the federal state to which a county belongs, divided into three economic sections, i.e., (primary (A), secondary (B-F), and tertiary (G-T))[12], is multiplied by the regional section shares of the employed persons (ET) (Kubis, Brachert and Titze 2008):

$$\kappa_i = \sum_k \kappa_{j,k} * \frac{ET_{i,k}}{ET_i} , \tag{2}$$

where index i represents the respective county, j the corresponding federal state, k the economic section, κ the real capital intensity, and ET the number of employed persons. Based on the capital intensities, the capital stock for county i then results from:

$$K_i = \kappa_i * ET_i , \tag{3}$$

Furthermore, assuming section-specific capital intensities, we determine the depreciation rates δ_i for a county as follows:

$$\delta_i = \sum_k \frac{K_{i,k}}{K_i} \delta_{j,k} , \tag{4}$$

The depreciation rate of the capital stock in a county is the sum over the section-specific depreciation rates of the federal state weighted by the share of the county's capital stock in the respective section. The investment ratios are determined using the determined capital stock as follows:

$$I_{i,t} = K_{i,t+1} - (1 - \delta_{i,t})K_{i,t} , \tag{5}$$

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[12] Classification according to German Classification of Economic Activities 2008

$$\iota_{i,t} = \frac{I_{i,t}}{Y_{i,t}}.$$

Further components of the production function are the production elasticities α and $1 - \alpha$, for which the income shares of capital and labour are set. This is approximated with the share of labour compensation in gross value added at county level. Since labour compensation does not include the incomes of the self-employed, we assume, as is customary in literature, that the self-employed receive the same average compensation as workers employed in the same economic section (OECD 2001). The wage income ratio then results from the following relation:

$$1 - \alpha_i = \frac{Labour\ compensation_i * \frac{Total\ working\ population_i}{Number\ of\ employees_i}}{Gross\ value\ added_i}. \tag{6}$$

After determining the production elasticity α per county and year, the average is then calculated for each county over the analysis period under consideration from 2000 to 2019. For Germany as a whole, we obtain a value of 0.36 and 0.64 for α and $1 - \alpha$, respectively, which corresponds to the common approximation of production elasticities of the production factors capital and labour at national level (Kuntze and Kuckelkorn 2021).

Since the statistical offices only report price-adjusted values for gross value added at federal state level, it is also necessary to derive the implicit price deflator at county level. By calculating the price deflator at federal state level as the quotient between nominal and real gross value added for all three economic sections in constant 2015 prices, the implicit deflator at county level is obtained as the product of the price deflators of the associated federal state with shares of sectoral gross value added in total gross value added in county i:

$$P_i = \sum_k P_{j,k} * \frac{BWS_{i,k}}{BWS_i}, \tag{7}$$

where j denotes the federal state of county i, k the economic section, P the price deflator, and BWS gross value added. The real gross value added in county i then results from the quotient of nominal gross value added and the price index:

$$BWS_i^{real} = \frac{BWS_i^{nominal}}{P_i}. \tag{8}$$

3.1.2 Taking stock of economic development

3.1.2.1 Descriptive analysis

In order to analyse the economic development of the mining areas over time, it makes sense to look at various economic indicators that find their way into the production function. One of the most important indicators here is real gross domestic product per capita, which is shown for the individual regions in Fig. 3-1.

Fig. 3-1:   Gross domestic product per capita in euro (price-adjusted)
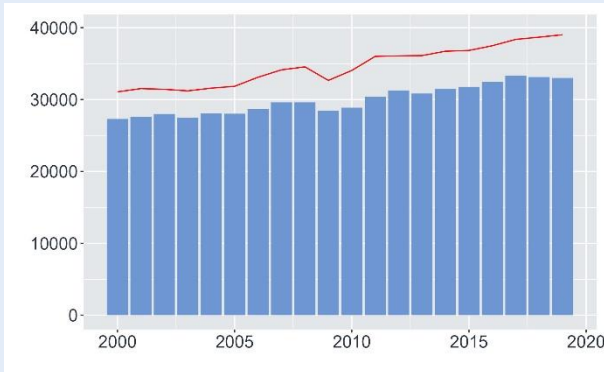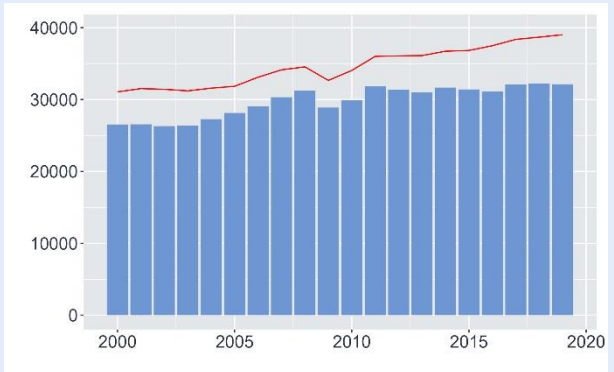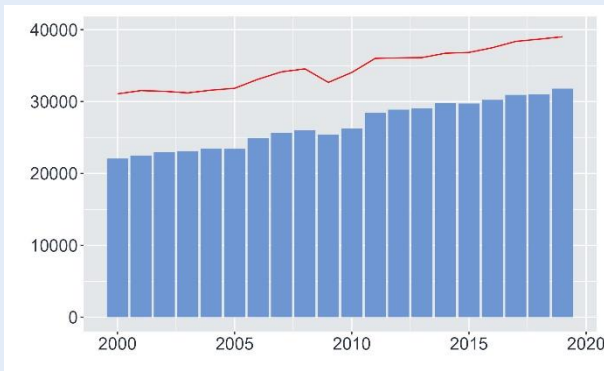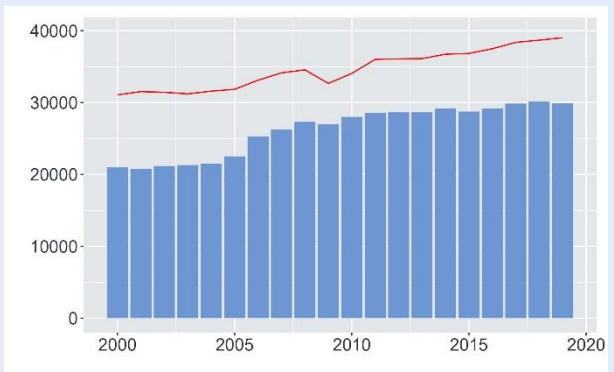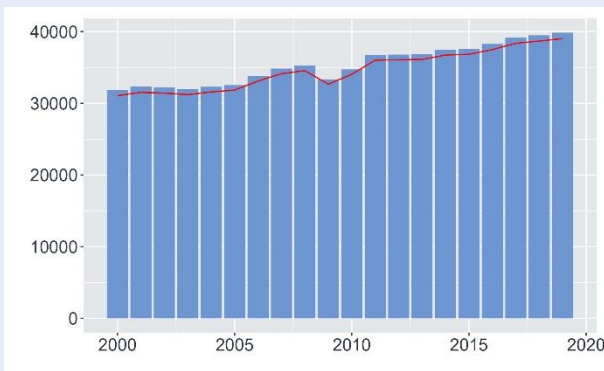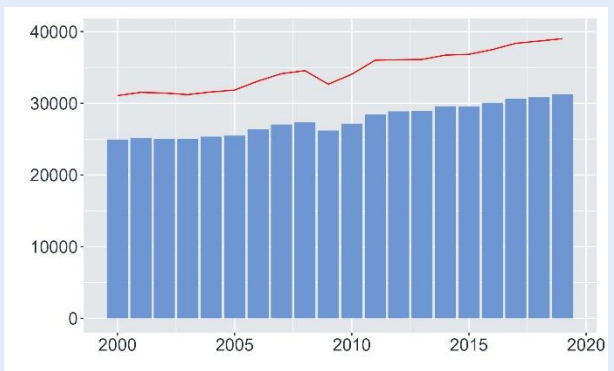
Note: The bars represent gross domestic product of the respective area shown, the red line represents the German national average.

Source: VGRdL, own calculation.

On average, gross domestic product (GDP) per capita in Germany increased by 1.2 percent p.a. between 2000 and 2019. The Saxon and Brandenburg parts of Lusatia (+2.5 percent and +1.9 percent, respectively), as well as the Saxon and Saxony-Anhalt parts of the Central German mining area (+2.0 percent and +1.6 percent, respectively) saw above-average growth rates, which can be attributed to the catching-up process of East Germany during this period.

Growth rates in other German regions were lower: When treated as an aggregated region, the counties that do not belong to the assisted areas according to sec. 2 InvKG recorded an average growth rate of 1.2 p.a., just like the counties of the control group described in Chapter 7, whilst the hard coal regions and the Rhineland each saw a growth rate of 1.0 percent.

Gross domestic product per capita of the East German mining areas considered was lower than in other regions in 2019: In the Saxon and Brandenburg parts of Lusatia, it totalled EUR 26,305 (67 percent of the German average) and EUR 29,902 (77 percent of the German average), respectively, and in the Saxon and Saxony-Anhalt parts of the Central German mining areas, this figure was EUR 31,794 (81 percent of the German average) and EUR 28,015 (72 percent of the German average), respectively. The control group's GDP per capita totalled EUR 31,225 (80 percent of the German average), the coal regions recorded EUR 32,142 (82 percent of the German average), the Rhineland EUR 33,004 (84 percent of the German average) and the non-assisted regions EUR 39,839 per capita, two percent above the German average in 2019.

Fig. 3-2 shows the sectoral structure of gross value added (GVA) in the mining areas, the non-assisted areas and the control group. A uniform classification of the contributions by the coal industry and mining to economic growth and GVA does not exist, but this contribution is included in aggregated economic sections B, D and E, which is the smallest possible differentiation of this section at county level.[13] The sectoral structure has a role to play, but regional value added is mainly generated by the services section, which accounts for over 60 percent of GVA across all regions. This is followed by the manufacturing section, including agriculture, forestry, fisheries and construction (sections A, C, F), with a contribution to GVA of over 20 percent each. In comparison, the contribution by mining, quarrying and energy supply (BDE section) to total gross value added is rather low.

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[13] Classification according to German Classification of Economic Activities 2008: B = Mining and quarrying, D = Electricity supply, E = Water supply; sewerage, waste management and remediation activities.

Fig. 3-2:   Shares of economic sections in price-adjusted gross value added (in percent)

Rhenish mining area

Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)

Lusatian mining area (Saxony)

Lusatian mining area (Brandenburg)

Not eligible for funding under the InvKG

Counties of the control group in the event study design

A, C, F   B, D, E   G-T
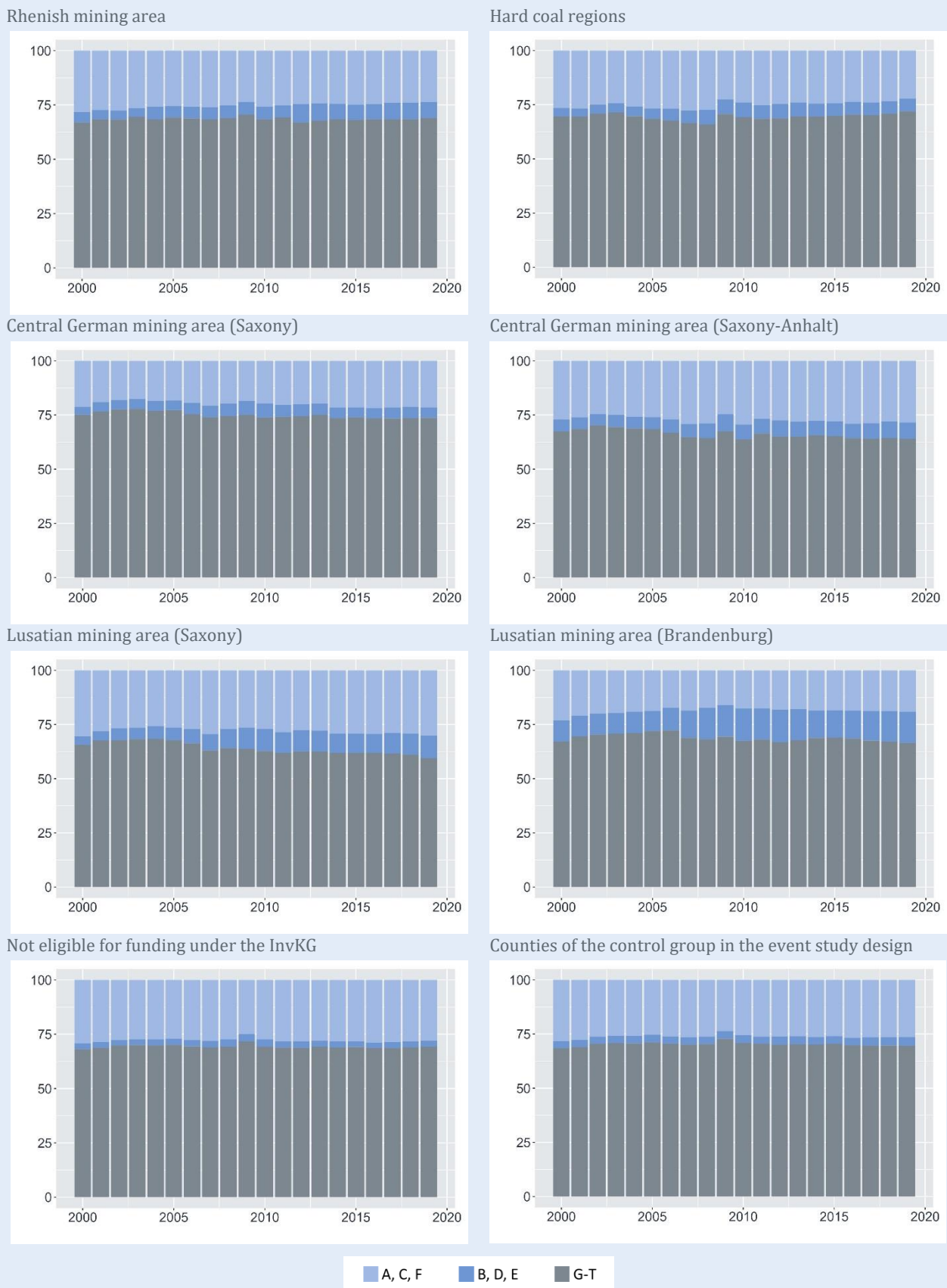
Source: VGRdL, own calculation.

However, it can be noted that the contribution of the BDE section to GVA is higher in coal regions than in non-assisted areas. Within the coal regions, the Brandenburg part of Lusatia has the highest share of these economic sections in total production, with an average contribution of 12.4 percent, followed by the Saxon part of Lusatia with a contribution of 8.0 percent. Over the years, the Saxony-Anhalt part of the Central German mining area shows a sector share of 6.5 percent, followed by the Rhenish mining area with a contribution of 6.1 percent, the hard coal regions with 5.6 percent and the Saxony part of the Central German mining area with 5.0 percent. The control group here has a contribution of 3.5 percent, while all non-assisted areas aggregate a mean contribution of 2.8 percent of these sections.

Although the coal industry and mining make some contribution to economic growth and gross value added, one can sum up that regional value added is mainly generated by other sections, especially the services section. The role of the coal industry can therefore only be essential for economic development if the coal industry's demand for intermediate goods contributes significantly to gross value added in the other sections of the economy or if the coal industry supplies indispensable intermediate goods. To estimate such effects, regional input-output tables are needed, but the statistical offices do not provide these tables in the necessary sectoral and regional detail.

Another indicator of regional economic prosperity is the development of wages, which significantly impact local purchasing power. Fig. 3-3 represents annual labour compensation before taxes per employee in the regions under consideration. The red line represents the German average in each case. It can be seen that the wage level in the East German coal regions is continuously below that of the West German regions as well as below the national average. Gross wages in the Saxon and Brandenburg parts of Lusatia, e.g., totalled 79 percent and 84 percent, respectively, of the German average in 2019, whereas gross wages in the Rhineland and the hard mining areas totalled 94 percent and 92 percent of the German average.

Fig. 3-3: Annual labour compensation before taxes per employee (in euro)
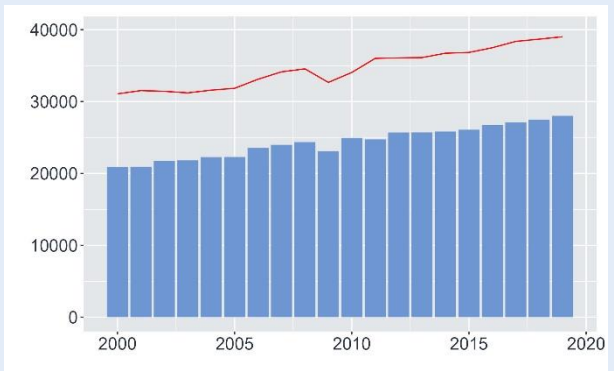

Rhenish mining area
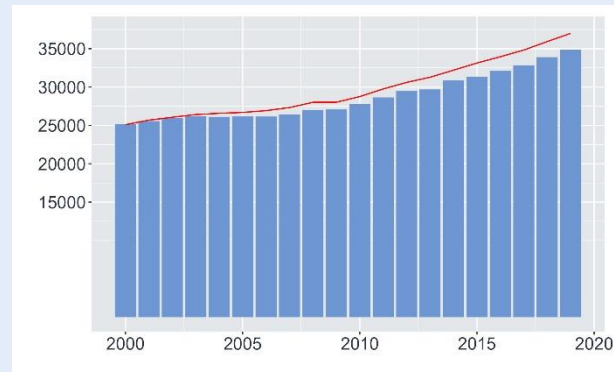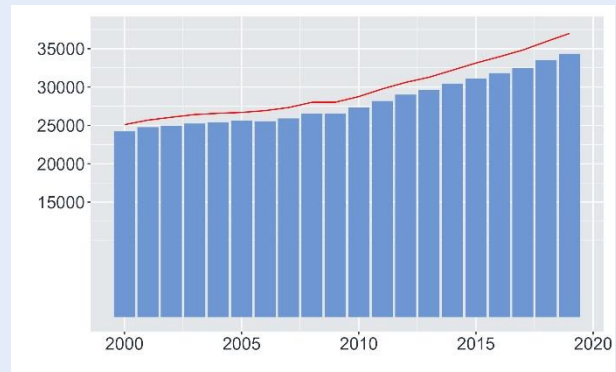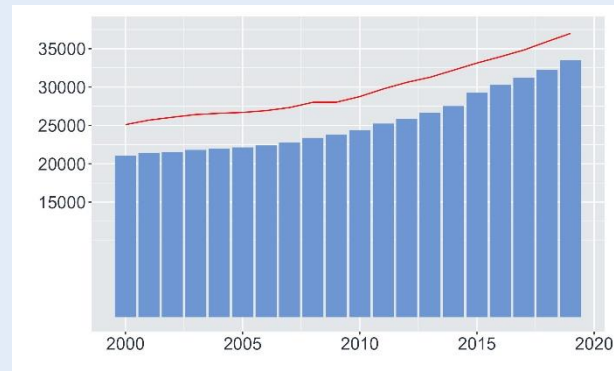
Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)
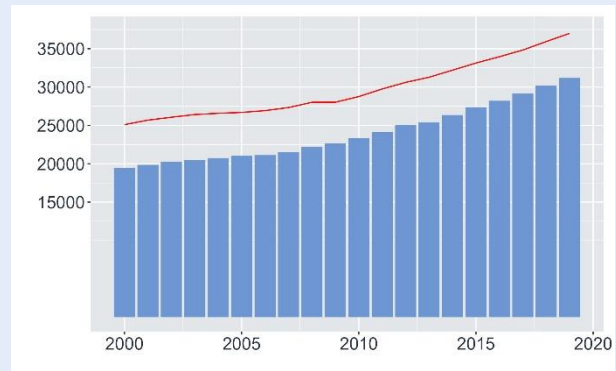
Lusatian mining area (Saxony)
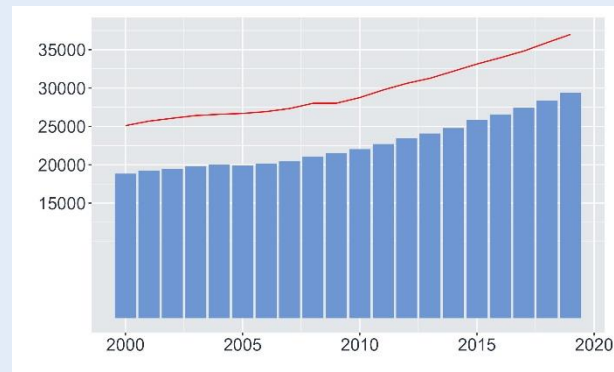
Lusatian mining area (Brandenburg)
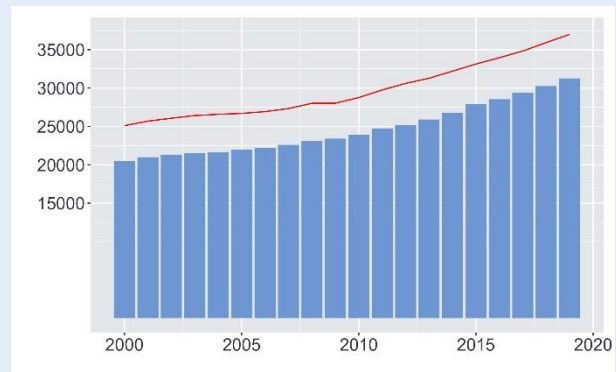
Not eligible for funding under the InvKG
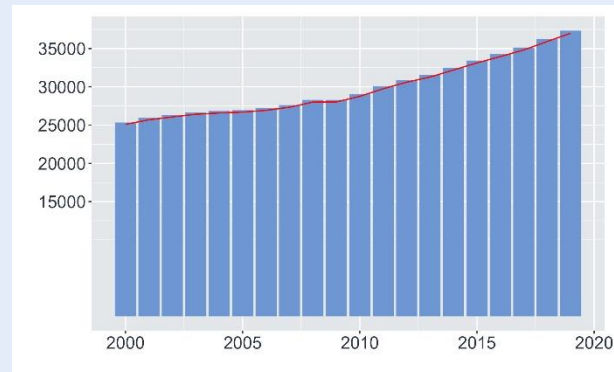
Counties of the control group in the event study design
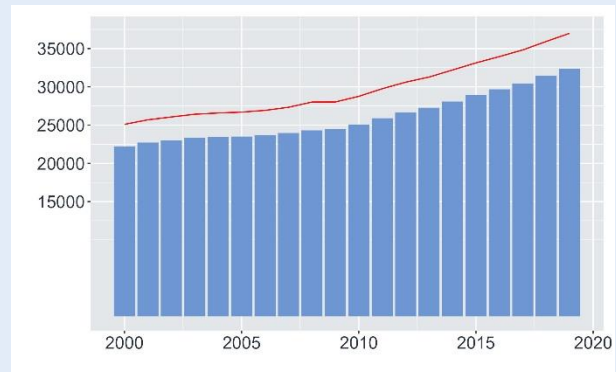
Note: The bars represent labour compensation before taxes per employee of the respective area shown, the red line represents the German national average.

Source: VGRdL, own calculation.

Furthermore, labour compensation can be subdivided into the economic sections A, C, F; B, D, E, and G-T. Fig. 3-4 shows the sectoral contributions by economic sections to labour compensation and presents a pattern similar to the breakdown of GVA in Fig. 3-2. The highest time-averaged contribution by the BDE section is again in the Brandenburg part of the Lusatian mining area with 6 percent, whereas the non-assisted areas show an average contribution of 2 percent. Furthermore, it is noticeable here that labour productivity in the BDE section is generally high. This means that differences between the coal regions and the non-assisted areas are smaller in labour compensation in the BDE section.

Overall, the sectoral structure in the coal regions does not differ much from other regions. This suggests that the composition of the economic sections alone cannot fully explain the large differences in gross domestic product per capita between the coal regions and the non-assisted areas.

The unemployment rate of a region is one indicator of the regional labour market. It shows the relative under-utilisation of labour supply by relating the registered unemployed to the total labour force. Fig. 3-5 shows the unemployment rate for the analysed regions. The unemployment rate has been declining over time across all counties.

In 2019, the unemployment rate was 8.2 percent in the hard mining areas, 7.7 and 5.7 percent, respectively, in the Saxony-Anhalt and Saxony parts of the Central German mining area, 6.3 percent each in the Brandenburg and Saxony parts of Lusatia, 6.5 percent in the Rhineland, 5.7 percent in the control group and 4.5 percent in all non-assisted areas. The high unemployment rate in the coal counties, especially since the mid-2000s, could be one of the reasons why gross domestic product per capita in these regions is lower than in the non-assisted areas.

Unemployment rates were particularly high in Central Germany and Lusatia at the beginning of the 2000s. However, a drastic decline in unemployment rates in these regions can be observed over time. In the Brandenburg and Saxon parts of Lusatia, the rate fell by 12.4 and 13.7 percentage points, respectively from 2000 to 2019, while in the Saxon and Saxony-Anhalt parts of the Central German mining areas it fell by 10.3 and 13.3 percentage points, respectively. This could reflect that many unemployed people found employment. However, it is also conceivable that the number of unemployed decreases when they reach retirement age or leave the region.

Overall, it can be said that unemployment rates in the coal regions have been declining over time, indicating positive developments in terms of employment and the labour market.

Fig. 3-4:   Shares of economic sections in labour compensation (in percent)
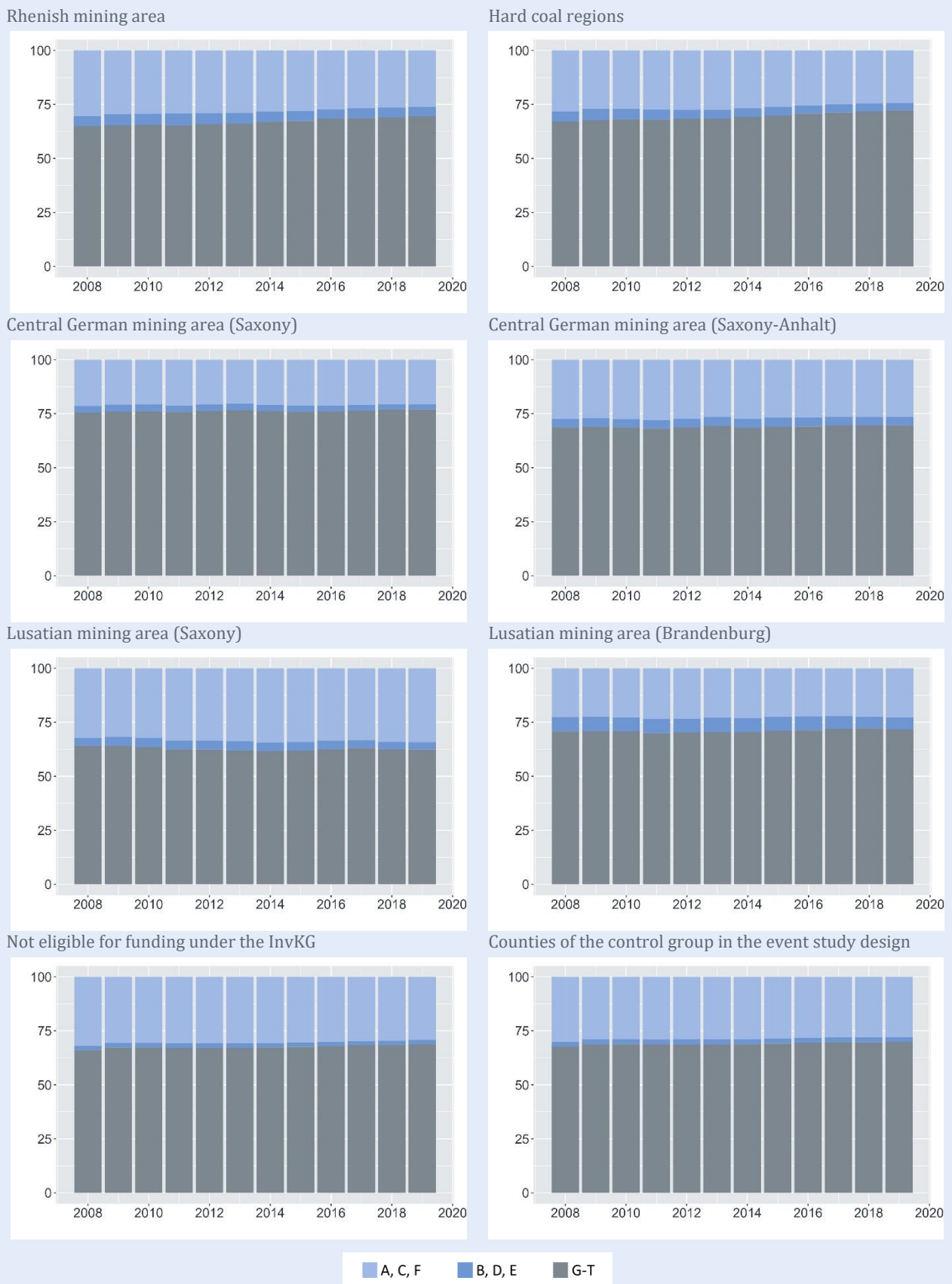
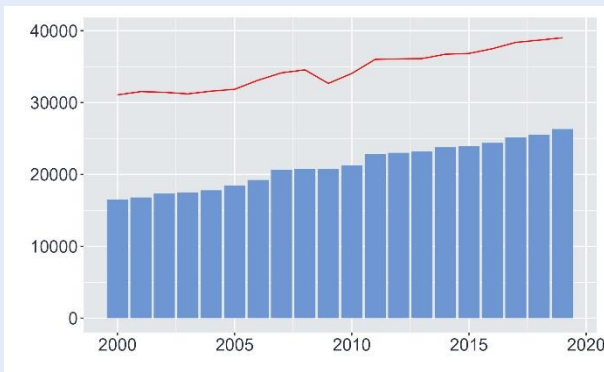Rhenish mining area

Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)

Lusatian mining area (Saxony)

Lusatian mining area (Brandenburg)

Not eligible for funding under the InvKG

Counties of the control group in the event study design

A, C, F   B, D, E   G-T

Source: VGRdL, own calculation

- 35 -

Fig. 3-5:   Unemployment rate (in percent)
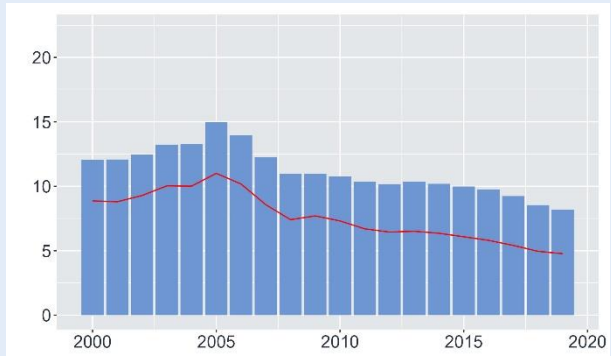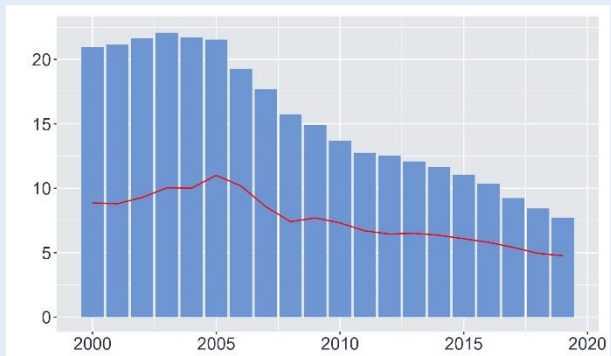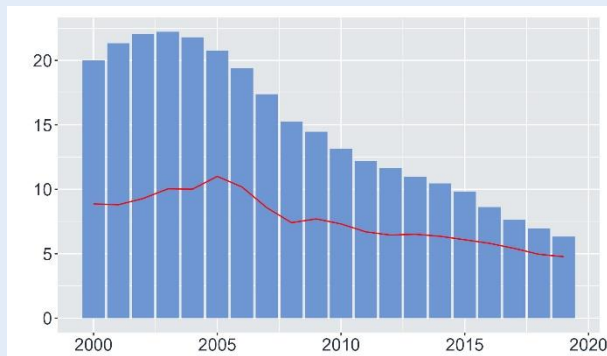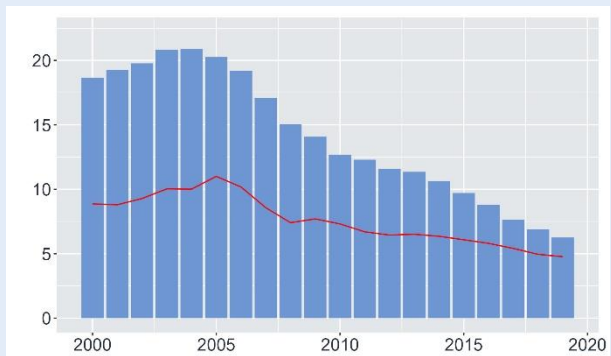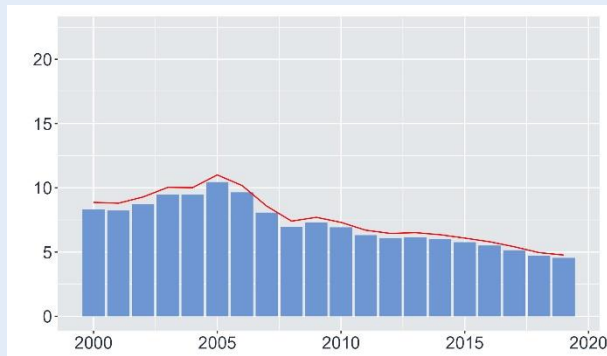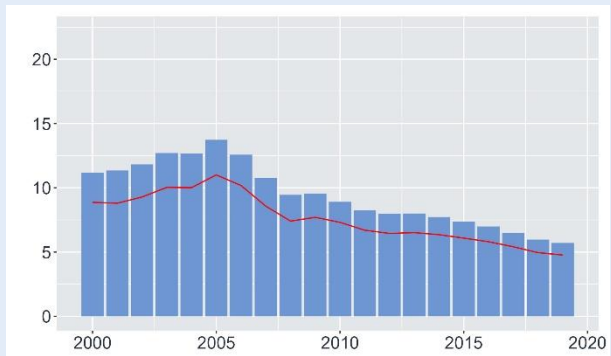
Note: Bars represent the unemployment rate for the respective region and the red line the unemployment rate in Germany.

Source: Federal Employment Agency, own calculation.

Fig. 3-6 presents the old-age dependency ratio in order to identify the composition of the population. This quotient represents the ratio between people of retirement age, i.e., those aged 65 and over, and people of working age, defined here as people aged between 15 and 64. A comparatively high share means that the labour force potential in the region is comparatively lower.

In Lusatia in particular, the ratio of people aged 65 and over to those of working age rose relatively sharply compared to the other regions, by 7 percentage points for the years 2013 to 2019, whereas in the regions that are not eligible under the InvKG, this ratio rose by 2 percentage points during the same period.

In 2019, the Saxon and Brandenburg parts of Lusatia had the highest ratio of older people to the working-age population, at 49.8 percent and 44.6 percent, respectively, next to the Saxony-Anhalt part of the Central German mining area at 44.7 percent. The red line again indicates that these regions have been significantly above the German average over the years. The control group follows with a share of 37.9 percent, the Saxon part of the Central German mining area with 36.4 percent, the hard mining areas with 35.1 percent, the non-assisted areas with 33.3 percent and the Rhineland with 32.9 percent.

When leaving the labour force, many people no longer contribute to regional economic growth and gross value added to the same extent. This could slow down the catching-up process in the future, especially if there is no immigration from other German regions or other countries.

Besides the composition of the population, total factor productivity is another driver of a region's economic growth. An important factor that can increase productivity is the human capital that exists in an area. Human capital here refers primarily to the educational level of the working-age population.

Fig. 3-7 shows the share of school leavers from general education schools who have obtained a general higher education entrance qualification. This share can be used as an indicator for human capital, provided that there is no outbound migration. There are major differences between the regions, with the share having increased in some counties and county-free cities in 2021 relative to 2012 and having decreased in others relative to 2012.

In the Lusatian counties in particular, the share of school leavers with a higher education entrance qualification has declined sharply compared to 2012. This suggests that the potential for future economic growth in this region may be limited.

Fig. 3-6:   Old-age dependency ratio (in percent)

Rhenish mining area
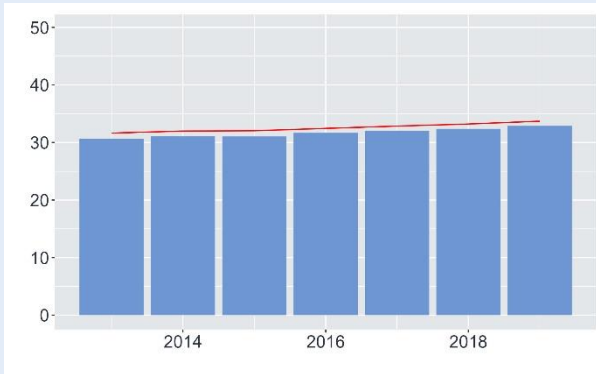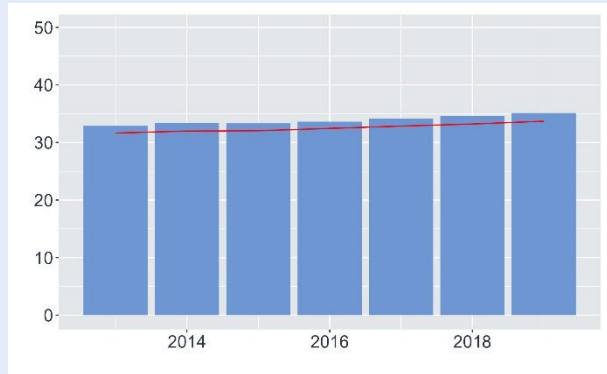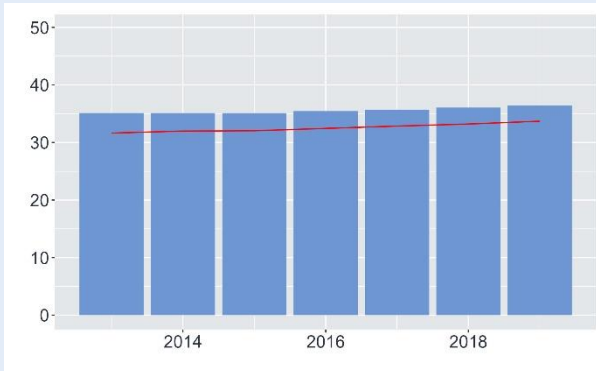
Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)
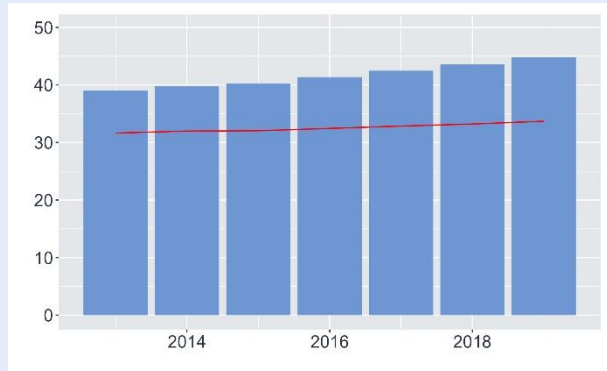
Lusatian mining area (Saxony)

Lusatian mining area (Brandenburg)
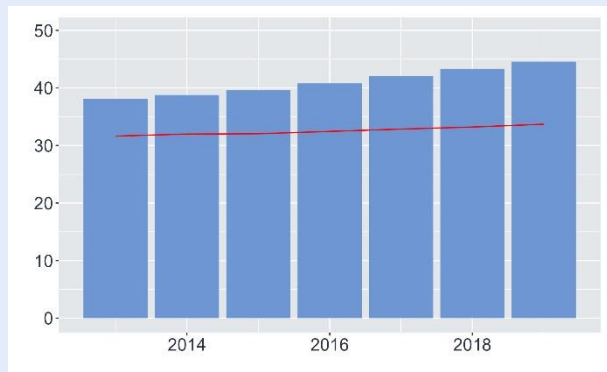
Not eligible for funding under the InvKG

Counties of the control group in the event study design
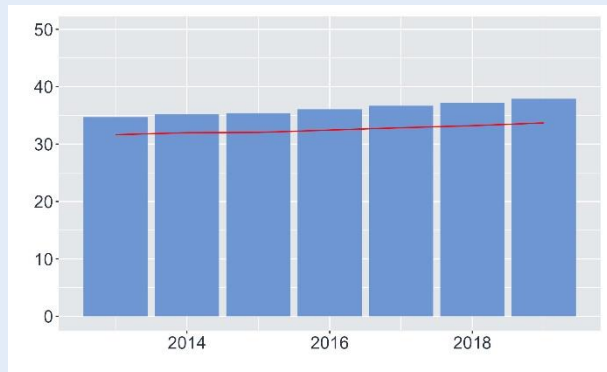
Note: Bars represent the old age-dependency ratio for the region and the red line for Germany.

Source: VGRdL, own calculation.

Furthermore, the county-specific analysis shows an urban-rural divide with regard to school leavers with a higher education entrance qualification, particularly for the Central German mining area, with the city of Leipzig and the city of Halle having higher shares than the counties in the mining area. Furthermore, most of the counties in the Central German mining area and Lusatia are below the German average, whereas the counties in the Rhineland and in some regions in the hard mining areas are above the German average. This suggests that education in the Central German and Lusatian mining areas may contribute less to growth compared to other counties in Germany, given the assumption that the region's school leavers essentially represent the future regional labour potential.

The share of skilled labour is another indicator of the educational level of the working-age population in a region. Unlike school leavers, people in the counties work there at the time of reporting and therefore already actively contribute to the qualification level of a region's labour force. Fig. 3-8 shows the number of employees subject to social security contributions by qualification for the regions considered. The share of people without qualifications remains relatively constant over the years in the regions. Counties in the Central German mining area and Lusatia have the lowest share here with values between 7 and 9 percent in 2022, whilst the Rhineland has the highest share with 17 percent. A high share of people without any qualifications may mean that this group is more likely to be in marginal employment and thus contributes less to the region's economic growth. In some coal regions, moreover, the share of people with an academic degree is lower than in the non-assisted areas (2022: 19.6 percent), with the exception of the Rhenish mining area (2022: 18.1 percent) and the Saxon part of the Central German mining area (2022: 22.7 percent).

This again suggests an urban-rural divide, as counties in the Rhineland mining area are located in the immediate catchment area of large university cities in the Rhineland, while the high share in the Saxon part of Central Germany can be explained by the city of Leipzig. In the counties of Lusatia, on the other hand, the share is in the order of 14 percent in 2022, so that here, compared to the other regions, the share of people with vocational school qualifications is highest.

Fig. 3-7: Share of school leavers with higher education entrance qualification (in percent)

Germany: 35.1 (2012, yellow dotted line), 34.3 (2021, orange dashed line)
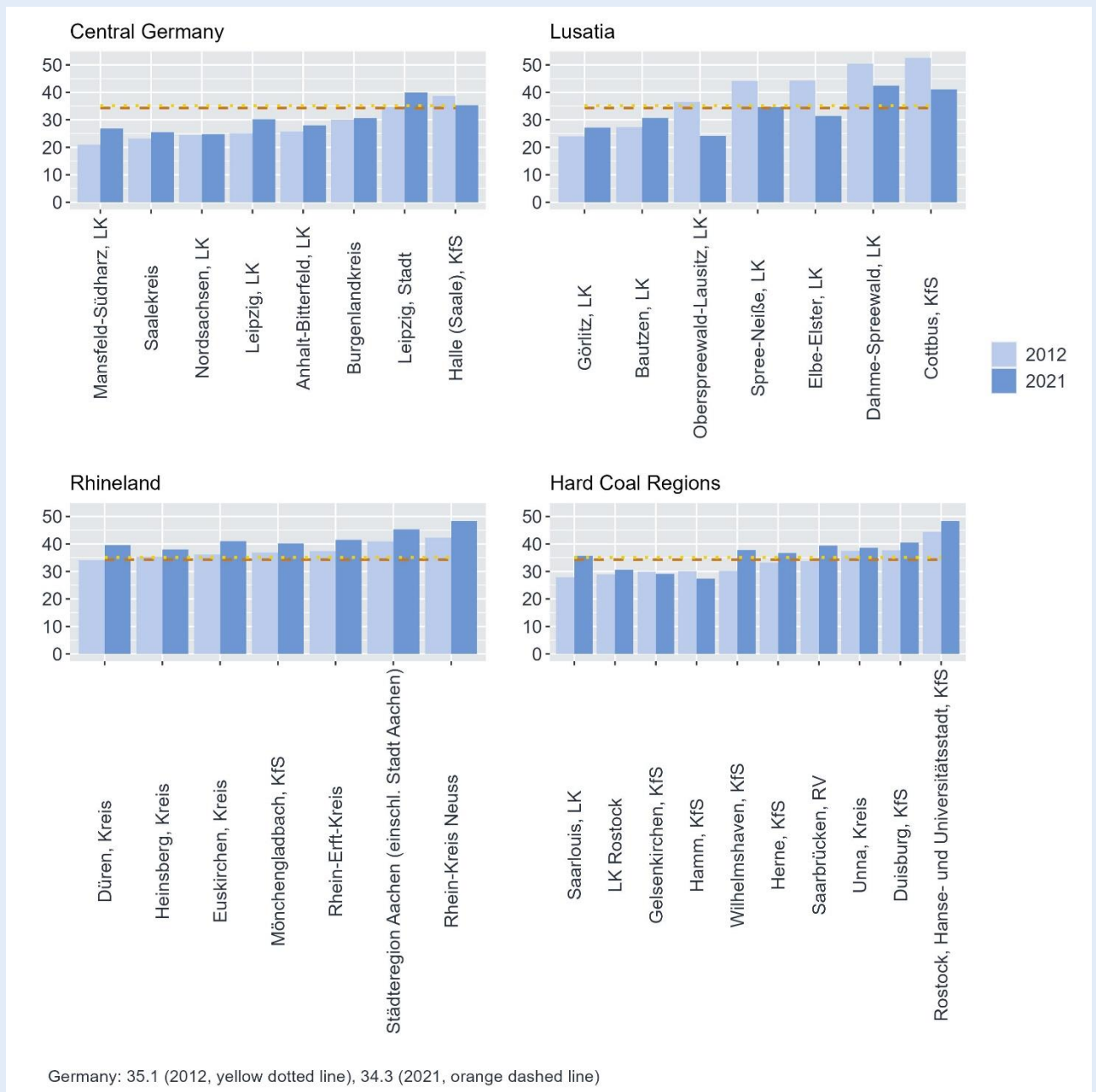
Source: Regionalatlas, own calculation.

**Fig. 3-8:** Share of employees subject to social security contributions by qualification (in percent)

Rhenish mining area
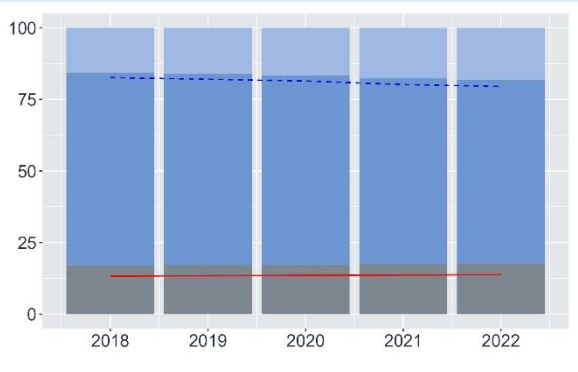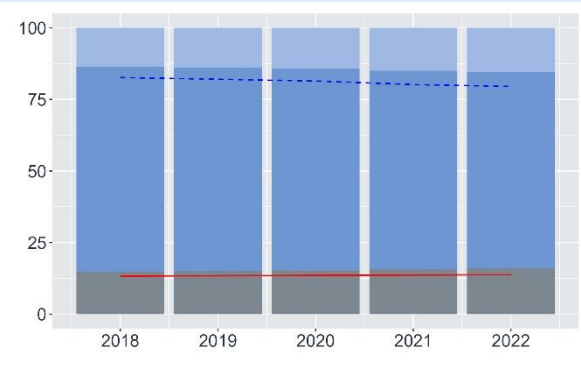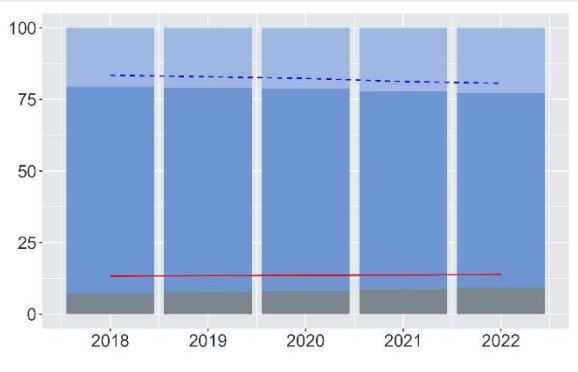
Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)
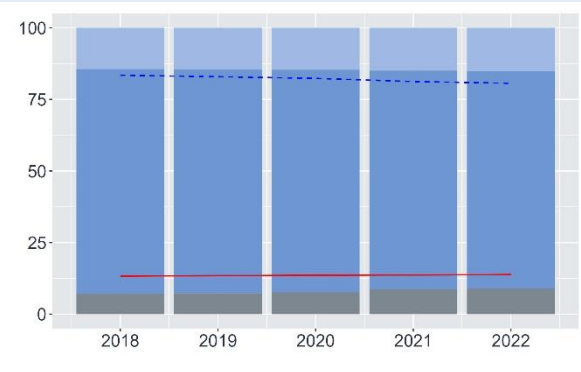
Lusatian mining area (Saxony)
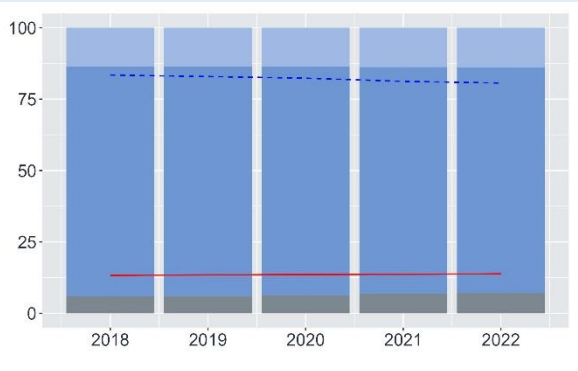
Lusatian mining area (Brandenburg)
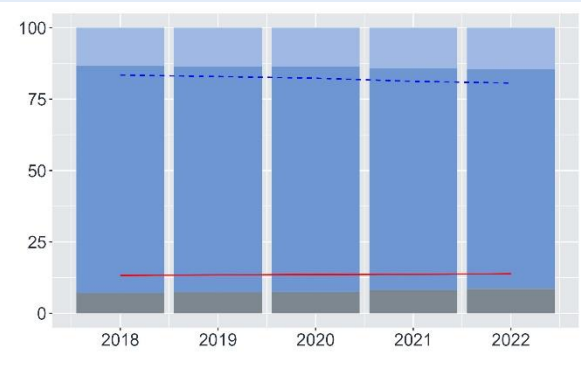
Not eligible for funding under the InvKG
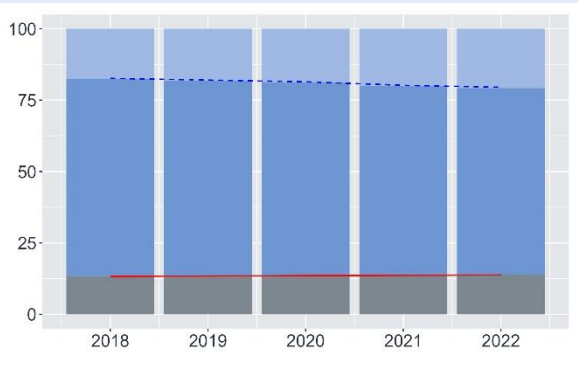
Counties of the control group in the event study design
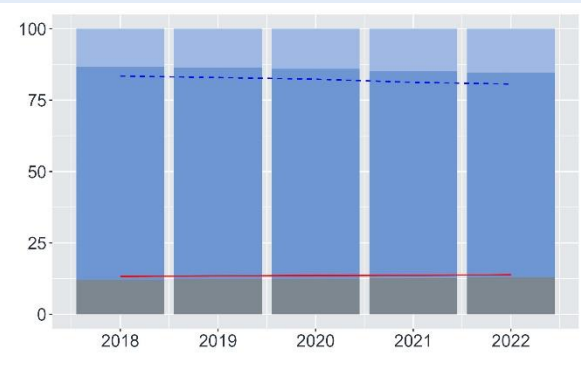
Note: Share of employees in the region subject to social security with an academic degree light-blue bar, with vocational training dark-blue bar, no degree grey bar. Share of employees in Germany with an academic degree dashed blue line and with no degree red line.

Source: Federal Employment Agency, own calculation.

3.1.2.2 Growth accounting

Growth accounting is a method of analysing economic growth in a region (r) or a country.[14] This method breaks growth down into different factors to see which of the inputs to the production function had the highest contribution to growth. For this purpose, the contributions of capital ($g_{r,t}^K$) and labour growth ($g_{r,t}^L$) weighted with the production elasticities are subtracted from production growth ($g_{r,t}^Y$) in order to determine the growth contribution of total factor productivity ($g_{r,t}^A$). Growth accounting is carried out at mining area level.[15]

$$g_{r,t}^A = g_{r,t}^Y - (1 - \alpha) \cdot g_{r,t}^L - \alpha \cdot g_{r,t}^K, \tag{9}$$

$$g_{r,t}^X = 100 \cdot \left(\frac{X_{r,t}}{X_{r,t-1}} - 1 \right), \text{ for } X \in \{Y, A, L, K\}.$$

Annual growth rates are often subject to cyclical fluctuations and can obscure long-term processes. For this reason, the upper part of Fig. 3-9 presents mean growth decomposition for the period from 2001 to 2019.[16] It can be seen that the Saxon part of Lusatia and that of the Central German mining areas have higher production growth rates of 1.4 percent and 2.2 percent, respectively, compared to the hard mining areas (0.8 percent), the Rhineland (1.2 percent), the control region (1.1 percent) and the non-assisted areas (1.4 percent). In contrast, the Central German counties in Saxony-Anhalt especially recorded weak growth.

In the East German mining areas, growth in these two decades is not due to an increase in capital stock or increased use of working hours. Total factor productivity is mainly responsible for growth in the counties in Saxony and Brandenburg. In the Saxony-Anhalt counties, the productivity contribution is significantly lower and comparable to the Rhineland, the hard coal mining areas and the other counties in Germany. The contribution of capital to growth is positive in all the regions considered and particularly pronounced in the Saxon part of the Central German mining area, whilst the contribution of labour is negative in Lusatia and in the Saxony-Anhalt part of the Central German mining area. This reflects the strong outbound migration from these counties during the 2000s.

In order to enhance the understanding of the long-term trends, the growth decomposition of the mining areas is considered for the first and second decade of the 21st century (middle and lower part of Fig. 3-9). The growth decomposition by decade in the different regions shows different trends. Growth has flattened out in Lusatia and in the Saxony-Anhalt part of the Central German mining area.

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[14]   See Nelson (1973).

[15]   First, gross value added, hours worked and the capital stock of the counties (i) belonging to a coal mining area (r) are added up ($X_{r,t} = \sum_{i \in r} X_{i,t}, \text{ for } X \in \{Y, A, L, K\}.$) The growth rates are then calculated at mining area level.

[16]   The average annual growth rate of the individual production factors $\left(\frac{1}{t_{end} - t_{start}} \sum_{t_{start}}^{t_{end}} g_{r,t}^X \right)$ weighted with the respective elasticities is shown. Annual growth accounting can be found in the Annex for the individual coal mining areas.

Fig. 3-9:   Growth decomposition for price-adjusted gross domestic product by county

2001-2019 period
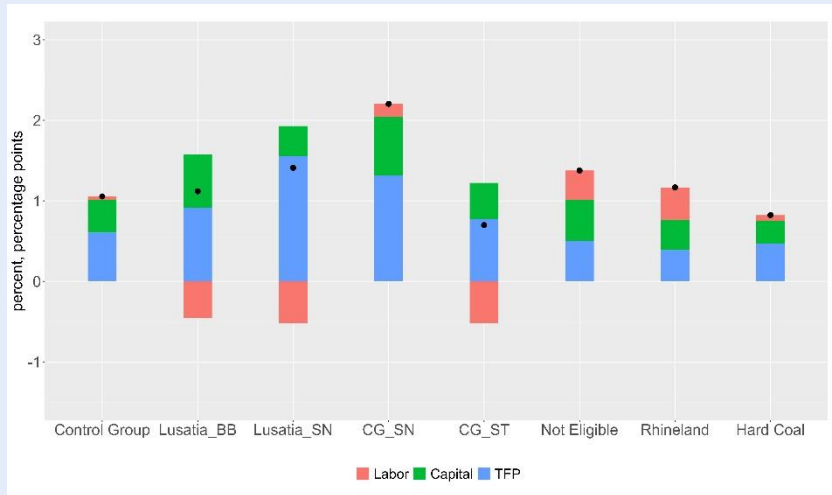
2001-2010 period
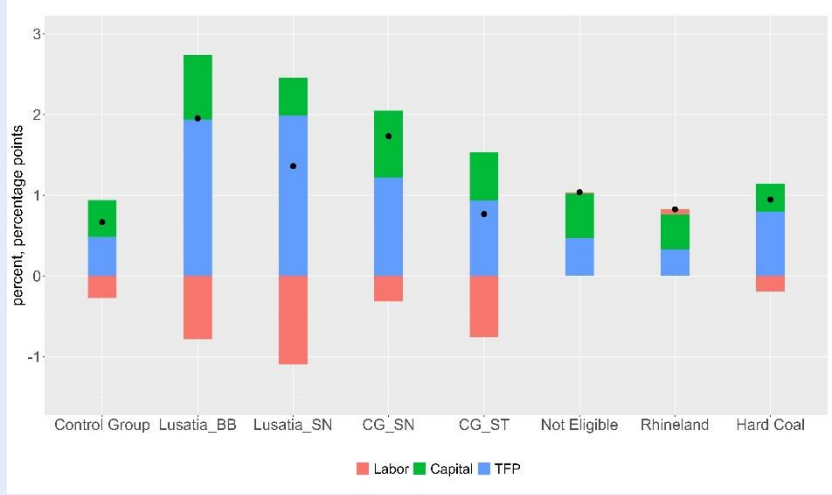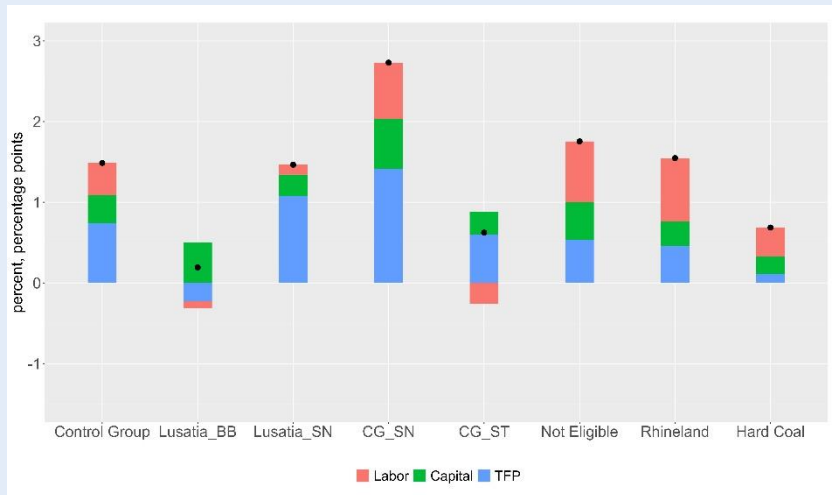
2011-2019 period

Notes: BB – Brandenburg,   SN – Saxony,   ST – Saxony-Anhalt.   CG – Central   German   mining   area.   Not
                 Eligible – aggregated counties in Germany that are not assisted areas. Hard Coal – counties mentioned as
                 eligible in the InvKG, Chapter 2, sec. 12.

Sources: VGRdL, own calculation.

These areas, in particular, have seen a sharp decline in productivity rates, however, with some interesting differences. In Lusatia, the contributions by labour to growth are now no longer negative, indicating positive changes. On the other hand, the negative contribution by the labour factor in the Saxony-Anhalt part of the Central German mining area has become smaller, indicating some stabilisation.

In contrast, growth in the Saxon part of the Central German mining area is expanding further. This is mainly driven by productivity increases, but also by inbound migration, leading to a stronger contribution by the labour factor. A similarly positive development can be seen in the Rhineland, where growth increased again in the second half of the analysis period. The labour factor made a particularly strong contribution in this area. Similar developments can also be observed for the other counties in Germany. Overall, the growth decomposition shows that economic growth develops differently in the German regions studied. Whilst growth is levelling off in some areas, there is a positive trend in other regions with stronger contributions by labour and improved productivity.

The growth contributions by the economic sections will now be looked at on a nominal basis in the following. As described in section 3.1.1, the price deflator at county level is estimated using the implicit price deflators of the respective federal state. These are not explicitly available for the mining, energy and water management sections. As we intend to present these economic sections separately for our purposes, the sectoral growth decomposition remains on a nominal basis. Fig. 3-10 shows that the services section contributed most to nominal economic growth in all regions, followed by manufacturing. The relative contribution by the mining, energy and water sections is higher in all coal regions than in counties that are not located in the assisted regions. In Lusatia, this section's contribution to growth is particularly strong in the Saxon and Saxony-Anhalt parts, at 0.6 percentage points. Coal phase-out means that the positive growth contributions by this section and the associated value creation in upstream and downstream supply chains will in part disappear or turn negative.

In order to get a better picture of the temporal variation of the contributions, the analysis period is subdivided into shorter periods in the middle and lower part of Fig. 3-10. Here it is particularly clear that the contributions by the mining, energy and water sections were higher in the coal regions between 2001 and 2010 than they were in the following decade. In the Brandenburg part of Lusatia, this section accounts for the second highest share of total production growth after the services section, with a contribution of 0.9 percentage points, while in the second decade of the 2000s this contribution was down to 0.2 percentage points there. This illustrates the restructuring process of the lignite coal mining industry, which has already been underway for years in some mining areas. The loss of importance of the mining section is also evident in the hard coal mining areas, for which the figure still shows a contribution of 0.4 percentage points by the mining, energy and water industries, whereas this fell to 0 percentage points in the years between 2011 and 2019. The decline in this contribution is due to the phase-out of hard coal production, which already ended in 2018 when the last two mines, i.e., Prosper-Haniel and Ibbenbüren, were closed.

Fig. 3-10:   Growth decomposition of nominal gross value added by section

2001-2019 period
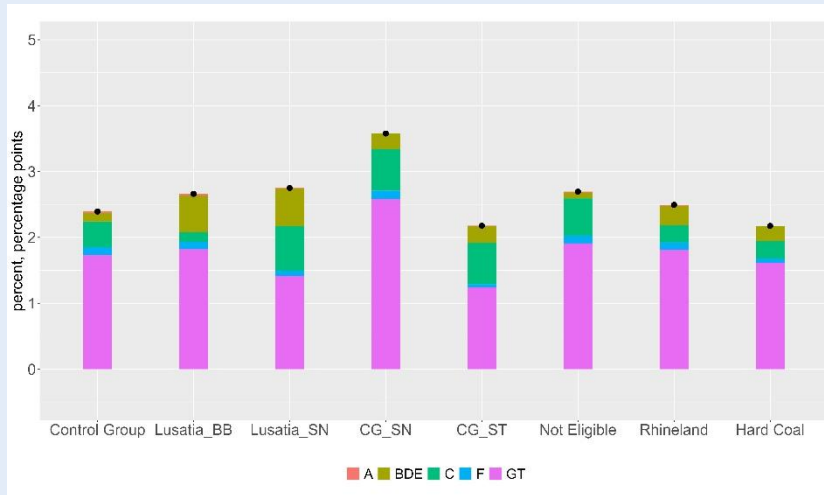
2001-2010 period
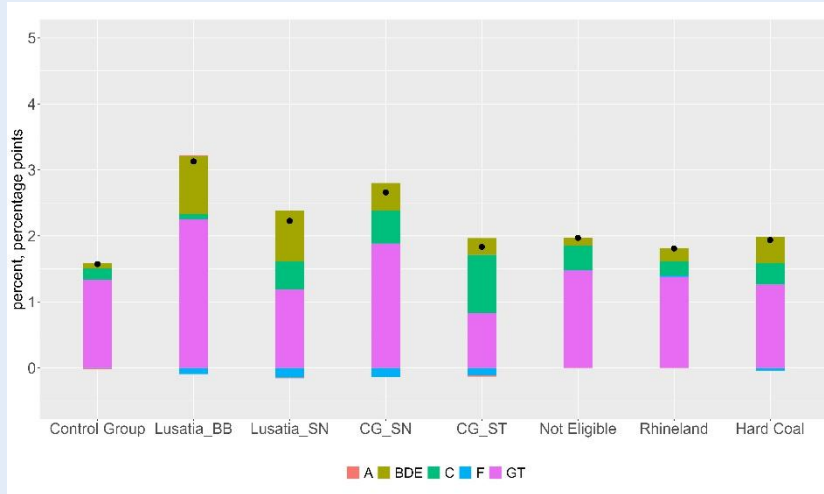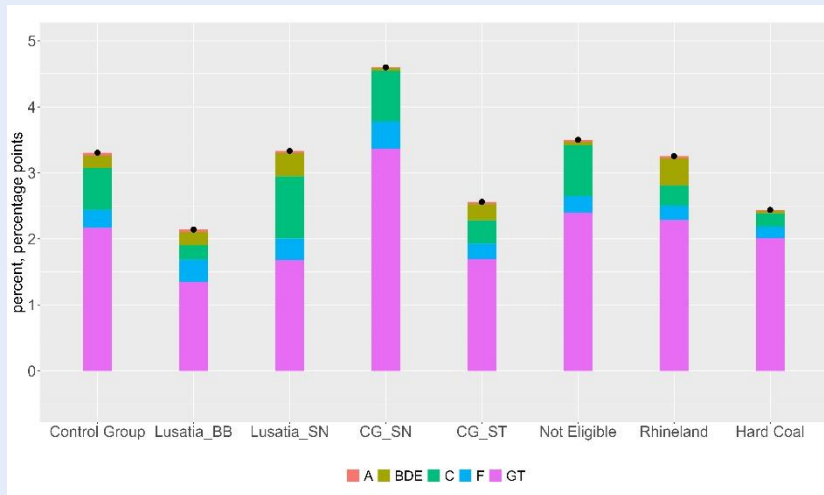
2011-2019 period

Notes: BB – Brandenburg,   SN – Saxony,   ST – Saxony-Anhalt.   CG – Central   German   mining   area.   Not
                Eligible – aggregated counties in Germany that are not assisted areas. Hard Coal – counties mentioned as
                eligible in the InvKG, Chapter 2, sec. 12.

Sources: VGRdL, own calculation.

3.2 Development of the lignite coal industry until 2022

This section outlines the development of the lignite coal sector in Germany (for further reading see also: DIW 2014; Statistik der Kohlenwirtschaft 2016; Oei et al. 2017; SRU 2017, RWI 2018). The focus here is particularly on the share of lignite coal in electricity generation and primary energy consumption as well as the direct employment effects of the lignite coal industry.

3.2.1 Importance of the lignite coal sector for energy generation in Germany

Table 3-2 shows the share of lignite coal in electricity generation and primary energy consumption. Before funding under the InvKG started in 2019, lignite coal accounted for 18.7 percent of gross electricity generation (2000: 25.7 percent, 2010: 23.0 percent) and 9.3 percent of primary energy consumption in Germany (2000: 10.8 percent, 2010: 10.6 percent). This shows that lignite coal was still an important energy source at that time. Since the beginning of production and especially with the start of the war in Ukraine in 2022, this importance has only changed slightly. For example, the amount of elecricity generated from lignite coal in 2022 increased by 2.2 TWH compared to the reference year 2019. This increased the share of lignite coal in gross electricity generation to more than 20 percent again. This development is also seen in primary energy consumption where the share of lignite coal rose from 9.3 percent in 2019 to 9.9 percent in 2022.

Table 3-2: Share of lignite coal in electricity generation and primary energy consumption

	2000	2010	2019	2000-2019	2021	2022	2019-2022
Gross electricity generation	in TWh			in % p.a	in TWh		in % p.a
Total	576.6	633.5	609.4	0.3	584.3	573.8	-2.0
of which lignite coal	148.3	145.9	114.0	-1.4	110.1	116.2	0.6
share of lignite coal in %	25.7	23.0	18.7	.	18.8	20.2	.
Primary energy consumption (in million tonnes HCE)	in TWh			in % p.a	in TWh		in % p.a
Total	3990	3938	3466	-0.7	3990	3938	-1.9
of which lignite coal	430	419	322	-1.5	313	323	0.1
share of lignite coal in %	10.8	10.6	9.3	.	9.1	9.9	.

Source: Own calculations according to data from Statistik der Kohlenwirtschaft (2023) and BMWK (2022).

3.2.2 Lignite coal production in Germany

In 1990, the volume of lignite coal produced in Germany still totalled 357 million tonnes (Statistik der Kohlewirtschaft 2023). In 2022, it was around 63 percent lower. Different regional mining intensities are evident. While at the time of German reunification, the Lusatian mining area was characterised by the largest production volumes in Germany, production volumes in the East German mining areas fell by 113.0 million tonnes (Lusatian mining area) and 64.4 million tonnes (Central German mining area)

in the first ten years after reunification. This corresponds to a reduction in production of 67 percent (Lusatian mining area) and 80 percent (Central German mining area). Between 2000 and 2017, lignite coal production stabilised at a level of 170 million tonnes (Table 3-3). From 2017 to 2019, production dropped further from 171 to 131 million tonnes. This is roughly the amount that was also produced in 2022.

Table 3-3: Lignite coal production in Germany

Coal mining area	2000	2010	2019	2000-2019	2021	2022	2019-2022
	in thousand tonnes			in % p.a	in thousand tonnes		in % p.a
Lusatian mining area	55,006	56,673	51,998	-0.3	46,815	48,522	-2.3
Rhenish mining area	91,898	90,742	64,807	-1.8	62,584	65,294	0.2
Central German mining area	16,431	20,004	14,509	-0.7	16,858	16,985	5.4
Helmstedt mining area	4,141	1,984	-		-	-	
Coal mining areas total	167,660	169,403	131,314	-1.3	126,257	130,801	-0.1
	in % of the production of all mining areas				in % of the production of all mining areas		
Lusatian mining area	33	33	40		37	37	
Rhenish mining area	55	54	49		50	50	
Central German mining area	10	12	11		13	13	
Helmstedt mining area	2	1	0		0	0	
Coal mining areas total	100	100	100		100	100	

Source: Own calculations according to data from Statistik der Kohlenwirtschaft (2023).

Since German reunification, the Rhenish mining area has been the most important lignite coal region in Germany, even though the area's share in total production in Germany has fallen from 55 percent (2000) to 50 percent (2022). This is followed by the Lusatian mining area (increase from 33 to 37 percent) and the Central German mining area (increase from 10 to 13 percent) in second and third place, respectively. In the Helmstedt mining area, where production was already down to just 2 percent of total lignite coal production in Germany in 2000, production ended on 30 August 2016 when the Schöningen opencast mine was closed.

3.2.3 Direct employment in the lignite coal sector in Germany

The number of people directly employed in opencast lignite coal mining and lignite coal-fired power plants in Germany fell by 1.6 percent p.a. between 2000 and 2019 from around 26,800 in 2000 to just under 20,300 in 2019 (Table 3-4). The values differ only slightly between the mining areas. The Rhenish mining area has seen employment decline by an average of 1.5 percent p.a., the Lusatian mining area by 1.4 percent and the Central German mining area by 0.9 percent. The clear differences in the reduction of employment over time are striking. Whilst the periods from 2000 to 2005 and from 2015 to 2019 are characterised by sharper declines in employment in the lignite coal sector, employment remained relatively stable in the period from 2006 to 2014. The most significant decline in employment is found in the Helmstedt mining area, where employment at the current margin is steadily approaching zero, With just 38 people being still employed here in the lignite coal sector in 2022.

Table 3-4: Direct employment in the lignite coal sector in Germany

Coal mining area	2002	2010	2019	2000-2019	2021	2022	2019-2022
	Number			in % p.a	Number		in % p.a
Lusatian mining area	10,338	8,049	8,116	-1.4	7,362	7,675	-1.8
Rhenish mining area	12,693	11,606	9,785	-1.5	8,481	7,676	-7.8
Central German mining area	2,745	2,508	2,334	-0.9	2,052	1,827	-8.7
Helmstedt mining area	987	541	101	-12.5	53	38	-27.8
Coal mining areas total	26,827	22,704	20,336	-1.6	17,948	17,216	-5.4
	in % of the employees in lignite coal mining in all mining areas				in % of the employees in lignite coal mining in all mining areas		
Lusatian mining area	38.5	35.5	39.9		41.0	44.6	
Rhenish mining area	47.3	51.1	48.1		47.3	44.6	
Central German mining area	10.2	11.0	11.5		11.4	10.6	
Helmstedt mining area	3.7	2.4	0.5		0.3	0.2	
Coal mining areas total	100	100	100		100	100	

Notes: The information refers to the years from 2002 to 2022 as employment data for the lignite coal sector, including employees in the general-supply lignite coal-fired power plants, are available here.

Source: Own calculations according to data from Statistik der Kohlenwirtschaft (2023).

However, this is not only due to the fact that lignite coal production in the Helmstedt mining area was finally discontinued in 2016, but also to the fact that the only remaining lignite coal-fired power plant, Buschhaus, was finally shut down on 1 October 2020 after four years in safety standby. Since 2019, regional differences have become apparent in the development of employment in the mining areas. Whilst the loss of jobs increases in the Rhenish and Central German mining areas, the Lusatian mining area records only minor losses and is the only mining area in Germany where employment increases between 2021 and 2022.

This development also leads to changes in the relative employment weight of the mining areas. Between 2000 and 2019, the Rhenish mining area still accounted for almost half of the people directly employed in the lignite coal sector (on average 48 percent). This was followed by the Lusatian and Central German mining areas and, with significantly lower relevance, the Helmstedt mining area. The Lusatian mining area saw the share of employment increase from 38.5 percent in 2002 to 44.6 percent in 2022. This puts the Rhenish and Lusatian mining areas on an equal footing in terms of relative employment weight in 2022. The share of the Central German mining area fluctuates between 10 and 12 percent during the same period (see Fig. 3-11).

The regional and macroeconomic importance of the lignite coal sector can also be classified, in regard to direct employment, on the basis of the share of employees subject to social security contributions and the total population (Table 3-5).[17] According to this, the lignite coal sector has the greatest significance for the Lusatian mining area in terms of direct employment. Accordingly, the share of people directly employed in the lignite coal sector as a proportion of the total labour force in this region in 2022 was still over 1.4 percent; in the Rhenish mining area, the share of the total labour force was 0.7 percent and in the Central German mining area it was a good 0.2 percent. What's more, the declining shares since 2002 are also related to the significant increase in the number of people in employment during this period. Looking at the share of people directly employed in the lignite coal sector as a percentage of the labour force for Germany as a whole, this figure totalled 0.04 percent in 2022. The employment rate, i.e. the share of lignite coal employees in the total population, also shows that the overall economic importance of the lignite coal sector is rather low, even in the lignite coal regions. The lignite coal-specific employment rate in the lignite coal regions varies on average between 0.7 (Lusatian mining area) and 0.1 percent (Central German mining area). For Germany as a whole, employees in this sector account for 0.02 percent of the total labour force. This shows a further decline in the sector's importance across all mining areas in recent years. It also indicates regionally different dynamics and takes place much faster in the Helmstedt and Rhenish mining areas than in Central German and especially in the Lusatian mining areas.

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[17]   For the calculations in this section, we use the demarcation of the coal mining areas according to the 2018 RWI report, however, with the Central German coal mining area extended to include the Altenburger Land region. All other definitions remain the same. The region of the Helmstedt coal mining area is made up of the counties of the city of Braunschweig, Helmstedt, Wolfenbüttel and the city of Wolfsburg. Under the InvKG, only the county of Helmstedt is an assisted area pursuant to sec. 11 et seqq.

Fig. 3-11: Employment shares of the lignite coal mining areas in Germany

Shares of lignite coal regions in direct employees in the lignite coal sector in percent (2002)

- Lusatian coal mining area
- Rhenish coal mining area
- Central German coal mining area
- Helmstedt coal mining area

Lignite

- Lusatian coal mining area
- Rhenish coal mining area
- Central German coal mining area
- Helmstedt coal mining area
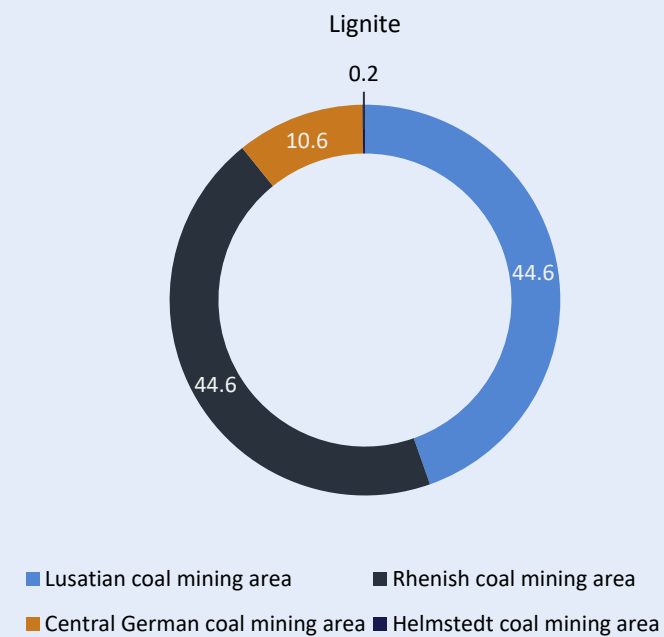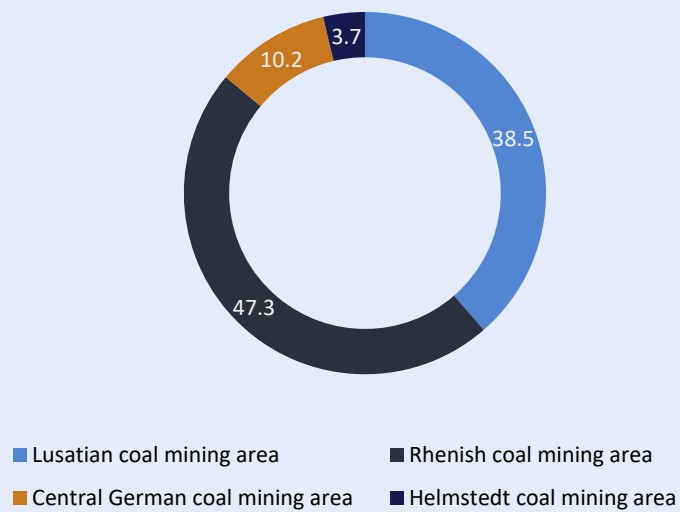
Sources: Own presentation according to data from Statistik der Kohlenwirtschaft (2023).

Table 3-5: Share of direct employees in the lignite coal sector in the total labour force and population, respectively, of the respective lignite coal regions

Coal mining areas	2002	2019	2020	2021	2022	2002-2019	2019-2022
	Share of employees in the lignite coal sector in the total labour force in %					Change in %	
Lusatian mining area	1.81	1.50	1.46	1.38	1.44	-0.31	-0.06
Rhenish mining area	1.24	0.83	0.81	0.73	0.66	-0.41	-0.17
Central German mining area	0.32	0.26	0.24	0.23	0.20	-0.06	-0.06
Helmstedt mining area	0.25	0.02	0.01	0.01	0.01	-0.23	-0.01
Germany	0.07	0.05	0.04	0.04	0.04	-0.02	-0.01
	Share of employees in the lignite coal sector in the total population in %					Change in %	
Lusatian mining area	0.77	0.71	0.68	0.65	0.67	-0.06	-0.04
Rhenish mining area	0.52	0.40	0.38	0.34	0.31	-0.12	-0.09
Central German mining area	0.14	0.13	0.12	0.11	0.10	-0.01	-0.03
Helmstedt mining area	0.12	0.01	0.01	0.01	0.00	-0.11	-0.01
Germany	0.03	0.02	0.02	0.02	0.02	-0.01	0

Source: Own calculations according to data from Statistik der Kohlenwirtschaft (2023), Federal Employment Agency (2023) and Federal Statistical Office (2023).

3.3 Special features of the early lignite phase-out in North Rhine-Westphalia

In order to secure the energy supply in Germany after the end of gas supplies from Russia, the federal government, the state of North Rhine-Westphalia and the power plant operator agreed not to shut down the power plant units on the north-south line at the Garzweiler opencast mine on December 31, 2022, as initially planned, but to continue operating them until March 31, 2024. In addition, there is an option for an extension until 31.03.2025. In order to comply with climate policy targets, it was also decided to shut down existing capacities at the Niederaußem and Neurath power plants as early as 31.03.2030 and not 31.12.2038 as originally planned. This new phase-out plan is set out in amendments to the Coal-fired Power Generation Termination Act and a public law agreement to reduce and end lignite-fired power generation.

The early termination of coal-fired power generation and the associated mining in the Rhenish mining area means that only half of the approved mining volume of 560 million tons will be exhausted by 2023. Even though the costs will change as a result of the early phase-out of coal-fired power generation, the contracting parties have agreed that no additional compensation payments will be made. Accordingly, compensation of EUR 2.6 billion is still planned. However, the payments have been adjusted to the new

timetable. The total amount will now be paid out in ten installments until 2030. Annual installments of EUR 173 million were agreed for the years 2020 to 2023. For the years 2024 to 2029, the installments will be increased to EUR 318 million.

The reduction in the amount of coal mined up to 2030 will also change the land requirements in the Garzweiler opencast mine. This eliminates the need to relocate some villages in this region. The areas and properties that remain must now be integrated into the region's revitalization plans. This also changes the plans for the restoration or renewal of the infrastructure. For example, highway 61 cannot be restored as initially planned. Corresponding alternatives for traffic routing must therefore be created.

In addition, according to the new plans, there will no longer be any direct employment or added value in coal-fired power generation in the Rheinisch mining area from 2030. By shortening the phase-out, it can be expected that the negative effects will be somewhat stronger than with the original phase-out path, e.g. because employees who would have retired under the original plans will now be unemployed. Accordingly, the indirect effects in other areas are also likely to be larger. For this reason, it will probably be necessary to adapt the labor market policy measures for the affected employees in opencast mining and power plants. For example, the planned retraining and qualification measures must be adapted to the new timetables.

3.4   Current scientific studies on structural change in the coal regions

Structural change in the (lignite) coal regions is the subject of a large number of scientific studies. The various aspects examined in these studies include, in particular, an analysis of the (economic) initial situation in the individual regions. In addition to the current importance of lignite mining for the respective region, the demographic development as well as the regional labor markets and production structures are considered. Some studies use model-based analyses to quantify the effects of phasing out lignite mining or the effects of structural support, particularly on economic output and employment. Based on the results of the analysis, the studies derive options for action for the further handling of structural change.

3.4.1   Economic importance of lignite and regional framework

Based on the study commissioned by the BMWi on the socio-economic conditions of the German lignite regions (RWI 2018), Dehio and Schmidt (2019) and Oei et al. (2019) show the sometimes very different conditions for structural change in the InvKG funding regions. These are the Lusatian, Central German and Rheinisch mining areas. The factors considered include the importance of lignite for regional employment, economic development and demographic change in the regions as well as their transport links and conditions for innovation through research and development. In terms of employment, lignite is more important in the Lusatian coalfield than in the other coalfields. Calculations using input-output analyses put the proportion of employment subject to social insurance contributions that is directly, indirectly or induced by the lignite sector at 3.3 percent in 2016 (2.0 percent directly). In the Rheinisch mining county, the share was 1.8 percent (1.2 percent) and in the Central German mining county 0.5 percent (0.3 percent). There are also some significant differences in other factors that are likely to be relevant for the upcoming structural change. For example, the counties in the Rheinisch mining county are more urban and central and have good transport links to the neighboring conurbations, while the

counties in Lusatia is rural and peripheral. It is also likely to be particularly affected by demographic change and will see a noticeable decline in the number of people of working age in the coming years. With regard to the expected capacity for innovation, indicators also show that the eastern German lignite regions are clearly lagging behind. Overall, the challenges posed by structural change are therefore likely to be particularly great here. Nevertheless, structural change should be accompanied by suitable regional economic policy measures in all mining areas.

Other studies contain a detailed inventory for individual regions. Berger et al. (2019), for example, provide a comprehensive analysis of the location potential for the Lusatia region. Among other things, it focuses on the differences between the sub-regions within the counties. Based on the indicators, previous studies and case studies on past experiences with structural change processes, the authors derive recommendations for action to develop the region's economic potential.

3.4.2 Expected effects of the coal phase-out and structural support

Various economic models are used in a number of studies to estimate the impact of the coal phase-out, particularly on the affected mining areas. However, the exit scenarios considered differ across the studies and often do not correspond to the current decision-making situation due to the dates of publication. Nevertheless, the studies highlight relevant mechanisms and allow conclusions to be drawn about the expected extent of structural change and starting points for dealing with it.

Oei et al. (2019, 2020) combine a model of the energy system with two economic models, an input-output model and a regional macroeconomic general equilibrium model, and examine the regional economic effects of the coal phase-out. The analysis of the input-output linkages shows further indirect losses in the area of suppliers of intermediate goods and the loss of income in addition to the direct losses of jobs and value added in the lignite sector. In the macroeconomic model, further losses also arise, for example through increased electricity prices. These are not limited to the lignite mining areas. As a policy implication, in addition to the need for direct labor market and social policy measures, reference is made to the potential for new employment that arises in the regions, for example in the course of the energy transition.

Heinisch et al. (2021) analyze the effects of various scenarios for the German coal phase-out using a dynamic general equilibrium model for Germany, which includes four regions, the three lignite mining regions and the rest of Germany. The phase-out leads to a temporary increase in unemployment in the coalfields and a reduction in the working population due to migration. In addition, average earned income will fall, with lower real wages also being linked to higher unemployment.

A report by the German Economic Institute (IW) on behalf of the German Lignite Association (DEBRIV) examines the importance of the lignite industry and the effects of an accelerated coal phase-out on employment and value creation in Germany and in the individual mining areas and discusses the challenges of the impending accelerated structural change and options for economic policy support (Bertenrath et al. 2018). As in other studies, the study focuses in particular on the economic strength, economic structure, existing human capital, infrastructure and research and development with regard to the preconditions in the regions. Options for action are discussed on this basis.

On behalf of the North Rhine-Westphalian Ministry of Economic Affairs (MWIDE NRW), a study by RWI (2021) calculates the direct and indirect effects on employment and value creation resulting from the premature coal phase-out for North Rhine-Westphalia. It also discusses the desired distribution of subsidies. With regard to their use, reference is made, among other things, to the promotion of research and development to achieve technical progress in the energy sector and the alternative use of the infrastructure of the lignite sector. Another study by RWI (2022) on behalf of MWIDE NRW estimates the expected employment effects at a small-scale level as a result of the coal phase-out in the Just Transition Fund funding area in the northern Ruhr region. The sub-region of the northern Ruhr area will be affected by an impending loss of jobs and apprenticeships in the coming years due to the decline and discontinuation of the refining and use of hard coal.

A study by IW Consult (2021), also for MWIDE NRW, examines the expected effects of structural funding on value creation and employment in the Rheinisch mining area. According to the study, the funds used will have a significant positive impact on employment. A distinction is made between the effects occurring in the investment phase and in the operating phase and possible additional spillover effects are taken into account. A scenario analysis shows what would result in a more dynamic or a more pessimistic scenario. The study refers in particular to the selection of projects as a decisive lever for realizing potential. It is also important to involve companies intensively, accelerate processes and exploit synergy effects.

3.4.3 Fields of action and instruments for promoting regional structural change

Based on the economic literature, Holtemöller and Schult (2019) describe investment as a key determinant of long-term economic performance. Of particular importance are private investment in physical capital, expenditure on research and development with the aim of technological progress, expenditure on education to increase human capital and investment in public capital stock, such as transport infrastructure. In the long term, education and research and development are seen as the most important drivers of growth, and the promotion of structural change should therefore focus primarily on these. In contrast, a focus on promoting investments in tangible assets or specific sectors and technologies is not considered to be promising in terms of long-term goals.

In a meta-analysis, Prognos (2018) evaluates studies on structural change in the lignite regions and identifies and evaluates the economic fields of action discussed in them for the individual regions. This includes the energy industry in all mining areas, where opportunities exist in the field of renewable energies. Energy research and energy storage are also likely to be relevant. In addition, the chemical industry and the logistics and mobility sector in particular are identified as important fields of action. Other fields of action include tourism. The identification of the fields of action is followed by a discussion of the instruments that can be used to promote structural change. These include, in particular, the provision of commercial areas and infrastructure, including the expansion of the broadband and electricity networks. The ability to innovate in the mining counties is largely determined by the universities and research institutions and the companies located in the counties. As in the RWI study (2018), the use of instruments to increase innovative capacity is recommended and the great importance of knowledge transfer is pointed out. Other recommended instruments include those to increase start-up activity, to secure employment and the availability of skilled workers through

(vocational) training and the attractiveness of the location, including through soft location factors and the safeguarding of services of general interest. The funding conditions and governance of structural change through suitable and strong institutions are also important.

Comprehensive studies are also available for other mining regions and individual areas. For example, a detailed analysis of the innovation potential and innovation transfer in the region was carried out for the Rheinisch mining county on behalf of the Zukunftsagentur Rheinisches Revier (2021). It takes stock of the innovation system and aims to identify strengths and weaknesses. The latter are seen in particular in the networking between the existing research institutions and the regional economy. The authors' recommendations for action include the promotion of selected fields of innovation as well as the use of specialization advantages and regional strengths in order to develop value creation potential. In particular, networking and cooperation between the players should be promoted.

3.4.4 Assessment of the accompanying measures

Against the backdrop of the initial planning and implementation of the funding measures, there are also initial assessments from an economic perspective. For Saxony, for example, Ragnitz (2021) is very critical of some of the funding regulations and, in particular, the selection of funded projects made up to that point. Although the latter could improve local living conditions in many cases, they could hardly increase regional growth potential. Markwardt et al. (2022), on the other hand, come to a more positive assessment based on an analysis of the allocation of funds in Lusatia in Brandenburg.

The study by Markwardt, Rettig, Schnellenbach, Titze and Zundel (2023) provides an interim assessment of Lusatia in Brandenburg two years after the start of the InvKG. The study argues that the region is on the right track. Based on job announcements, compensation for the "losses" caused by the coal phase-out can be expected. In addition, the regional energy producer is planning to develop renewable energy business areas, which will further relieve the pressure to compensate. The previous measures in the InvKG were primarily aimed at strengthening infrastructures in the area of research and development. Together with the expansion of business-related infrastructures, the conditions are therefore in place to create critical masses of high-quality business activities. Against the backdrop of very good employment prospects, the study sees the bottleneck as securing and attracting skilled workers and improving physical accessibility, for example by expanding rail-based transport infrastructures.

In a position paper on the lignite phase-out, Berkner et al. (2022) point out, among other things, problems in the interaction between the levels (federal, state and regional/municipal) with regard to the funding instruments and their implementation. On the one hand, there is a tendency to consider infrastructure measures that would have been carried out anyway as structural reinforcement. On the other hand, there is a trend for structural change funds at municipal level to be seen as an expansion of budgetary leeway and used for measures that are not related to the problem. It could also be that spending the funds as quickly as possible is not appropriate for the long-term nature of structural change.

4 Characterisation of the support measures

The funding measures under the InvKG are characterised by a number of special features that will be discussed in detail in this chapter.[18] These features have an important role to play for the evaluation in general, the development of an appropriate research design and the data required for this. Section 4.1 addresses the characteristics of infrastructures whose promotion is the focus of the InvKG. An essential characteristic of infrastructures is that their impacts can only be measured with a considerable time delay. This aspect is addressed in section 4.2. Infrastructures in the economic context of a production function are addressed in section 4.3. It is indispensable for the analysis of the effects of the InvKG to establish a theoretical connection between the measures and the production function. This aspect is discussed in section 4.4 while section 4.5 finally describes how the cluster concept can be applied to the facts contemplated in the InvKG.

4.1 Life cycle of infrastructures

The funding measures addressed in the InvKG are predominantly investments in infrastructure in the broadest sense. A special feature of infrastructures is that their provision and use are characterized by various market imperfections and are subject to extensive state regulation (see e.g. Fritsch 2018). The life cycle of infrastructures comprises four phases, which can cover different periods of time (see Fig. 4-1).

Fig. 4-1: Infrastructure life cycle

Decision on the infrastructure	Planning	Construction	Utilization
• Decision on the financing of the infrastructure • Application for subsidies	• Optimization of the use of resources • Public participation processes • Formal and effective incidence of financial flows	• Construction measures • Formal and effective incidence of financial flows • Interdependence of intermediate inputs	• Use of the infrastructures • Differentiation of beneficiaries from non-beneficiaries

Source: Own presentation.

During the *application* phase, decisions are made on issues relating to the financing of the infrastructure. Specifically, it is a question of which budget items are to be used to pay for the project. In the case of the InvKG, a very specific funding program is addressed.

The *planning phase* comprises all activities associated with the creation of building rights. From an economic point of view, it is about balancing out conflicts of use. Suitable commercial areas (land as a production factor) is not available in unlimited quantities. In addition, externalities arise from the use of land (for an overview, see Fritsch 2018). These are phenomena where third parties who are not directly related to certain economic activities are affected. The impact can be both positive (positive

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[18] Sections 4.1 and 4.3 in this chapter are based on Brachert, Giebler and Titze (2023).

external effect) and negative (negative external effect) in nature. A typical example from practice is noise and emissions from transport infrastructure. Against the background of this mixed situation, building law provides for extensive public participation processes. In a not insignificant number of cases, conflicts of use can only be resolved after lengthy legal disputes. Planning can be undertaken by the responsible authorities at federal, state or municipal level themselves, or private planning offices can be commissioned. The awarding of state contracts to private companies affects aspects of formal (where does the project take place?) and effective (where are the financial flows spent?) incidence. The final creation of building rights is the responsibility of the relevant authorities.

The *construction phase* essentially concerns building measures. Aspects of formal and effective incidence of the award of public contracts are of great importance in this phase, as the financial volumes spent during construction significantly exceed those of planning. Furthermore, in order to assess the effects of the construction phase, it is crucial - where feasible - to also collect information on the construction companies' upstream links in order to adequately address questions of effective incidence.

The *utilization phase* ultimately concerns the use and maintenance of the infrastructure. The most relevant aspect for the impact analysis here (in addition to the points mentioned in the previous section) is how reliably the group of direct beneficiaries (the "treatment group") can be distinguished from the group that does not benefit from the use of the infrastructure (the "control group"). The effect of a measure can only be credibly determined later on if both groups are precisely defined.[19]

4.2   Delays in measuring the effects

This section deals with the question of the extent to which reliable findings on the effects of InvKG measures can already be derived at this point in time. Four aspects need to be considered in this context, namely different points in time for the start and end of the measures, delays in the impact of the measures on the results themselves and delays in the provision of suitable statistical data for analyzing the results. Fig. 4-2 illustrates these aspects using three examples. *Measure 1* could, for example, be the expansion of an industrial estate as part of the promotion of Arm 1 measures. In this example, construction activities begin on 01.01.2022 and the measure is completed after three years. It will take a further two years to market the commercial area and construct the production facilities in this industrial estate. Assuming reporting delays in the official statistics for regional gross value added of a further two years, the first effects (if any) would not be detectable until 2029.

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[19]   To assess the suitability of certain methods for specific practical evaluations, an evaluation system based on a point scale has become established in international economic research. This point system of the so-called "Maryland Scientific Methods Scale" (Sherman, Gottfredson, MacKenzie, Eck, Reuter and Bushway 1998) ranges from 1 (simple correlations, no statements on causal effects possible) to 5 (randomized control studies, very reliable statements on causality possible). Madaleno and Waights (2016) have further developed this scoring system. According to this evaluation scheme, at least level 3 must be achieved in order to be able to credibly evaluate the effect of a program on the participating companies. One of the methods that allows causal interpretations of the results is the difference-in-differences design. This involves comparing the development of a target variable of the treatment group before and after the intervention with a control group. The difference in the target variable is then the effect of the intervention. In this way, for example, the development of a municipality from the InvKG support area could be compared with the development of a municipality outside the support area, whereby observed and unobserved variations in regional characteristics must be controlled for. Depending on the observation unit, e.g. counties, municipalities, businesses, labor force, inhabitants, certain methods and designs may be more suitable than others. Information on the control group should generally be obtained from secondary data.

Fig. 4-2: Schematic presentation of time delays in impact measurement
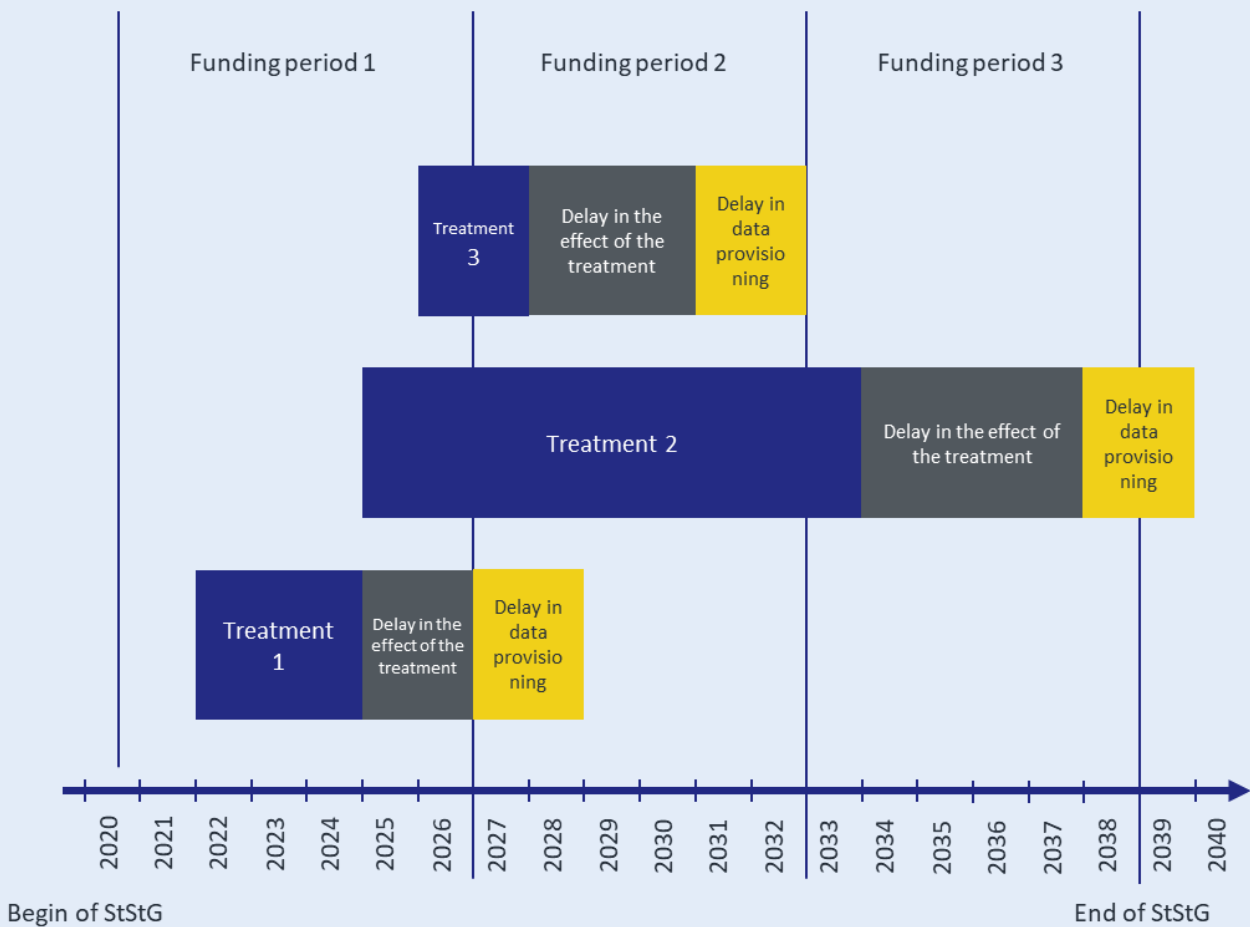
Source: Own presentation.

Measure 2 contains an example of an infrastructure project from Arm 2. In this case, the measure starts on 01.01.2025 and the realization of the project, including all planning and construction activities, takes ten years. Assuming a further four years for impact delays and two years until suitable data is available, impacts that go beyond the effects of the construction phase would not be demonstrable until 2040.

Finally, *measure 3* could relate to the establishment of a research institute as part of Arm 2 measures. After a start on 01.01.2026, staff recruitment will take a further two years. The evaluation cycles that non-university research institutes regularly have to undergo can be used to estimate the delay in impact. In these evaluation cycles, the institutes have to prove their scientific performance and their social significance. If this is not successful, public research funding ends. Evaluations usually take place every four to seven years. When it comes to the impact that the institutes have on the (supra)regional economy and society, additional delays in the provision of data may have to be taken into account. In this example, they amount to a further two years, so that the first comprehensive statements on the effects of measure 3 could be made in 2033. Given the great heterogeneity of the measures initiated in the InvKG, significant time delays are therefore to be expected when measuring the effects.

4.3 Theoretical considerations from the production function

The considerations from the previous sections make it clear that the life cycle of infrastructure can trigger both supply-side and demand-side effects (see Fig. 4-3).

Fig. 4-3: Infrastructure promotion from a supply-side and demand-side perspective
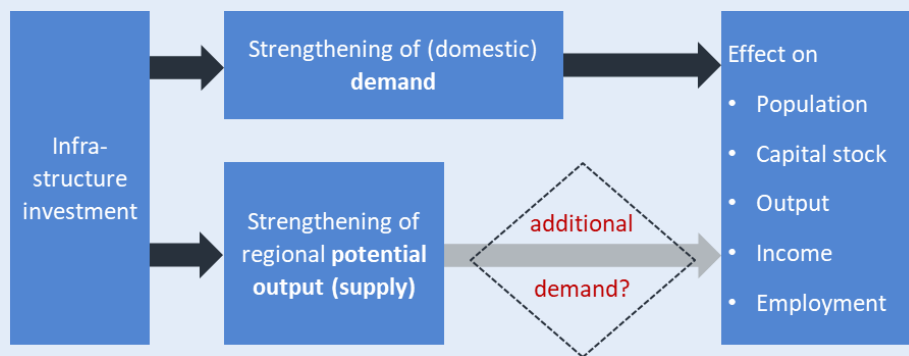
The demand side is particularly affected during the planning and construction phases of infrastructure. Here, mainly short to medium-term effects of the policy measure can be expected (depending on the type of infrastructure project). The associated cash flows generate additional (regional) employment and income. In addition, multiplier effects and upstream linkages of the measures must be taken into account. The extent to which the specific measures of the InvKG have a demand-side impact on economic policy targets in the InvKG funding regions themselves depends on the interplay between formal and effective incidence (see, for example, the discussions in Karl et al. 2012). For example, the planning and construction of infrastructure projects can be realized by companies from the region (or from the assisted area) or by actors from outside the region. Accordingly, the expeditures can also remain in the region or flow in part to other regions. Answering this question places very high demands on the data to be collected in the funding process.

For example, it must be known which companies have undertaken services and preliminary work for the planning and construction of the infrastructure and to what extent, as well as the cost structures of the companies concerned (investments, employment and payroll, preliminary work, etc.).

Once the infrastructures have been successfully built, their use also leads to a change in the possible effects on the supply side. A suitable starting point for analyzing the supply side is the concept of the production function. This concept is a standard approach in economic research to illustrate the relationships between the use of resources, i.e. production factors, and output (measured as gross value added, for example). Infrastructure measures are generally expected to enable the other factors of production (capital, labor, location) to better exploit their potential in the assisted regions - or, in other words, to increase the productivity of the factors of production (see Fig. 4-4).

Fig. 4-4: Influence of infrastructure support on regional potential output
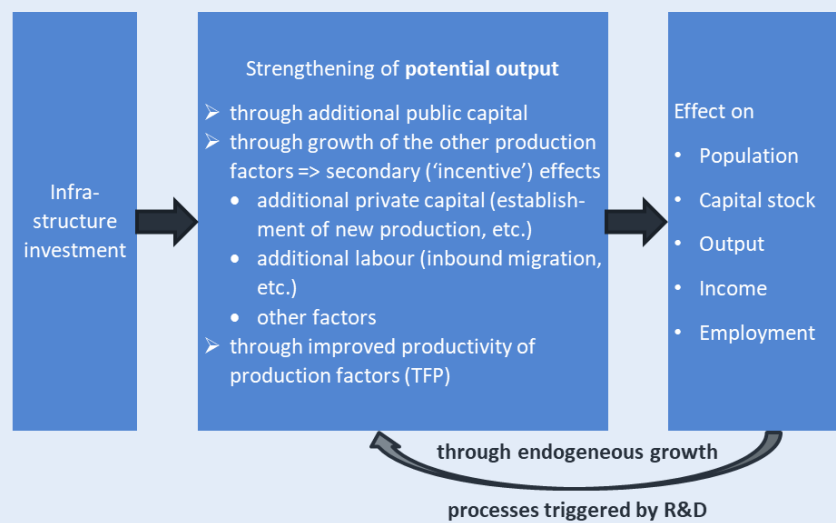
Source: Based on Bade et al. 2012, p. 32.

An important prerequisite for analyzing the effects is to assign the various bundles of measures of the InvKG to the possible production factors. If necessary, it may make sense to combine funding areas if they can be clearly assigned to a production factor. The following section deals with this idea.

4.4 Cluster concept

This section evaluates the measures under the InvKG in terms of the effects they can have on value creation and labor market targets in the counties. A systematic evaluation of the individual measures must be carried out against a suitable reference framework. The InvKG offers a whole bundle of different measures that address different economic objectives via different impact channels. Given the variety of measures, it is necessary to categorize or cluster the measures to reduce complexity. However, it should be noted that every categorization is accompanied by a loss of information. This results in a conflict of objectives between the level of detail and the interpretability of a category. If there are too few categories, there may no longer be any variance between the categories but too much variance within a category. If there are too many categories, the results can no longer be interpreted meaningfully due to the great heterogeneity. This conflict of objectives is addressed by creating a total of eight categories for clustering the measures provided for in the InvKG. These are then discussed in terms of their effects on the labor market and value creation.

The formation of the clusters is based on the work of Ragnitz (2021) and Markwardt et al. (2022), who carried out analyses of the state measures under Chapter 1 InvKG for Saxony and Brandenburg. The aforementioned studies were roughly based on the model of an economic production function. The study in this report goes one step further and uses categories that the relevant economic literature addresses as determinants of (regional) economic development. In addition to presenting the intervention logic for each cluster, empirical evidence for the associated effects is also included. This step also makes it possible to deal with possible (undesirable) side effects of individual measures of so-called spatially effective policies - which include the InvKG.

The discussion on the effects of clusters is based on the work of Neumark and Simpson (2015) and the What Works Centre for Local Economic Growth (WWCLEG) (2022). These two overview studies attach great importance to ensuring that only empirical evidence based on a credible identification of the effects of economic policy interventions with regional objectives is included in the evaluation. The aim is therefore not only to depict statistical correlations between the measures and economic policy objectives, but also to make statements on the causality for the achievement of an economic policy objective. A set of methodological instruments based on the model of the counterfactual is crucial for this. This involves the question of what would have happened if the intervention had not taken place. This model is methodically implemented by means of control group analyses, in which the development of a target variable of the supported study unit is compared with that of its statistical, non-supported "twin".

Against this background, the eight clusters of measures are now discussed. It should be noted that the literature discusses measures that are used worldwide but are only permitted to a very limited extent in the context of the InvKG, such as direct subsidies to companies. At the same time, the InvKG contains measures that have not yet received extensive attention in the relevant regional economic literature.

4.4.1 Cluster 1: Accessibility

This cluster includes all measures aimed at reducing transportation costs, i.e. primarily the development and expansion of road and rail infrastructure. If accessibility is understood in a broader sense, this also includes the grid-bound infrastructures for the supply of electricity, gas and water as well as communication systems. Neumark and Simpson (2015) and WWCLEG (2022) place these measures in the debate on positive externalities (in a spatial context, i.e. agglomeration benefits). Well-developed transport infrastructures improve the trade of goods and services as well as the mobility of labor and provide positive impulses for economic growth through the efficient allocation of production factors (see also Ahlfeldt and Feddersen 2018 and the literature cited there).

However, the empirical evidence on the effects of transport infrastructure on labor market outcomes is mixed (see WWCLEG 2022 for a detailed analysis). Some studies report positive effects of infrastructure investments on regional employment, while other studies find no effects. The empirical literature also points to asymmetric effects, which are reflected, for example, in an increase in demand for highly qualified employees in regions that already have concentrations in this employee group. With regard to the distribution of economic activities in the area, the evidence is also ambiguous. On the one hand, improvements in the transport infrastructure can lead to peripheral areas benefiting from this, for example through suburbanization. On the other hand, there may also be a shift from peripheral regions to the centers. There is also evidence in the literature of a positive effect of transport infrastructure on wages, income and company productivity. There are also indications of positive effects with regard to company entries, although it is not yet clear whether this forces existing companies out of the market. At a local level, it has also been shown that infrastructure investments can lead to an increase in local land prices.

In the context of accessibility (WWCLEG 2022), the state provision of broadband infrastructure has received particular attention in the empirical literature. Studies show an impact of communication infrastructure on firm productivity, number of firms and various labor market outcomes (employment,

wages and income). However, these effects are not always positive or necessarily noticeable. Whether the potential of broadband infrastructures can be leveraged depends on complementary activities at company level, such as company training and further education as well as company reorganization processes. In addition, large differences in the effects can be observed across different sectors and employment profiles. Service industries with a high share of highly qualified employees may benefit more from broadband infrastructures than manufacturing industries with a high share of low-skilled employees. There are also indications that the effects are higher in agglomerations than in rural regions.

4.4.2   Cluster 2: Education

This cluster ties in with human capital theory, according to which a well-educated workforce (in terms of school, university and vocational training) has higher labor productivity (Mincer 1962, Lucas 1988). Acemoglu et al. (2006) point out that the closer the economy moves towards the technological frontier, the more important highly qualified workers become for economic growth. The WWCLEG (2022) has compiled evidence for two types of interventions in this context, namely measures to promote training and measures to promote further training. With regard to the first category, evidence shows that in-company training increases individual skill levels and stimulates further education and training activities. In-company training can contribute to an increase in wages. People who take part in (subsidized) company-based training tend to have better employment opportunities after completing the measure and are less likely to become unemployed.

With regard to the second category, in-company training measures, there is evidence of a positive effect on employment and participants' incomes. Shorter programs are more effective for measures involving less formal training content. In contrast, longer programs are more effective for higher qualification requirements. In general, it can be seen that practical training measures are more effective. It is also beneficial if employers are involved in the training measure, as this allows training formats to be developed that are tailored to the workplace.

4.4.3   Cluster 3: Culture

This category is related to a discourse in economic literature that views cultural facilities as a location factor for households. This applies in particular to highly qualified employees who would benefit greatly from the consumption of culture. Highly qualified employees themselves in turn represent an important long-term factor in leading the region onto a new growth path (Krueger and Lindahl 2001; Falck et al. 2011).

The WWCLEG (2022) deals with the topic of culture in a broad sense and primarily examines the available (short-term) evidence on major cultural and sporting events. The overall impact of such events on the local economy is hardly demonstrable. Possible wage and income effects are generally small and limited to the immediate location of the major event or certain types of workers. There are also indications of an increase in local land prices, which could have distributional implications. An increase in international interdependencies due to increased exports and imports (goods and services, the latter primarily tourism) is likely, but may only be short-lived.

4.4.4 Cluster 4: Health

This cluster takes into account the fact that a healthy population has a positive impact on the regional labor force potential. Health impairments reduce the labor force potential, which in turn can have an inhibiting effect on regional economic development (Deaton 2003). This aspect has hardly been dealt with in the relevant regional economic literature to date, which is why no evidence on this aspect can be presented in this report.

4.4.5 Cluster 5: Business locations

The sites for businesses cluster is primarily concerned with the availability of locations at a very granular level. In particular, these are measures aimed at expanding, upgrading or revitalizing business locations, but also activities aimed at strengthening entrepreneurial skills. This categorization ties in with the discourse that location factors are subject to a spatial hierarchy. There are factors that can only be influenced at national level (e.g. legal system), others at regional level (e.g. state law) and others only at local level (e.g. trade tax rates, commercial space) (cf. Maier and Tödtling 2006).

Direct subsidies to companies are also considered an important location factor (Neumark and Simpson 2015; WWCLEG 2022). As these are - with a few exceptions - excluded by the InvKG, economic policy interventions are not considered in detail in this context. The situation is different in the JTF, where companies are explicitly included in the target group.

The InvKG and the STARK federal program include opportunities to provide advisory services for local businesses to improve their business model. The WWCLEG (2022) has compiled broad evidence for this type of intervention. The majority of the studies analyzed report positive effects of such initiatives on various business outcomes. The effects are slightly better for operational output (sales and turnover) than for the indicators employment and productivity.

4.4.6 Cluster 6: Research and development

This cluster ties in with the endogenous growth theory and the discussion on the economic impact patterns of regional state innovation and research funding. This refers in particular to the importance of education, research and development, innovation and technical progress for regional development (Romer 1990, for an overview of the literature see Weber 2010, for the state of knowledge on the impact patterns of research funding see Rothgang et al. 2021). Here too, interventions that directly subsidize companies are only feasible to a very limited extent within the framework of the InvKG, even if there is extensive evidence in this regard (Neumark and Simpson 2015; WWCLEG 2022). At best, direct funding of research and development activities at company level would be possible in the JTF, which is not the subject of this report.

However, Neumark and Simpson (2015) also compile a series of findings on the effects of universities and research institutions on regional development. The studies indicate that these institutions have positive spillover effects on productivity at the locations. However, these are locally limited and often only affect selected sectors. These include in particular those with a high technological fit with universities and those sectors that have a high share of university graduates. There are indications that

not only existing companies benefit from knowledge spillovers, but that the existence of universities and research institutions also favors the establishment of high-tech companies in the region.

4.4.7 Cluster 7: Climate (energy efficiency, emission reduction) and sustainability

This cluster is concerned with measures that serve environmental and climate protection in the broadest sense. The background to this category is that neglecting environmental and climate protection can lead to high location costs in the future, which - in extreme cases - make economic activities in certain areas impossible. There is not yet a sufficient amount of literature discussing this topic in a regional economic context. For this reason, this aspect cannot be described in more detail at the present time.

4.4.8 Cluster 8: Social capital

These are measures aimed at strengthening general trust in society, social cohesion and generally accepted norms. Ultimately, the aim is to reduce transaction costs, which should be reflected in gains in prosperity (see North 1990 and the discussion in Böhnisch and Schneider 2013). The empirical regional economic literature on this aspect is also limited to date. The WWCLEG (2022), for example, compiles evidence on the effects of urban revitalization programmes. This shows that revitalization measures have at best limited effects on reducing crime, improving health, well-being or education. In addition, the effects are locally limited. A limited effect is also evident with regard to other target variables, such as the improvement of income and employment. An increase in property prices was also observed.

4.4.9 Interim conclusion on expectations regarding labour market and value creation impacts

The measures provided for in the InvKG (including the STARK federal program) are highly heterogeneous and address different regional economic objectives via different impact channels. It is necessary to cluster the measures and thus reduce the complexity of the funding measures accordingly. All InvKG measures are assigned to at least one of the eight clusters. For the measures within the framework of the STARK federal program and in the state arm, the allocation is based on the funding categories or funding areas that were made directly by the approval authorities in the approval statistics. For the federal measures under Sections 14-22 InvKG, each individual measure was manually assigned to at least one of the clusters.

The relevant regional economic literature does not provide comprehensive evidence on the impact of the measures for all clusters. The study situation is best for the research and development, education, accessibility and culture clusters. Here there is clear evidence of positive effects of the measures on regional economic targets. However, side effects are also reported for these measures - for example on land prices - which may have distributional consequences. For the future evaluation, it must be taken into account that there may be complementarities between the individual clusters. In order to fully exploit the advantages of knowledge generation from activities in the field of research and innovation, for example, opportunities for exchange are needed to enable knowledge transfer at a personal level. This in turn requires sufficient accessibility to the locations. Similar constellations can also be found between other clusters. At this stage, we will leave it at a mere description of the clusters without going into the complementarities between them in more detail.

4.5 Application of the cluster concept to the facts contemplated in the InvKG

This section deals with how the cluster concept described above can be applied to the facts of the InvKG. In view of the fact that the InvKG was launched less than three years ago and the administrative funding processes have only just begun, the only way to categorize projects is to assign them to clusters manually. Empirical methods for group formation, such as a statistical cluster analysis, require extensive data on the characteristics of the projects (so-called cluster variables), which are not (yet) available at the present time.

As with any categorization, there can be no completely objective classification in the case of the clustering of InvKG measures. The result of the clusters in their current form is based on theoretical considerations based on economic literature and several expert discussions with the institutions involved in the implementation of the InvKG. Adjustments to this concept in the future cannot be ruled out and are possible at any time. The current approach is due to the fact that it is only possible to begin with an analysis of such a wide-ranging InvKG program. The following description is based on the structure of the InvKG.

Measures from the first pillar of the InvKG (Chapter 1) are assigned to the clusters on the basis of the funding areas already defined in the law in accordance with Section 4 (1) InvKG (see Table 4-1). In some cases, it is not possible to precisely assign a funding area to a cluster. These are then categorized via "weights" to at least one of the eight clusters. Funding area *7 - Infrastructure R&D, knowledge transfer, education and training*, for example, touches on aspects that affect both Cluster *2 - Education* and Cluster *6 - Research and development*. The funding area is then divided equally (with a weighting of 0.5) between the two clusters mentioned.

This approach is only suitable to a limited extent for the classification of measures in Pillar 2. The measures in sections 14, 16 and 17, for example, are so diverse that they can only be assigned to a cluster manually on the basis of the project descriptions provided. The establishment and expansion of federal authorities (Section 18 InvKG) is not classified. In accordance with the service contract, this is not the subject of the analyses in the reports to be prepared. The transport projects from §§ 20-22 are fully assigned to Cluster *1 - Accessibility*.

Table 4-1:	Application of the cluster categories to the funding areas according to sec. 4 (1) InvKG		
Number of the funding area according to sec. 4 (1) InvKG	Description	Cluster category	Weight
1	Business-related infrastructure	5 – Business locations	1.0
2	Transport infrastructure	1 – Accessibility	1.0
3	Infrastructure for services of general interest	2 – Education	1/3
3	Infrastructure for services of general interest	3 – Culture	1/3
3	Infrastructure for services of general interest	4 – Health	1/3
4	Urban planning, urban and regional development	5 – Business locations	1.0
5	Communication infrastructure	1 – Accessibility	1.0
6	Tourism infrastructure	5 – Business locations	1.0
7	Infrastructures for R&D, knowledge transfer, education and training	2 – Education	0.5
7	Infrastructures for R&D, knowledge transfer, education and training	6 – Research and development	0.5
8	Climate and environmental protection	5 – Business locations	0.5
8	Climate and environmental protection	7 – Climate (energy efficiency, emission reduction) and sustainability	0.5
9	Nature conservation	4 – Health	0.5
9	Nature conservation	7 – Climate (energy efficiency, emission reduction) and sustainability	0.5

Source: Own presentation.

For the clustering of projects that receive funding under STARK (Section 15 InvKG), the analysis uses a classification that is already contained in the legal regulations - as is already the case for the funding areas under Section 4 (1) InvKG. Specifically, a link is established between the funding categories from Annex 1 of the STARK Directive and the eight clusters. The classification is based on the descriptions in the aforementioned appendix. The funding categories are clearly assigned to at least one of the eight clusters (see Table 4-2). For this reason, the weighting of a funding category is always exactly one.

Table 4-2: Application of the cluster categories to the funding categories in the STARK guideline (sec. 15 InvKG)

Number of the funding category according to STARK guideline – Annex 1	Description	Cluster category	Weight
1	Networking	6 – Research and development	1.0
2	Knowledge and technology transfer	6 – Research and development	1.0
3	Consulting	8 – Social capital	1.0
4	Qualification/education and training	2 – Education	1.0
5	Sustainable adaptation of public services	6 – Research and development	1.0
6	Planning capacities and structural development organisations	5 – Business locations	1.0
7	Sense of community and common understanding of the future	8 – Social capital	1.0
8	Foreign trade	5 – Business locations	1.0
9	Scientific monitoring of the transformation process	6 – Research and development	1.0
10	Strengthening entrepreneurial action	5 – Business locations	1.0
11	Innovative approaches	6 – Research and development	1.0

Source: Own presentation.

5   Formal incidence of InvKG funds

In order to cushion the economic and social impact of the phase-out of coal-fired power generation, the Federal Government is providing the federal states with extensive financial aid, which is distributed among the federal states with lignite coal mining areas according to the distribution keys set out in the InvKG (see Table 5-1 below) and totals EUR 40bn (Chapters 1, 3 and 4 InvKG). In addition, the hard coal-fired power plant sites in the federal states of North Rhine-Westphalia, Mecklenburg-Western Pomerania, Saarland as well as the former Helmstedt mining area in the federal state of Lower Saxony and the Altenburger Land in the Free State of Thuringia receive total funding of slightly more than EUR 1bn under Chapter 2 (sec. 11 and 12 InvKG).

Table 5-1:   Distribution of the financial volumes[a] under the InvKG among the federal states (in billion euro unless otherwise stated) (as per 31 December 2022)

Federal state	Key for the distribution of funds in Chapters 1, 3 and 4 (in percent)	Responsibility of the federal states		Responsibility of the Federal Government Chapters 3 and 4	Total (Chapters 1 to 4)	JTF funds credited to the InvKG[b]	Total JTF funds
		Chapter 1	Chapter 2				
Brandenburg	25.8	3.612	-	6.708	10.320	0.668	0.786
North Rhine-Westphalia	37.0	5.180	0.662	9.620	15.462	0.580	0.683
Saxony	25.2	3.528	-	6.552	10.080[c]	0.548	0.645
Saxony-Anhalt	12.0	1.680	-	3.120	4.800[c]	0.309	0.364
Lower Saxony	-	-	0.247	-	0.247	-	-
Mecklenburg-Western Pomerania	-	-	0.053	-	0.053	-	-
Saarland	-	-	0.129	-	0.129	-	-
Total	100.0	14.000	1.090	26.000	41.090	2.106	2.478

Notes: [a] In addition to the volumes mentioned here, compensation payments for the operators of lignite coal-fired power plant sites in North Rhine-Westphalia (RWE Power AG EUR 2.6bn), Brandenburg and Saxony (LEAG, EUR 1.75bn) will flow into the regions affected by the coal phase-out (Coal-fired Power Generation Termination Act (KVBG, *Kohleverstromungsbeendigungsgesetz*) sec. 44). Furthermore, employees who are at least aged 58 years and leave the labour force receive for a maximum of five years an adjustment allowance as a bridging allowance until they receive statutory pension (section 57 KVBG). – [b] 85 percent of the JTF funds are credited towards the federal states' budgets. In the case of Brandenburg, funding is credited towards the budget in Chapter 1. In the case of the federal states of Saxony, Saxony-Anhalt and North Rhine-Westphalia, funding is credited towards the budgets in Chapters 3 and 4. – [c] The scope of the InvKG also includes the Altenburger Land in the Free State of Thuringia. Within the framework of Chapter 2 InvKG, this county receives financial assistance amounting to 90 million EUR, which is credited in equal shares towards the budgets of the federal states of Saxony and Saxony-Anhalt for the Central German mining area.

Source: IWH presentation.

The Just Transition Fund (JTF) programme is directly related to the objectives of the InvKG. The European Union provides additional financial resources from this fund for investment purposes to areas

facing severe socio-economic challenges due to the transition to a climate-neutral economy.[20] 85 percent of the planned JTF funds are credited towards Pillar-2 measures (Chapters 3 and 4 InvKG), with the federal state of Brandenburg being an exception where funding is credited towards Pillar 1 (Chapter 1 InvKG). The federal states' budgets for Pillar-2 or Pillar-1 funds are thus reduced by 85 percent of the funds to which the federal state is entitled from the JTF (regardless of the actual drawdown of funds). In contrast to the InvKG, which (apart from a few special individual cases) only permits assistance for business-related infrastructures, private companies are also explicitly included in the target group of the JTF.

5.1 Measures under the responsibility of the federal states (Pillar 1)

With the entry into force of the agreement between the Federal Government and the federal states on 27 August 2020, support for the regions affected by the phase-out of lignite coal mining and lignite coal-based power generation was able to begin through financial assistance from the Federal Government to the federal states. The subject of the following evaluation are measures under Chapter 1 InvKG, also referred to as 'Pillar 1'.[21] In order to analyse the status of implementation in the first funding period (2020-2026), two different types of information are taken into account that depict different phases of the administrative funding process. One is the ex-ante notification by the federal states to the Federal Office for Economic Affairs and Export Control (BAFA). The other is a special query by the federal states regarding the data status as per 31 December 2022 which is based on the federal states' reporting obligation pursuant to sec. 8 (3) InvKG. All federal states have implemented a project qualification procedure prior to formal approval. The intention of this approach is to select those projects from the pool of possible project ideas that are eligible and qualify for funding. BAFA is involved in the evaluation of eligibility. This also results in the ex-ante notification for the analysis. The ex-ante notification step attempts to exclude 'totally unsuitable projects' from funding in advance. The set of ex-ante notifications can be understood as a kind of 'pool' of projects. Not all of the projects registered here will in fact be approved. Some projects, for instance, are withdrawn or postponed. It is important to note, however, that no formal approval can be given without a prior ex-ante review by BAFA.

Table 5-2 shows that the federal states have so far registered 316 projects (column 1), backed by a funding volume of around EUR 5.8bn (column 2). The figures show that the total budget of the federal states for the first funding period is oversubscribed (column 3), which is mainly due to the federal states of Brandenburg and Saxony-Anhalt. The budget for the Free State of Saxony is almost exhausted. Major buffers still exist, especially for the federal state of North Rhine-Westphalia. With regard to the columns in the ex-ante notification section, however, it should be noted that not all of the notified projects are in fact approved. As already described, these project lists can be seen more as a kind of 'stockpile' out of which only certain projects will in fact be implemented. In other words, this means that the federal states

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[20] See Regulation (EU) 2021/1056 of the European Parliament and of the Council of 24 June 2021 establishing the Just Transition Fund, Official Journal of the European Union L 231/1, 30 June2021.

[21] The federal states are also responsible for measures under Chapter 2 InvKG. These are sites of hard coal-fired power plants (North Rhine-Westphalia, Mecklenburg-Western Pomerania, Saarland) as well as the former Helmstedt coal mining area (Lower Saxony) and the Altenburger Land (Thuringia), which are also affected by the phase-out of thermal coal utilisation. With a budget of just over EUR 1bn, the measures in Chapter 2 amount to a small fraction of what is available for the 'original' lignite coal regions. So far, only one project in this funding line is being implemented (Lower Saxony). A more in-depth presentation of these measures is therefore left to future reports.

of Brandenburg and Saxony-Anhalt have a substantial pool of projects from which to draw for further project qualification and approval, whereas the pool in North Rhine-Westphalia is rather small.

The second part of Table 5-2 (columns 4 to 8) addresses the question as to how many projects have been approved (and completed) by the federal states. The overall picture shows that the federal states approved slightly more than one third of the projects registered with BAFA (column 5). This means that almost 13 percent of the budget available in funding period 1 is firmly committed (columns 6 and 7). Here, too, there is a high variance among the federal states. Approvals are particularly advanced in the federal state of Saxony-Anhalt, followed by the federal states of Saxony and Brandenburg. The federal state of North Rhine-Westphalia has not yet approved any project.

The time of approval therefore represents an important point in the administrative funding process, as the grant recipients can draw down (federal) funds from this moment on. Columns 7 and 8 show the outflow of funds. These figures illustrate the extent to which funding actually generated momentum in approved projects. As Table 5-2 shows, this has only happened to a small extent. The outflow of funds for all federal states together totals around 47 million EUR. The rate of outflow of funds among approved projects amounts to around 7 percent.

Table 5-2: Previous use of funds for grants by mining area and federal state

Coal mining area	Budget for funding period 1 (2020-2026) in million euro	Ex-ante notifications to BAFA by 31 December 2022 with 'no objections' note			Reports by the federal states/as per 31 December 2022 with 'completed' or 'approved' status				
		Number Projects [a] (1)	Federal Government funds in million euro (2)	Budget utilisation in percent [c] (3)	Number Projects [a] (4)	Committed federal funds in million euro (5)	Budget utilisation in percent (6)	Outflow of funds in million euro (7)	Outflow of funds as a percentage of funds spent (8)
Lusatian mining area (BB)	1,419.0	70	1,934.7	136.3	21	163.5	11.5	22.0	13.5
Lusatian mining area (SN)	1,386.0	99.5	900.4	96.3	36.5	178.5	18.3	11.0	6.1
Central German mining area (SN)		43.5	434.4		16.5	74.8		8.8	11.8
Central German mining area (ST)	660.0	61	1,082.0	163.9	33	283.7	43.0	5.3	1.9
Rhenish mining area	2,035.0	41	1,395.3	68.6	0 [b]	0.0 [b]	0.0 [b]	0.0	0.0
Total	5,500.0	316	5,786.8	105.2	107	700.4	12.7	47.2	6.7

Notes: [a] Decimal places for the number of projects are due to the fact that a project takes place at several sites. In this specific case, the sites are located in different mining areas of Saxony. – [b] The government of the federal state of North-Rhine Westphalia has not yet approved any financial assistance projects in the federal state. – [c] Rates greater than 100 percent are explained by the fact that not all projects notified for ex-ante review are in fact implemented.

Source: Raw data: BMWK, BAFA, reports by the federal states. Own calculation.

This result suggests that – given the administrative processes explicitly demanded by the legislator as well as other circumstances, such as the Covid-19 pandemic – delayed impacts are to be expected (see also section 4.2).

Table 5-3 shows the distribution of funds from Pillar 1 among the counties in the assisted area, again differentiated according to ex-ante notifications to BAFA (columns 1 to 3) and approvals made to date by the authorities of the federal states (columns 4 to 7).

Table 5-3: Use of financial assistance so far by federal state (top 15 – data as per December 2022)							
		Ex-ante notifications to BAFA by 31 December 2022 with 'no objections' note			Reports by the federal states/as per 31 December 2022 with 'completed' or 'approved' status			
County	Coal mining area	Federal Government funds in million (1)	Share of total expenditure in percent (2)	Cumulative share in percent (3)	Federal Government funds in million (4)	Share of total expenditure in percent (5)	Cumulative share in percent (6)	Outflow of funds in million euro (7)
Cottbus	Lusatian mining area – BB	918.2	15.9	15.9	103.4	14.8	14.8	10.1
Spree-Neiße	Lusatian mining area – BB	552.2	9.5	25.4	35.3	5.0	19.8	6.4
Bautzen	Lusatian mining area – SN	541.6	9.4	34.8	66.4	9.5	29.3	0.8
Aachen urban region	Rhenish mining area – NW	464.5	8.0	42.8	-	-	29.3	-
Düren	Rhenish mining area – NW	416.9	7.2	50.0	-	-	29.3	-
Görlitz	Lusatian mining area – SN	353.9	6.1	56.1	111.7	15.9	45.2	9.4
Saalekreis	Central German mining area – ST	346.2	6.0	62.1	199.9	28.5	73.7	0.3
Oberspreewald-Lausitz	Lusatian mining area – BB	341.1	5.9	68.0	9.9	1.4	75.1	2.7
Halle (Saale)	Central German mining area – ST	295.4	5.1	73.1	14.1	2.0	77.1	0.0
Leipzig, City	Central German mining area – SN	226.0	3.9	77.0	6.4	0.9	78.0	1.7
Burgenlandkreis	Central German mining area – ST	165.7	2.9	79.9	22.0	3.1	81.1	4.9
Anhalt-Bitterfeld	Central German mining area – ST	160.0	2.8	82.6	27.5	3.9	85.0	0.1
Rhein-Erft-Kreis	Rhenish mining area – NW	137.6	2.4	85.0	-	-	85.0	-
Mönchengladbach	Rhenish mining area – NW	133.8	2.3	87.3	-	-	85.0	-
Leipzig, County	Central German mining area – SN	115.0	2.0	89.3	9.9	1.4	86.4	1.2
Other counties	All regions	618.3	10.8	100.0	93.7	13.5	100.0ᵃ	8.7
	Total	5,786.8ᵃ	100.0ᵃ	-	700.4ᵃ	100.0	-	47.2ᵃ

Notes: ᵃ Rounding differences in the range of decimal places.

Source: Raw data from BMWK, BAFA, reports by the federal states. Own calculation.

The table illustrates that (so far) funding is strongly focussed on only very few counties within the assisted area. Slightly more than three quarters of Pillar-1 funding is applied in ten counties, and a strong disparity can be seen even among the top ten. The budget pre-notifications made for the city of Cottbus (rank 1) as part of the ex-ante reporting process are around four times as high as those available for the city of Leipzig (rank 10). This evaluation also reveals that so far only a small part of the approved funds could actually be drawn down.

The 107 approved projects and the 316 projects from the 'pool' can now be allocated to the various funding areas and clusters of measures contemplated in sec. 4 (1) InvKG. In the following, the evaluation is carried out at federal state and mining area level. The approach follows a study by Markwardt et al. (2022). There are clear differences in the priorities of the federal states and mining areas, both in terms of the projects already approved and those in the "pool". According to Table 5-4, the analysis of the funding volume approved to date reveals a high variance in funding priorities between the federal states. In the states of Brandenburg, Saxony and North Rhine-Westphalia, funding area 8 (R&D infrastructures, knowledge transfer and education and training) stands out, in which a high percentage of federal funds have already been firmly committed through approvals in Pillar 1.

Even if the weighting may still shift to a certain extent when the projects from the project pool that have not yet been approved receive consideration, the focus in this funding area remains clearly visible. Priority in Saxony-Anhalt is given to projects from funding area 1 (business-related infrastructure). This federal state has the highest rate of approved or planned projects in this category compared to all the federal states. The federal state of Brandenburg follows some way behind. Funding area 2 (transport projects) is of great importance in the Saxon part of the Central German and the Rhenish mining area. In addition, projects from funding areas 3 and 4 (infrastructures for the provision of services of general interest as well as urban planning, urban and regional development) play a major role in the Free State of Saxony.

Table 5-4: Previous use of funds[a] for financial assistance by mining area and funding area (reports by the federal states as per 31 December 2022)

Federal state/mining area level			1 – Business-related infrastructure	2 – Transport infrastructure	3 – Infrastructure for services of general interest	4 – Urban planning, urban/regional development	5 – Communication infrastructure	6 – Tourism infrastructure	7 – Infrastructures for R&D, knowledge transfer, education and training	8 – Climate and environmental protection	9 – Nature conservation	Total [b]
BB (LR)	Approved/completed	Projects	33.3	14.3	23.8	4.8	0.0	4.8	19.0	0.0	0.0	100.0
		Volume	**27.2**	**31.3**	6.4	0.3	0.0	0.1	**34.8**	0.0	0.0	100.0
	Pool	Projects	34.3	8.6	22.9	2.9	2.9	12.9	11.4	4.3	0.0	100.0
		Volume	**39.1**	6.4	5.7	2.8	4.6	9.4	**26.8**	5.2	0.0	100.0
SN (LR)	Approved/completed	Projects	2.7	2.7	30.1	5.5	2.7	21.9	20.5	8.2	5.5	100.0
		Volume	1.9	18.6	13.5	2.2	0.5	13.5	**29.0**	14.0	6.9	100.0
	Pool	Projects	10.1	4.0	30.2	12.1	3.5	18.1	15.1	5.0	2.0	100.0
		Volume	7.9	7.7	12	**27.3**	3.1	8.7	**27.2**	5.0	1.2	100.0
SN (MR)	Approved/completed	Projects	0.0	6.1	24.2	18.2	0.0	18.2	21.2	12.1	0.0	100.0
		Volume	0.0	1.3	13.7	12.1	0.0	13.8	**50.7**	8.4	0.0	100.0
	Pool	Projects	11.5	9.2	29.9	13.8	1.1	16.1	11.5	4.6	2.3	100.0
		Volume	15.7	**22.7**	**20.6**	2.1	0.1	11.4	15.7	8.5	3.3	100.0
ST (MR)	Approved/completed	Projects	12.1	6.1	6.1	63.6	3.0	9.1	0.0	0.0	0.0	100.0
		Volume	**82.3**	2.3	6.3	7.6	0.0	1.5	0.0	0.0	0.0	100.0
	Pool	Projects	23.0	4.9	13.1	24.6	1.6	23	6.6	3.3	0.0	100.0
		Volume	**65.4**	0.6	5.6	4.8	0.0	7.7	15.5	0.3	0.0	100.0
NW (RR)	Approved/completed	Projects	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
		Volume	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	Pool	Projects	14.6	14.6	0.0	12.2	0.0	7.3	36.6	14.6	0.0	100.0
		Volume	13.6	**31.5**	0.0	3.0	0.0	2.2	**40.4**	9.2	0.0	100.0

Notes: [a] Particularly high values are highlighted in boldface. – [b] Due to rounding differences in the range of decimal places, the individual shares may not add up to precisely 100 percent.

Source: Raw data: BMWK, BAFA, reports by the federal states. Own calculation.

If the approved projects are classified according to the cluster model developed in the project for all measures funded through the InvKG (see Table 5-5 as well as Annex 2), it becomes apparent that all four mining states focus their funding measures on cluster category 5 (business locations).

Table 5-5: Previous use of funds[a] for financial assistance by mining area and cluster categories (reports by the federal states as per 31 December 2022)

Funding area according to sec. 4 (1) InvKG — Federal state/mining area level			1 – Accessibility	2 – Education	3 – Culture	4 – Health	5 – Business locations	6 – Research and development	7 – Climate and sustainability	8 – Social capital	Total [b]
BB (LR)	Approved/completed	Projects	14.3	17.5	7.9	7.9	42.9	9.5	0.0	0.0	100.0
		Volume	**31.3**	**19.5**	2.1	2.1	**27.5**	**17.4**	0.0	0.0	100.0
	Pool	Projects	11.4	13.3	7.6	7.6	52.1	5.7	2.1	0.0	100.0
		Volume	11.0	**15.3**	1.9	1.9	**53.9**	**13.4**	2.6	0.0	100.0
SN (LR)	Approved/completed	Projects	5.5	20.3	10.0	12.8	34.2	10.3	6.8	0.0	100.0
		Volume	19.0	**19.0**	4.5	7.9	**24.6**	**14.5**	10.4	0.0	100.0
	Pool	Projects	7.5	17.6	10.1	11.1	42.7	7.5	3.5	0.0	100.0
		Volume	10.8	**17.6**	4.0	4.6	**46.4**	**13.6**	3.1	0.0	100.0
SN (MR)	Approved/completed	Projects	6.1	18.7	8.1	8.1	42.4	10.6	6.1	0.0	100.0
		Volume	1.3	**29.9**	4.6	4.6	**30.1**	**25.3**	4.2	0.0	100.0
	Pool	Projects	10.3	15.7	10.0	11.1	43.7	5.7	3.4	0.0	100.0
		Volume	**22.8**	**14.7**	6.9	8.5	**33.4**	7.8	5.9	0.0	100.0
ST (MR)	Approved/completed	Projects	9.1	2.0	2.0	2.0	84.8	0.0	0.0	0.0	100.0
		Volume	2.3	2.1	2.1	2.1	**91.4**	0.0	0.0	0.0	100.0
	Pool	Projects	6.6	7.7	4.4	4.4	72.1	3.3	1.6	0.0	100.0
		Volume	0.6	9.6	1.9	1.9	**78.0**	7.8	0.1	0.0	100.0
NW (RR)	Approved/completed	Projects	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
		Volume	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	Pool	Projects	14.6	18.3	0.0	0.0	41.5	18.3	7.3	0.0	100.0
		Volume	**31.5**	**20.2**	0.0	0.0	**23.4**	**20.2**	4.6	0.0	100.0

Notes: [a] Particularly high values are highlighted in boldface. – [b] Due to rounding differences in the range of decimal places, the individual shares do not add up to precisely 100 percent.

Source: Raw data: BMWK. Own calculation.

The focus shifts when the analysis is expanded to include all projects contained in the project pool, i.e., increasing in Brandenburg and Saxony and decreasing somewhat in Saxony-Anhalt. All in all, the focus on the 'business locations' cluster category is most pronounced in Saxony-Anhalt. The federal states of Brandenburg, Saxony and North Rhine-Westphalia also focus their funding measures on cluster categories 2 and 6 (education as well as research and development). The share of funding in these two cluster categories is comparatively low in Saxony-Anhalt. Finally, projects in cluster category 1 (accessibility) play a major role in the federal states of Brandenburg and North Rhine-Westphalia as well as in the Saxon part of the Central German mining area.

5.2   Measures under the responsibility of the Federal Government (Pillar 2)

The following analyses evaluate the approval statistics of those measures for which the Federal Government is responsible. The analyses follow a standardized scheme. They begin with a presentation of the aggregated figures and are then differentiated at geographical level (federal state-mining area and county level) and content level (structure according to the law and the cluster model). A fully comprehensive evaluation of the measures in a temporal dimension is not possible with the data currently available. However, aggregate outflows of funds (actual outflows) up to 31 December 2022 are shown.

Under the responsibility of the Federal Government, 68 measures have so far been adopted by the Coordination Body of the Federal Government and the Federal-State Governments (BLKG) in accordance with sec. 14 to 17 InvKG (including the Immediate Action Programme of the Federal Ministry of Finance (BMF)) with a planned expenditure volume of EUR 12.4bn (until the end of the term of the respective measures) (as per 22 December 2022). Table 5-6 shows the distribution of funds among the mining areas by federal state. Added to this in this presentation are the projects according to sec. 18 InvKG which are designed to create new jobs in the lignite coal regions by establishing federal authorities. Measures with an application volume of EUR 433m have been approved here up to now. It should be noted, however, that various authorities (for instance, departmental research institutions of individual federal ministries or downstream authorities such as the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) in Cottbus) are also funded from funds under sec. 17 InvKG.[22]

Table 5-6:   Funds budgeted so far by mining area (as per 22 December 2022)

Coal mining area	Total budget (million euro)	Total of all projects (in million euro) according to				Total (million euro)	Budget utilisation (in percent)
		sec. 14-17	TP	sec. 18	PC and SF		
Lusatian mining area (BB)	6,708	2,318	1,085	239	90	3,733	55.6
Lusatian mining area (SN)	4,472	2,406 ᵃ	1,468	193	70	4,137	92.5
Central German mining area (SN)	2,080	1,480 ᵃ	536	0	44	2,060	99.0
Central German mining area (ST)	3,120	1,654 ᵃ	913	0	56	2,622	84.0
Rhenish mining area (NRW)	9,620	4,507 ᵃ	2,314	0	150	6,971	72.5
Coal mining areas total	26,000	12,363	6,316	433	410	19,522	75.1

Notes: TP = Transport projects, PC = Process costs, SF = Immediate Action Programme. – ᵃ These values also include the funds credited to the InvKG, which the federal states have at their own disposal within the framework of the JTF.

Sources: Raw data: BMWK. Own calculation.

Furthermore, Table 5-7 shows the transport infrastructure projects according to Chapter 4, Annex 4 and 5 of the InvKG. The BLKG has so far approved 30 projects for this funding category (25 rail construction projects, four projects on federal roads and one project on federal motorways) with a total

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volume of EUR 6.3bn. The overall view on these measures also allows insights into the budget utilisation achieved so far (ratio of the sum of funds planned so far to the total budget of the mining area) by mining areas and federal states. This is where the mining areas in Saxony and Saxony-Anhalt reach their budget limits. In the Brandenburg part of the Lusatian mining area and in the Rhenish mining area, on the other hand, there is still scope for the allocation of further funds, which are, however, already subject to specific implementation plans (for instance, the Innovation Center University Medicine Cottbus (IUC) and the Lausitz Science Park (LSP) in the Brandenburg part of the Lusatian mining area). The administrative costs for the implementation of the federal measures (for instance, personnel costs for the implementation of the StStG) currently amount to around 1.25 percent of total expenditure (EUR 244m). The Federal Ministry for Digital and Transport (BMDV) (81 percent) and the Federal Ministry for Economic Affairs and Climate Action (BMWK) (19 percent) account for most of the expenditure.

Table 5-7 allows insights into the relative weight of transport infrastructure projects in each mining area. These absorb 24.3 percent of the budgeted funds across all mining areas. With regard to the implementation status so far, certain differences exist between the different mining areas. In the Brandenburg part of Lusatia, the share of funds for transport projects is comparatively low at 16.2 percent. In contrast, this type of project is relatively important in the Saxon part of the Lusatian mining area and the assisted areas in Saxony-Anhalt. The Rhenish mining area and the Saxon part of the Central German mining area are characterised by funding shares for transport projects of around 25 percent of total funds. Furthermore, the shares of funds budgeted according to different modes of transport show a clear focus of transport infrastructure projects on rail transport. Only Saxony-Anhalt sets certain priorities here for investments in federal trunk. In the Saxon part of the Central German mining area, the completion of federal motorway 72 is particularly relevant.

Table 5-7:   Funds budgeted so far in transport projects (TP) by mining area (as per 22 December 2022)

Coal mining area	Total amount of budgeted funds for TP (in million euro)	TP share in total budget (in percent)	Share by transport mode (in percent)		
			Rail	Motorway	Federal roads
Lusatian mining area (BB)	1,085	16.2	94.6	0.0	5.4
Lusatian mining area (SN)	1,468	32.8	95.8	0.0	4.2
Central German mining area (SN)	536	25.8	65.9	34.1	0.0
Central German mining area (ST)	913	29.3	68.9	0.0	31.1
Rhenish mining area	2,314	24.1	100	0.0	0.0
Coal mining areas total	6,316	24.3	90.7	2.9	6.4

Notes: TP = transport projects

Sources: Raw data: BMWK. Own calculation.

Most of the transport projects (80 percent) come from Annex 4 of the InvKG. It is important to note here that the transport and economic benefits of the projects are assumed to be given for reasons of structural support. The determination of need is binding for planning approval for these projects. This implies that ex-ante positive benefit-cost ratios do not necessarily have to be present in the assessment of transport projects as a basis for their realisation. It must hence be examined whether economically sustainable operation or use of the infrastructures created will be possible in the medium term.

Table 5-8 classifies the funds budgeted so far according to the cluster model. In addition to the eight cluster areas, another four categories are introduced. Besides the above-mentioned process costs (in particular, personnel costs for the implementation of the StStG), these include the Immediate Action Programme[23] of the Federal Ministry of Finance (BMF) in connection with the federal STARK programme, which will be evaluated separately below. Furthermore, the categories for the Just Transition Fund (JTF)[24] and the establishment of public authorities can also be found here. These are characterised by special funding objects and are therefore not part of the classified measures in the cluster model. As already described in the introduction to Chapter 5, the JTF is a stand-alone programme under which the EU provides additional financial resources to regions facing particular challenges in the climate-neutral transformation of the economy and society. 85 percent of the funds allocated to the federal states under the JTF are credited towards the federal states' budgets under the InvKG. The JTF is subject to its specific funding regime outside the InvKG. The federal states are responsible for selecting eligible projects.

The classification of the measures shows that priorities are different in the mining areas. In the Lusatian mining area (Brandenburg), for instance, measures in the research and development and education clusters absorb around 42 percent of funds. Relevant fields of expenditure are also found in the accessibility cluster and the federal STARK programme. The situation in the Saxon part of the Lusatian mining area is similar to that in Brandenburg although the measures there focus on the areas of research and development and accessibility. In addition, there are the JTF measures, which, unlike in Brandenburg, are credited in this area. In the Saxon part of the Central German mining area, the absolute majority of the budgeted funds can be allocated to the research and development cluster. This means that the region has the highest share of funds in this cluster compared to the other mining areas. In the Saxony-Anhalt part of the Central German mining area, on the other hand, the clusters of the accessibility measures and the sum of research, development and education are almost on par. Relevant budgeted funds are also found in areas of the federal STARK programme and the JTF. The budgeted funds in the Rhenish mining area are similar to those in the Saxony-Anhalt regions. In this case, however, there is an additional clear accentuation of funds in the area of the federal STARK programme.

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[23] The Immediate Action Programme – like the federal STARK programme – is a separate funding line within the InvKG. The first immediate actions for structural support in the coal regions began in 2018, some of which are still continued in the InvKG.

[24] The same applies to the JTF as to the Immediate Action Programme. This is a separate funding line within the InvKG regulations. At this point in time, it is not possible to make any concrete statements regarding the categories to which the projects in the JTF belong. According to the available documents, there was no outflow of funds in the JTF until 31 December 2022.

Cluster	Lusatian mining area (BB)	Lusatian mining area (SN)	Central German mining area (SN)	Central German mining area (ST)	Rhenish mining area
1 – Accessibility	29.1	35.5	26.0	34.8	34.2
2 – Education	15.6	0.1	0.1	4.8	0.1
3 – Culture	2.7	2.4	1.3	5.0	1.8
4 – Health	0.0	0.0	0.0	0.0	0.0
5 – Business locations	3.5	0.1	0.1	0.1	0.1
6 – Research and development	26.1	38.6	54.5	29.4	29.8
7 – Climate and sustainability	1.6	0.4	0.4	1.1	1.2
8 – Social capital	0.0	0.0	0.0	0.0	0.0
Further measures by the Federal Government					
9 – Process costs	1.2	1.3	1.1	1.4	1.2
10 – Immediate Action Programme and STARK	13.8	8.0	8.1	11.6	23.2
11 – Establishment of public authorities	6.4	4.7	0.0	0.0	0.0
12 – JTF	0.0	9.0	8.4	11.8	8.3
Total	100	100	100	100	100

Table 5-8: Funds budgeted so far (in percent) by mining area and cluster (as per 22 December 2022)

Source: Raw data: BMWK. Own calculation.

The measures also differ in terms of spatial incidence within the mining areas. In the case of measures such as the placement of public authorities or research institutions, for instance, localised employment effects can initially be expected at the location of the institutions. The same applies to infrastructure projects, which, depending on their type, will have different regional impacts within the mining areas depending on the routes. Other measures, in contrast, do not have an explicit geographical focus and are open to all eligible stakeholders in the mining areas. Examples include the federal STARK programme, the coal area-specific increases under the 7th energy research programme of the BMWK or the funding programme of the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) 'Municipal Model Projects for the Implementation of Ecological Sustainability Goals in Structural Change Regions' (KoMoNa). In order to map a formal regional incidence of funds, the next step is to characterise the projects in terms of their expected impact in space.

The analysis starts with the 30 transport projects that have so far been approved by the BLKG. The underlying planned routes permit a regionalisation of the funds at a small-scale level.[25] The transport projects serve to strengthen the public capital stock in the assisted areas and are designed to improve

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[25]   For this purpose, GIS methods are used to determine the physical distance of a railway or road section located in a regional territorial unit and then its share in the total line. This share is used to distribute the total cost of the project evenly over each line kilometre. This approach is based on the strict assumption that each line kilometre is equally expensive. In reality, this will not be the case, but this approach gives a rough approximation of the actual InvKG funds flowing into a region. For lines where no physical distance could be determined, the costs are shared equally between the municipalities concerned.

the accessibility of the regions. The vast majority of counties (20 out of 22) in the assisted areas benefit from the transport projects. For instance, at least one transport project can be found in all counties of the Lusatian (Brandenburg and Saxony) and the Central German (Saxony and Saxony-Anhalt) mining areas. In the Rhenish mining area, only the counties of Heinsberg and Euskirchen are not yet subject to funding. In addition, 12 counties directly bordering to the mining areas also benefit to a small extent from the funding provided under the InvKG. The sites of the hard coal-fired power plants, the former lignite coal mining area of Helmstedt and the Altenburg region have not yet been directly affected by the transport projects.

The regional funding intensity at county level for the transport projects can now be determined with the help of the distribution of the planned funds per transport project to the line kilometres of the counties directly benefiting from it. Table 5-9 allows insights into the TOP-15 counties, which are assumed to benefit most from the funding. It must be considered that these funds will be drawn down over a longer period of time and that the regional impacts of the provision of infrastructures will only be felt after the roads and railways have been built. At the current planning stage, the county of Görlitz (Lusatian mining area - Saxony) will particularly benefit from the three transport projects which are carried out in this county. Larger investments can also be found in the Burgenlandkreis (Central German mining area of Saxony-Anhalt, five transport projects), the Spree-Neiße county (Lusatian mining area Brandenburg, five transport projects) as well as the urban region of Aachen and the Rhein-Erft-Kreis in the Rhenish mining area (two and four transport projects, respectively). The top counties together account for more than 90 percent of the earmarked funds.

Chapter 3 of the InvKG contains further federal measures that can be applied in the assisted areas pursuant to sec. 2 InvKG. These are divided into the following areas:

- Promotion of science, research, teaching and education in the assisted areas,

- Federal funding programme for model regions with greenhouse gas-neutral, resource-efficient and sustainable development,

- Measures to support the energy transition and climate protection,

- Expansion and establishment of federal programmes and initiatives to promote the areas under sec. 2 and

- Establishment of Federal Government facilities in the mining areas.

County name	Coal mining area	Total budgeted funds in million euro in total	Share of total expenditure on transport projects	Cumulative share
Görlitz	Lusatian mining area – SN	1,200	19.0	19.0
Burgenlandkreis	Central German mining area – ST	585	9.3	28.3
Spree-Neiße	Lusatian mining area – BB	564	8.9	37.2
Aachen urban region	Rhenish mining area – NRW	555	8.8	46.0
Rhein-Erft-Kreis	Rhenish mining area – NRW	552	8.7	54.7
Rhein-Kreis Neuss	Rhenish mining area – NRW	438	6.9	61.7
Düren	Rhenish mining area – NRW	393	6.2	67.9
Leipzig, County	Central German mining area – SN	310	4.9	72.8
Cottbus	Lusatian mining area – BB	226	3.6	76.4
Oberspreewald-Lausitz	Lusatian mining area – BB	186	2.9	79.3
Saalekreis	Central German mining area – ST	186	2.9	82.3
Leipzig, City	Central German mining area – SN	182	2.9	85.1
Düsseldorf	Rhenish mining area – NRW	176	2.8	87.9
Köln (Cologne)	Rhenish mining area – NRW	158	2.5	90.4
Bautzen	Lusatian mining area – SN	155	2.4	92.9
Other counties	All regions	451	7.1	100
	Total	6,316	100	100

Notes: TP = transport projects. The distribution of the total funds per transport project was carried out by proportionally allocating the costs of the measures to the line kilometres per infrastructure type and county. The distribution of the costs of the measures among the counties and federal states may deviate from this.

Sources: Raw data: BMWK. Own calculation.

Here, too, a regionalization of the funding or funding projects can be carried out for each individual area. Such regionalisation is shown in the following tables for the respective sec. 15 to 18 InvKG. We start with sec. 16 InvKG and the measures it contains to support the energy transition and climate protection. Funding projects in this area include, in particular, the establishment of various DLR institutes, the establishment of regulatory sandboxes for the energy transition and the creation of a centre of excellence for the heat transition in the assisted areas. Table 5-10 shows that seven counties in the assisted areas particularly benefit from these measures.

County name	Coal mining area	Total budgeted funds in million euro in total	Share of total expenditure on sec. 16 InvKG projects	Cumulative share
Cottbus	Lusatian mining area – BB	366	30.4	30.4
Aachen urban region	Rhenish mining area – NRW	244	20.3	50.7
Düren	Rhenish mining area – NRW	244	20.3	70.9
Halle (Saale)	Central German mining area – ST	132	11.0	81.9
Salzlandkreis	Central German mining area – ST	122	10.1	92.0
Saalekreis	Central German mining area – ST	68	5.6	97.6
Spree-Neiße	Lusatian mining area – BB	29	2.4	100
	Total	1,205	100	100

Table 5-10:   Funds budgeted so far in projects under sec. 16 InvKG – Measures to support the energy transition and climate protection by county (as per 22 December 2022)

Sources: Raw data: BMWK. Own calculation.

Measured in terms of the funds planned for the projects, the city of Cottbus, the city region of Aachen, the county of Düren as well as Halle (Saale) and the Salzlandkreis benefit from fund flows of more than 100 million EUR during the project terms. In total, funds of EUR 1.205bn have been planned in this area.

Projects under sec. 17 InvKG are designed to expand and establish federal programmes and initiatives to promote the areas under sec. 2 InvKG. The projects in this area can be differentiated in that they have a direct spatial impact (for instance, construction of a new technical centre at the German Biomass Research Centre in Leipzig) or are open to various stakeholders in the assisted area who have not been defined ex ante within the framework of an application procedure (for instance, via the JTF). Table 5-11 then provides insights into the geographical structure of the projects under sec. 17 InvKG.

With regard to the spatial incidence of the InvKG funds, two types of measures can be distinguished. The first category includes measures that can already be specifically allocated to a specific place at the planning stage. These include, in particular, the construction of new and the expansion of existing (transport) infrastructures, the location of which is essentially determined ex ante. The second category considers measures that are open to all stakeholders in the assisted area and whose geographical distribution is determined by the application pattern. Here, the regional allocation of funding here depends on the absorptive capacities of the regional units.

The evaluations show that EUR 2.7bn (or 31.6 percent) of the planned funds have no primary spatial focus in the assisted areas (category two). A significant part of these funds is earmarked for the JTF, which ties up around EUR 1.4bn. For the remaining funds, the impact of the projects can be expected to be directly focussed at the respective locations. Table 5-11 shows this geographical focus. The counties of Düren and Görlitz, the city of Cottbus, the counties of Nordsachsen and Bautzen as well as the Saalekreis benefit from the projects in particular. Here, the planned volume of funds amounts to between EUR 0.4bn and EUR 1.2bn by the end of the project term. The seven counties with the highest budgeted funds account for around 95 percent of the funds.

Table 5-11: Funds budgeted so far in projects under sec. 17 InvKG – Expansion and establishment of federal programmes and initiatives to promote the areas by county (as per 22 December 2022)

County name	Coal mining area	Total budgeted funds in million euro in total	Share of total expenditure on sec. 17 InvKG projects	Cumulative share
Düren	Rhenish mining area – NRW	1,170	20.3	20.3
Cottbus	Lusatian mining area – BB	1,127	19.6	39.9
Görlitz	Lusatian mining area – SN	903	15.7	55.5
Nordsachsen	Central German mining area – SN	886	15.4	70.9
Bautzen	Lusatian mining area – SN	638	11.1	82.0
Saalekreis	Central German mining area – ST	380	6.6	88.6
Leipzig, City	Central German mining area – SN	217	3.8	92.3
Aachen urban region	Rhenish mining area – NRW	139	2.4	94.7
Halle (Saale)	Central German mining area – ST	125	2.2	96.9
Spree-Neiße	Lusatian mining area – BB	80	1.4	98.3
Rhein-Erft-Kreis	Rhenish mining area – NRW	25	0.4	98.7
Euskirchen	Rhenish mining area – NRW	21	0.4	99.1
Oberspreewald-Lausitz	Lusatian mining area – BB	18	0.3	99.4
Heinsberg	Rhenish mining area – NRW	13	0.2	99.6
Rhein-Kreis Neuss	Rhenish mining area – NRW	7	0.1	99.8
Other counties	All regions	14	0.2	100
	Total	5,763	100	100
Ex-ante spatial allocation not possible	Total	2,662	100	100
Total sec. 17 InvKG projects	Total	8,425	100	100

Sources: Raw data: BMWK. Own calculation.

Sec. 18 InvKG also deals with the establishment of federal institutions in the mining areas. Accordingly, the Federal Government has committed itself under the Coal Regions Investment Act to establish at least 5,000 additional jobs at Federal Government agencies and other federal institutions in the assisted areas according to sec. 2 InvKG by 31 December 2028.[26] The following facilities are funded under the InvKG:

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[26] In its report on the implementation status of the Coal Regions Investment Act (InvKG) pursuant to its sec. 26 (2) to (4), the Federal Government fleshed this out in a statement at the end of 2022 (Bundesrat printed paper (*Drucksache*) 586/22, 3 Nov. 22, Berlin, p. 7): "In addition to the planned jobs resulting from the decisions of the BLKG and financed from InvKG funds, the Federal Government's plans also include jobs at public authorities and other federal institutions pursuant to sec. 18 InvKG, which the departments finance from their own budgets."

- Establishment of the BAFA branch office in Weißwasser,

- Expansion of the Federal Network Agency branch office in Cottbus,

- Competence Centre for Electromagnetic Fields and the

- Permanent establishment of a 'Centre for Artificial Intelligence in Public Health Research (ZKI)* at the Robert Koch Institute.

The establishment decisions come along with a specific location decision. Three counties in the assisted areas according to sec. 2 InvKG primarily benefit from these settlements. 45 percent of the budgeted funds will be primary spent in the county of Görlitz. The other beneficiary counties are also located in the Lusatian mining area. The city of Cottbus and the county of Dahme-Spreewald were selected as locations for the establishment or expansion of public authorities.

Table 5-12: Funds budgeted so far in projects pursuant to sec. 18 InvKG – Establishment of public authorities by county (as per 22 December 2022)

County name	Coal mining area	Total budgeted funds in million euro in total	Share of total expenditure on sec. 18 InvKG projects	Cumulative share
Görlitz	Lusatian mining area – SN	193	44.7	44.7
Cottbus	Lusatian mining area – BB	160	37.0	81.7
Dahme-Spreewald	Lusatian mining area – BB	79	18.3	100
	Total	433	100	100

Sources: Raw data: BMWK. Own calculation.

There is a slight contrast between the funds earmarked so far for the Federal Government's measures under sec. 14 to 22 InvKG and the funds actually spent in the projects. As per 31 December 2022, total outflows of funds amount to EUR 612m, including EUR 241.5m for projects according to sec. 14 to 17 InvKG. EUR 158.7m has so far been spent on transport projects, EUR 43.9m on the establishment of public authorities and EUR 167.6m on the combination of the Immediate Action Programme and process costs. A look at the annual outflows of funds without the Immediate Action Programme shows a continuous increase in outflows of funds starting from a low level in 2020. In 2022, a total of EUR 245.1m was spent in projects funded under the InvKG. This corresponds to an actual funding intensity of EUR 44 per capita in 2022 (population as per 31 December 2021) or EUR 109.8 over the entire project period (until 2022). The average yearly funding intensity in the period 2020 to 2022 has so far been around EUR 35.4 per capita in the assisted areas according to sec. 2 InvKG.

Table 5-13:   (Actual) funds spent so far by type of project (as per 31 December 2022)

Coal mining area	Total outflow of funds (million euro)	Total of all fund outflows (in million euro) after 2020 until 2022				Outflow of funds 2020 (without SF)	Outflow of funds 2021 (without SF)	Outflow of funds 2022 (without SF)
		sec. 14-17	TP	sec. 18	PC and SF			
All mining areas	611.8	241.5	158.7	43.9	167.6	53.6	147.3	245.1

Notes: TP = Transport projects, PC = Process costs, SF = Immediate Action Programme. .

Sources: Raw data: BMWK. Own calculation.

Table 5-14 finally presents the funds spent by cluster of measures. It shows that five clusters account for the vast majority of funding so far. Due to the timing, the Immediate Action Programme in conjunction with the federal STARK programme shows the largest outflows of funds, followed by expenditure on transport projects in the accessibility cluster. This already shows a continuously increasing outflow of funds over time. The same applies to the research and development cluster.

Table 5-14:   (Actual) funds spent so far by cluster (in million euro, as per 31 December 2022)

Cluster	2019	2020	2021	2022	Total
1 – Accessibility	0	38.6	37.6	82.5	158.7
2 – Education	0	0	2.5	5.4	7.8
3 – Culture	0	10.3	26.5	5.6	42.3
4 – Health	0	0	0	0	0
5 – Business locations	0	0	0.8	4.1	5.0
6 – Research and development	0	3.0	49.6	91.0	143.8
7 – Climate and sustainability	0	0	1.1	4.0	5.1
8 – Social capital	0	0	0	0	0
Further measures by the Federal Government					
9 – Process costs	0	0	0	1.6	1.6
10 – Immediate Action Programme and STARK	23.1	70.7	80.7	28.9	203.5
11 – Establishment of public authorities	0	1.4	20.0	22.4	43.9
12 – JTF	0	0	0	0	0
Total	23.1	124.0	218.8	245.5	611.8

Source: Raw data: BMWK. Own calculation.

In this case too, outflows of funds have increased sharply over time, totalling around EUR 144m so far. Further relevant outflows of funds can be seen in the areas of establishment of public authorities and culture. The cluster shares in the total outflows of funds roughly correspond to their shares in the budgeted funds. For instance, around one third of the expenditure here is found in each of the research/development and accessibility clusters. This is followed by the federal STARK programme

(15 percent of budgeted funds), the JTF (7 percent) and the education cluster (4 percent). Only expenditure in the education sector lags somewhat behind in the outflow of funds.

5.3 The federal STARK programme

The federal STARK programme is actually a measure in Pillar 2 of the InvKG. However, the pogramme is evaluated in a dedicated section due to its special position. The federal STARK programme is designed to support the transformation process in the mining areas by providing grants for non-investment structural strengthening measures. As per 31 December 2022, a total of 374 STARK applications have been submitted to the Federal Office for Economic Affairs and Export Control (BAFA). 155 of these applications representing funding of EUR 275.6m have been approved so far. 146 these 155 applications concerned the Lusatian, the Central German and the Rhenish mining areas. One application was approved for the former lignite mining area of Helmstedt, eight applications support projects at hard coal sites in Saarland and North Rhine-Westphalia.

Fig. 5-1: Cost structure of approved STARK projects (in percent, as per 31 December 2022)
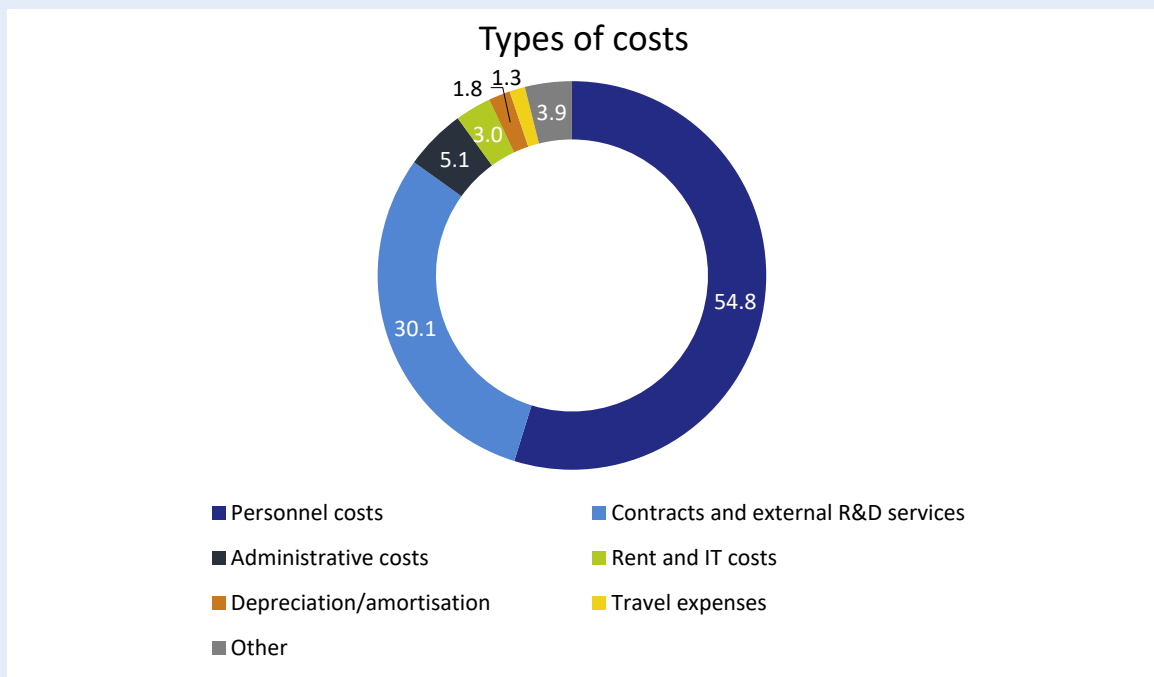
Source: Raw data: BAFA; own calculation and presentation.

The STARK projects mainly support personnel costs (see Fig. 5-1) which account for around 55 percent of total expenditure. Other dominant cost items are external contracts or third-party R&D services, accounting for around 30 percent of total expenditure. The remaining part of the funds is spent on administrative costs (5 percent) as well as rent, depreciation and amortisation, travel expenses and other costs. Table 5-15 summarises the geographical distribution of the 155 approved projects and their funding volume by mining area and year. The approved funding volume in 2021 thus totals EUR 14.7m across all projects. The approved funding volume for 2022 totals EUR 43.5m. This compares to approved disbursement amounts totalling EUR 36.5m (2021 and 2022). A significant portion of the project funds thus remains available for the coming years. From a geographical perspective, a third of the approved funding volume has so far been used for projects in the Rhenish mining area, followed by the two Lusatian mining areas which account for 16.8 (Saxon part) and 15.5 (Brandenburg part) percent of the funds.

Table 5-15:   Funds approved so far under the federal STARK programme by mining area (as per 31 December 2022)

Coal mining area	Applications approved	Grant volume in million euro			
		Total	of which in 2021	of which in 2022	of which paid out until 2022
Lusatian mining area (BB)	20	42.7	1.2	7.9	3.9
Lusatian mining area (SN)	25	46.3	4.1	7.2	7.9
Central German mining area (SN)	14	21.2	1.9	3.9	3.4
Central German mining area (ST)	26	36.2	2.7	5.8	5.5
Rhenish mining area	50	92.5	4.1	14.4	12.9
For multiple federal states/mining areas	11	27.5	0.8	3.3	2.5
Regions according to sec. 11 and 12 InvKG	9	9.1	0.0	1.1	0.5
Coal mining areas total	155	275.6	14.7	43.5	36.5

Notes: [a] Approvals until 31 December 2022 were considered. The sum of the values of the mining areas in the table may deviate slightly from the values in the 'Coal mining areas total' row due to rounding differences.

Sources: Own calculation based on BAFA project data.

Table 5-16 describes the structure of the STARK projects approved so far based on the funding priority to which the respective application was assigned. The eligible STARK projects can be assigned to at least one of the eleven funding categories listed in Annex 1 of the guideline of the federal STARK programme. The STARK funding guideline also call the need for participation of the federal state(s) in which the project is located. If a funding project is submitted to BAFA, the federal states are asked to confirm the relevance of the project in an integrated review procedure. Table 5-16 illustrates that around half (48 percent) of the approved applications are aimed at creating and strengthening regional planning capacities and structural development organisations which also tie up 42 percent of the funds applied for so far. Other important funding areas are knowledge and technology transfer as well as networking. So far, 24 projects (16 percent) have been assigned to the funding area of knowledge and technology transfer, absorbing 27 percent of the funds applied for. The 'networking' funding area concerns

16 projects with an application volume of EUR 29.8m, corresponding to around 11 percent of the total application volume for STARK funding. The other eight funding areas account for 27 percent of the projects and 21 percent of the funds applied for.

Table 5-16: Funds approved so far under the federal STARK programme by coal funding area (as per 31 December 2022)

Funding category [a] according to Annex 1 of the STARK guideline	Applications approved		Grant volume		
	Number	Share in percent	Absolute in million euro	Share in percent	of which disbursed by 2022 (in million euro)
1 – Networking	16	10.3	29.8	10.8	2.2
2 – Knowledge and technology transfer	24	15.5	73.2	26.6	8.8
3 – Consulting	1	0.6	9.6	3.5	1.9
4 – Qualification/education and training	8	5.2	8.2	3.0	0.3
5 – Sustainable adaptation of public services	5	3.2	1.7	0.6	0.1
6 – Planning capacities and structural development organisations	74	47.7	115.1	41.8	15.5
7 – Sense of community and common understanding of the future	9	5.8	8.8	3.2	1.3
8 – Foreign trade	3	1.9	3.4	1.2	0.3
9 – Scientific monitoring of the transformation process	3	1.9	2.8	1.0	0.5
10 – Strengthening entrepreneurial action	6	3.9	18.4	6.7	5.5
11 – Innovative approaches	6	3.9	4.6	1.7	0
Total	155	100	275.6	100	36.5

Notes: [a] BAFA does not systematically update the information on the funding categories in the lists. As a consequence, there may be deviations between the funding category at the time of application and at the time of approval in individual selected cases. The sum of the values of the funding categories in the table may deviate slightly from the values in the 'Total' row due to rounding differences.

Source: Own calculation based on BAFA project data.

The relative importance of the funding categories remains robust even when looking at multiple mentions of the categories at the project level. When looking at all the funding categories mentioned in the application rather than the funding priority, the area of planning capacities and structural development organisations remains dominant with 76 mentions (35 percent). This is again followed by networking (33 mentions or a share of 15 percent) as well as knowledge and technology transfer (27 mentions or a share of 12 percent). In this context, relative gains in importance are seen for the funding categories of sense of community and common understanding of the future (22 mentions or 10 percent), strengthening entrepreneurial action (14 mentions) as well as counselling and qualification/education and further training (14 and 10 mentions, respectively).

As the federal states assess the benefit of the project applications for regional development, it seems worthwhile in a second step to take a closer look at the regional priorities in funding areas. In this regard,

Table 5-17 shows clear differences between the mining areas. In the Rhenish mining area, most of the funding has so far was directed into the establishment and expansion of planning capacities and structural development organisations (65 percent). At least 19 and 11 percent of the funding volume flow into the areas of knowledge and technology transfer as well as strengthening entrepreneurial action. In the Lusatian mining area, funding focuses on knowledge and technology transfer where 38 percent (Brandenburg part) and 56 percent (Saxony part) of the funds are to be spent.

Table 5-17: Funds approved so far under the federal STARK programme by funding category and federal state (as per 31 December 2022)

Funding category according to Annex 1 of the STARK guideline	Brandenburg (Lusatian mining area)		Saxony (Lusatian mining area)		Saxony (Central German mining area)		Saxony-Anhalt (Central German mining area)		North Rhine-Westphalia (Rhenish mining area)	
	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent
1 – Networking	10.0	10.1	16.0	14.7	28.6	34.9	3.8	1.4	2.0	1.8
2 – Knowledge and technology transfer	15.0	38.3	36.0	55.9	14.3	30.1	23.1	20.3	8.0	18.6
3 – Consulting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 – Qualification/ education and training	15.0	5.8	0.0	0.0	0.0	0.0	15.4	6.3	2.0	3.7
5 – Sustainable adaptation of public services	0.0	0.0	4.0	1.7	0.0	0.0	7.7	0.9	4.0	0.7
6 – Planning capacities and structural development organisations	15.0	31.5	28.0	22.9	35.7	6.7	38.5	57.2	80.0	64.5
7 – Sense of community and common understanding of the future	15.0	7.3	8.0	0.8	14.3	1.6	7.7	13.7	0.0	0.0
8 – Foreign trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9 – Scientific monitoring of the transformation process	5.0	5.1	0.0	0.0	0.0	0.0	3.8	0.1	0.0	0.0
10 – Strengthening entrepreneurial action	0.0	0.0	8.0	4.0	7.1	26.7	0.0	0.0	4.0	10.8
11 – Innovative approaches	25.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100	100	100	100	100	100	100	100	100	100

Notes: a Approvals until 31 December 2022 were considered, ZV = Grant volume.

Source: Own calculation based on BAFA project data.

In the Brandenburg part of Lusatia, there is also a focus of projects on planning capacities (32 percent of the funding volume) and networking (10 percent of the funding volume). In the Saxon part of Lusatia, the development of planning capacities ties up around 23 percent of the funding volume with the networking category as another funding priority (15 percent of the funding volume). The Saxon part of the Central German mining area is characterised by comparatively different focal points where the focus is on projects in the funding areas of networking (35 percent of the funding volume), knowledge and

technology transfer (30 percent) and strengthening entrepreneurial action (27 percent). Funding in Saxony-Anhalt focuses on planning capacities and structural development organisations (57 percent of the funding volume). These are complemented by projects in the areas of knowledge and technology transfer (20 percent) and strengthening the sense of community and common understanding of the future (14 percent).

Analogous to the presentation of the classification of federal measures pursuant to sec. 14 to 22 InvKG, the measures of the federal STARK programme can also be classified in the cluster model of the project (see Table 5-18).

Table 5-18: Funds approved so far under the federal STARK programme by cluster and federal state (as per 31 December 2022)

Cluster	Brandenburg (Lusatian mining area)		Saxony (Lusatian mining area)		Saxony (Central German mining area)		Saxony-Anhalt (Central German mining area)		North Rhine-Westphalia (Rhenish mining area)	
	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent	Share of projects in percent	ZV share in percent
1 – Accessibility	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 – Education	15.0	5.8	0.0	0.0	0.0	0.0	15.4	6.3	2.0	3.7
3 – Culture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 – Health	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 – Business locations	15.0	31.5	36.0	26.9	42.9	33.4	38.5	57.2	84.0	75.3
6 – Research and development	55.0	55.4	56.0	72.3	42.9	65.0	38.5	22.8	14.0	21.0
7 – Climate and sustainability	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8 – Social capital	15.0	7.3	8.0	0.8	14.3	1.6	7.7	13.7	0.0	0.0
Total	100	100	100	100	100	100	100	100	100	100

Notes: [a] Approvals until 31 December 2022 were considered, ZV = Grant volume.

Source: Own calculation based on BAFA project data.

Based on the allocation of the projects to the clusters, the comparison of the mining areas provides the following picture. In the Brandenburg part of Lusatia, measures in the research and development cluster are given a priority with 55 percent of the funding volume. Other relevant spending is found in the business cluster (32 percent of the grant volume) and to a lesser extent in the cluster for strengthening social capital. In the Saxon part of Lusatia, the clearest prioritisation of measures can be seen with strong focus in the area of research and development (72 percent of the funding volume). About a quarter of the funding volume flows into the business locations cluster. The situation is similar in the Saxon part of the Central German mining area where around two thirds of the funds remain in the area of research and development. One third of funding goes to the business locations cluster. In the assisted regions in Saxony-Anhalt and North Rhine-Westphalia, on the other hand, projects related to the improvement of business location conditions dominate, with around 20 percent of funding being spent here in each of the research and development clusters.

The projects of the federal STARK programme also allow a further geographically disaggregated presentation of the applicants. For this purpose, information from the implementing organisation and the cooperation partners named in the project can be used. It should be noted that the implementing organisation of a STARK project can also be located outside the assisted area if the impact of the project is in the assisted area.

Table 5-19: Structure of STARK projects so far (by location of implementing organisation) by county (top 15 – as per 31 December 2022)

County name	Coal mining area	Number of projects	Total ZV in million euro Total	ZV share in percent	Cumulative ZV share in percent	of which disbursed by 2022 (in million euro)
Cottbus	Lusatian mining area (BB)	10	34.5	12.5	12.5	2.8
Düren	Rhenish mining area	15	25.9	9.4	21.9	2.7
Görlitz	Lusatian mining area (SN)	8	22.9	8.3	30.2	5.1
Düsseldorf	.	2	22.6	8.2	38.5	1.7
Leipzig, City	Central German mining area (SN)	9	19.1	6.9	45.4	1.6
Dresden,	.	5	15.3	5.6	51.0	1.9
Rhein-Kreis Neuss	Rhenish mining area	7	12.7	4.6	55.5	4.3
Berlin	.	4	12.1	4.4	59.9	2.4
Bautzen	Lusatian mining area (SN)	12	10.8	3.9	63.9	1.9
Burgenlandkreis	Central German mining area (ST)	2	9.1	3.3	67.2	2.5
Rhein-Erft-Kreis	Rhenish mining area	9	7.2	2.6	69.8	1.2
Halle (Saale)	Central German mining area (ST)	5	7.0	2.5	72.3	0.9
Heinsberg	Rhenish mining area	7	6.1	2.2	74.6	0.7
Chemnitz	.	1	5.9	2.1	76.7	0.1
Saalekreis	Central German mining area (ST)	6	5.5	2.0	78.7	0.6
Other locations	.	53	58.9	22.3	100	6.3
	Total	155	275.6	100	100	36.5

Notes: [a] Approvals until 31 December 2022 were considered, ZV = Grant volume. The amounts are allocated here via the seat of the organisation executing the project which can be outside the assisted areas of the InvKG.

Sources: Raw data: BMWK. Own calculation.

That being said, the implementing organisation of the vast majority of funding projects in STARK are located in the InvKG-assisted area. All of the assisted areas listed in Chapter 1 sec. 2 InvKG have at least one implementing organisation in STARK.

In total, 123 of the implementing agencies designated in 155 projects (79 percent) are located in these regions. They receive so far EUR 185m (67 percent) of the funding volume. Furthermore, seven of the eleven Chapter-2 regions receive STARK funding, with funding volumes varying between around EUR 1m and EUR 3m. Regional focal points for the seat of the implementing organisation are the city of Cottbus, the counties of Düren and Görlitz and the city of Leipzig. Outside the InvKG-assisted areas, relevant stakeholders are found mainly in the major cities close to the mining areas, such as Düsseldorf, Dresden and Berlin. Cottbus is the seat of the implementing organisation of a total of ten STARK projects with a funding volume of EUR 34.5m. The counties of Düren, Görlitz and the county-free city of Düsseldorf have grant volumes of between EUR 23m and EUR 26m, whereby the average project size differs significantly between the counties. It should be generally noted that the volume of funds disbursed for STARK projects does not exceed EUR 5.1m in any county until 31 December 2022. The average volume of funds disbursed to implementing organisations in the 22 InvKG-assisted areas from Chapter 1 sec. 2 InvKG totals EUR 1.2m. The average disbursement for the Chapter-2 regions totals EUR 0.6m.

In a final step, the structure of the cooperation partners can also serve as a measure for the regional incidence of funding in the STARK projects. In this regard, information regarding the geographical structure of the cooperation partners is available for 60 projects so far. This shows that in 74 percent of the cases, the respective implementing organisation has a cooperation partner in the Central German, Rhenish or Lusatian mining areas. The remaining 26 percent of cooperation partners are located outside the InvKG-assisted area where there are no cooperation partners in the Chapter-2 assisted areas either. Dominant locations at county level can be found in Leipzig, the counties of Spree-Neiße, Nordsachsen, the city of Cottbus as well as in the Saalekreis and Heinsberg. Outside the assisted area, stakeholders from Berlin, the Munich (City) and Cologne (City) are among the preferred cooperation partners.

In addition to the granted projects, there are currently 149 STARK projects that have not yet been approved but are in the application process.[27] An analysis of the funding categories (multiple mentions) shows a shift in the focus of funding categories for these projects towards the areas of knowledge and technology transfer (28 percent of mentions), networking (21 percent), consulting (11 percent) as well as strengthening entrepreneurial action (8 percent). The creation of planning capacities and structural development organisations only accounts for a share of 7 percent here. A similar structure can also be seen in the analysis of the funding priority of projects in the application process. Here, too, projects in the funding categories of knowledge and technology transfer and networking dominate (40 and 20 percent, respectively, and 41 and 19 percent of the application volume). When measured by the volume of applications, this is followed by the areas of strengthening entrepreneurial action and projects to create and strengthen planning capacities and structural development organisations.

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[27]   The explanations refer to applications with the status 'Application recorded in profi', 'Electronic application (easy-online)', 'Clarification of facts in the application', 'Signed application (easy-online)', 'Grant notice created' (and not decided until 2023), 'Grant notice can be created' and 'Signed application (easy-online)' that were received by 31 December 2022 and have a positive or pending vote by the federal state.

Table 5-20:   Projects in the application process under the federal STARK programme by funding area (as per 31 December 2022)

Funding category according to Annex 1 of the STARK guideline	Applications in the application process		Application volume	
	Number of mentions	Share in percent	Absolute in million euro	Share in percent
1 – Networking	50	20.6	50.9	18.6
2 – Knowledge and technology transfer	69	28.4	112.0	41.1
3 – Consulting	26	10.7	5.5	2.0
4 – Qualification/education and training	17	7.0	5.6	2.0
5 – Sustainable adaptation of public services	9	3.7	1.1	0.4
6 – Planning capacities and structural development organisations	18	7.4	27.4	10.0
7 – Sense of community and common understanding of the future	17	7.0	12.3	4.5
8 – Foreign trade	1	0.4	9.4	3.4
9 – Scientific monitoring of the transformation process	5	2.1	1.3	0.5
10 – Strengthening entrepreneurial action	20	8.2	28.8	10.5
11 – Innovative approaches	11	4.5	18.6	6.8
Total	243 (149 projects)	100	272.7	100

Notes: a Applications until 31 December 2022 were considered.

Source: Own calculation based on BAFA project data.

From a geographical perspective, it is clear that the Rhenish mining area is still characterised by a relatively large number of applications in the application process. It should be noted, however, that the Rhenish mining area also accounts for the largest share of available funds.[28] In this regard, 46 percent of the open applications with an application volume of 63 percent originate from this mining area. Compared to the applications currently being implemented, it is clear that applications from more than one mining area and from the Brandenburg part of the Lusatian mining area are of minor relevance. Relative gains in importance can be seen above all in the Chapter-2 regions and, to a lesser extent, for the Saxon part of the Lusatian mining area.

[28]   The funds generally available in the federal STARK programme are distributed among the federal states and coal mining areas as follows: Lusatian coal mining area (BB): 17 percent, Lusatian coal mining area (SN): 11 percent, Central German coal mining area (SN): 5 percent, Central German coal mining area (ST): 10 percent, Rhenish mining area: 56 percent.

Table 5-21: Projects in the application process under the federal STARK programme by mining area (as per 31 December 2022)

Coal mining area	Applications in the application process	Share in percent	Application volume	Share in percent
Lusatian mining area (BB)	8	5.4	17.0	6.2
Lusatian mining area (SN)	27	18.1	22.2	8.2
Central German mining area (SN)	13	8.7	21.1	7.7
Central German mining area (ST)	16	10.7	19.3	7.1
Rhenish mining area	68	45.6	172.5	63.2
For multiple federal states/mining areas	4	2.7	3.1	1.1
Other locations	13	8.7	17.6	6.4
Coal mining areas total	149	100	272.7	100

Notes: [a] Approvals until 31 December 2022 were considered.

Sources: Own calculation based on BAFA project data.

5.4 Regional incidence of InvKG funds in total

Finally, the analysis refers to an overall view of the funding that has been firmly earmarked (but not necessarily disbursed) so far within the scope of the InvKG. Table 5-22 shows the top-15 counties and the funds allocated to them that could be regionalised. The highest inflows of funds in this list are planned for the counties of Görlitz and Düren and the city of Cottbus. In each of these three regions, about ten times as much funding is earmarked as in the county of Oberspreewald-Lausitz (15th place). A large gap even exists between 3rd (Düren) and 4th place (Nordsachsen). In the county of Düren, about twice as much funding has been earmarked as in the county of Nordsachsen.

Finally, it should be noted that this list serves purely informative purposes for the regional earmarking of funds. It should not be the task of funding policy to distribute funds under the InvKG equally among all counties. Instead, funding should be channelled into uses where it will achieve the best results. It is obvious that some regions are more capable of absorbing the funds in a manner that serves their needs and goals best.

Table 5-22: Overall view of earmarked regionalisable funds in the InvKG by county (Pillar 1 and Pillar 2, top 15, in million euros, as per 31 December 2022)

County	Coal mining area	Total in million euros
Görlitz	Lusatian mining area – SN	2,430.7
Cottbus	Lusatian mining area – BB	2,016.4
Düren	Rhenish mining area – NW	1,832.7
Nordsachsen	Central German mining area – SN	945.1
Aachen urban region	Rhenish mining area – NW	943.9
Bautzen	Lusatian mining area – SN	869.8
Saalekreis	Central German mining area – ST	838.6
Spree-Neiße	Lusatian mining area – BB	710.3
Burgenlandkreis	Central German mining area – ST	616.6
Rhein-Erft-Kreis	Rhenish mining area – NW	584.5
Rhein-Kreis Neuss	Rhenish mining area – NW	457.5
Leipzig, County	Central German mining area – SN	424.1
Leipzig, City	Central German mining area – SN	321.2
Halle (Saale)	Central German mining area – ST	317.3
Oberspreewald-Lausitz	Lusatian mining area – BB	219.5

Notes: a Approvals until 31 December 2022 were considered.

Sources: Own calculation based on BAFA project data, BMWK, reports by the federal states.

6 First ex-ante analyses – Scenario for the economic development of the assisted regions

6.1 Projection methodology

In order to assess the impacts of the coal phase-out and of accompanying structural policy measures, a hypothetical reference scenario without a coal phase-out is required. Even without a coal phase-out, the assisted areas would face major challenges, for instance, in view of the expected population development. The present projections reflect the regional economic development that would have been expected without political intervention such as the coal phase-out. The approach used here is based on the EU method for estimating potential output (Havik et al. 2014). The reported results are to be understood as a first indication at this point in time. The further course of the evaluation will show how a variation of the assumptions impacts the projection results.

The potential output is specified as:

$$\bar{Y}_t = \bar{A}_t * \bar{K}_t^{\alpha} * \bar{L}_t^{(1-\alpha)} \,, \tag{9}$$

where the bar describes the respective trend size. The production factor labour can be broken down into different components. The trend of labour input $\bar{L}_t$ is given as:

$$\bar{L}_t = Popw_t * \overline{Part}_t * \overline{Dstd}_t \,. \tag{10}$$

where $Popw_t$[29] denotes the working-age population, $\overline{Part}_t$ the trend in the employment rate and $\overline{Dstd}_t$ the trend in hours worked per person employed. The working-age population is determined using population projections.

The employment rate and the average volume of work is extrapolated here as an ARIMA (2,1,0) process without a constant, which implies that both variables converge towards a constant value in each case:

$$\Delta x_{r,t} = \delta_1 \Delta x_{r,t-1} + \delta_2 \Delta x_{r,t-2} + v_{r,t} \,, \quad v_{r,t} \sim N(0, \sigma_{v,r}^2), \ x \in \{Part, Dstd\} \,. \tag{11}$$

The update of total factor productivity results from a two-step procedure. First, national total factor productivity is extrapolated as an ARIMA (2,1,1) process with drift. Subsequently, the rate of convergence of the regional total factor productivity (TFP_r) of each mining area to macroeconomic size (TFP_0) is estimated as the ARIMA (2,1,0) process:

$$\Delta \frac{TFP_{r,t}}{TFP_{0,t}} = \alpha_1 \Delta \frac{TFP_{r,t-1}}{TFP_{0,t-1}} + \alpha_2 \Delta \frac{TFP_{r,t-2}}{TFP_{0,t-2}} + \varepsilon_{r,t} \,, \quad \varepsilon_{r,t} \sim N(0, \sigma_{TFP,r}^2) \,. \tag{12}$$

The regional total factor productivity is then obtained by extrapolating the national level and the estimated productivity ratio according to (12).

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[29] See method of the European Commission: https://ec.europa.eu/eurostat/cache/metadata/Annexes/proj_19n_esms_an1.pdf.

The capital stock is projected by extrapolating the investment ratio $(\iota_{r,t})$ and the depreciation/amortisation ratio $(\delta_{r,t})$ using ARIMA processes.

The potential output and the capital stock are iteratively extrapolated for the years 2020 to 2040 as follows:

$$\bar{I}_{r,t} = \bar{Y}_{r,t} * \bar{\iota}_{r,t} , \tag{13}$$

$$\bar{K}_{r,t+1} = \bar{K}_{r,t} \left(1 - \bar{\delta}_{r,t}\right) + \bar{I}_{r,t} ,$$

$$\bar{Y}_{r,t+1} = \bar{A}_{r,t+1} * \bar{K}_{r,t+1}^{\alpha} * \bar{L}_{r,t+1}^{(1-\alpha)} .$$

First, the capital stock is updated with the help of the investment ratio $(\bar{\iota}_{r,t})$, the potential output $(\bar{Y}_{r,t})$ and the depreciation/amortisation ratio $(\bar{\delta}_{r,t})$. Then the potential output for the next period is determined.

After extrapolating the different variables, the trend components of the time series are estimated using the Hodrick-Prescott filter (Hodrick and Prescott 1997).[30]

6.2 Basic projections

Fig. 6-1 presents the real gross value added for the regions under consideration for the years 2000 and 2040. The projections indicate that the non-assisted areas will record an average annual growth rate of around 1.0 percent from 2020 to 2040. It is particularly the Saxon part of the Central German mining area that will experience above-average growth, closely followed by the Saxon part of Lusatia. This contrasts with the Saxony-Anhalt part of Central Germany, the hard coal mining areas and the Rhineland, which each show a lower average annual growth rate of 0.5 percent for this period. It is striking that the Brandenburg part of Lusatia stagnates throughout the entire projection period.

For a more in-depth examination of the projections, the mean growth decomposition of the assisted areas is presented in Fig. 6-2. It shows that total factor productivity (TFP) is a key growth driver in all regions, contributing slightly less than 0.5 percentage points to growth.

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[30]   The Lambda parameter determines the smoothness of the resulting trend and is set to the value 100. This is a standard value used in literature.

Fig. 6-1: Price-adjusted GVA and trends, 2000-2040

Rhenish mining area
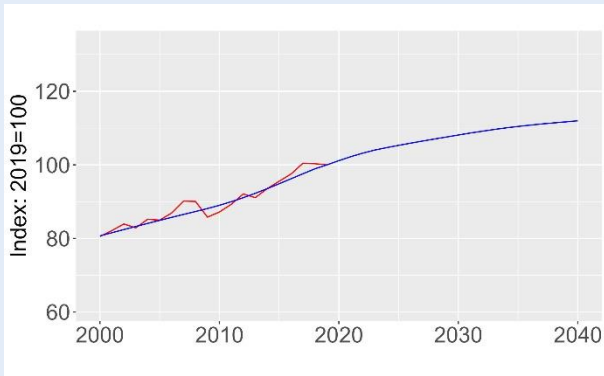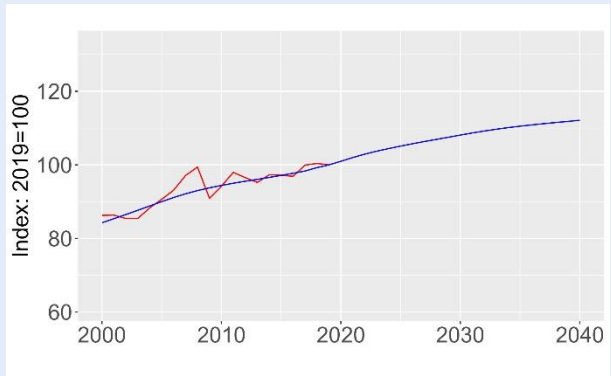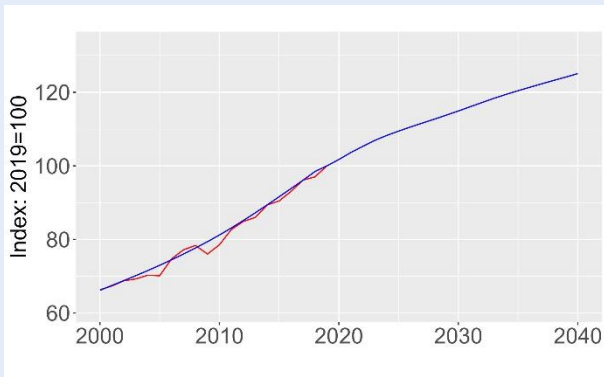
Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)
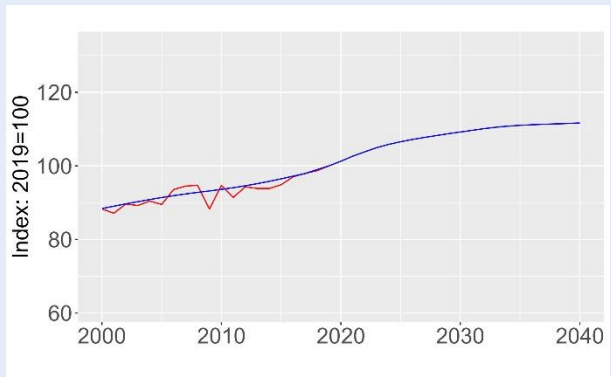
Lusatian mining area (Saxony)
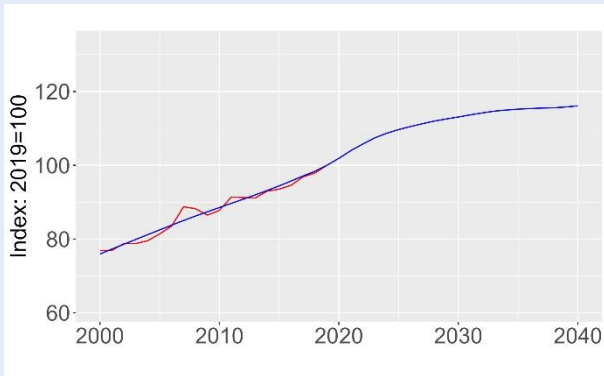
Lusatian mining area (Brandenburg)
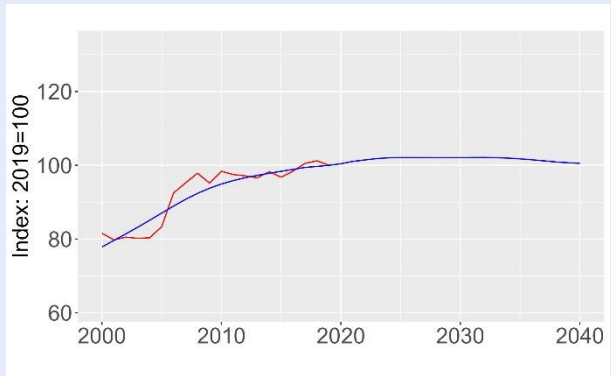
Not eligible for funding under the InvKG
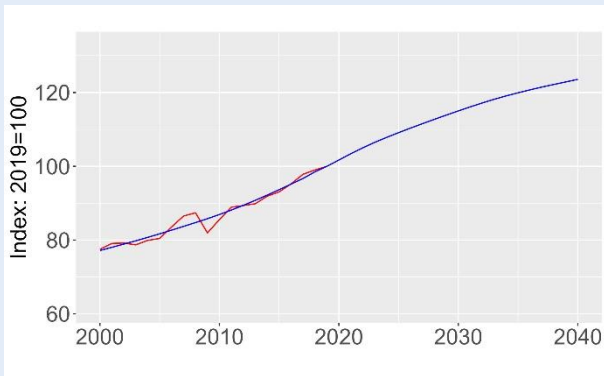
Counties of the control group in the event study design
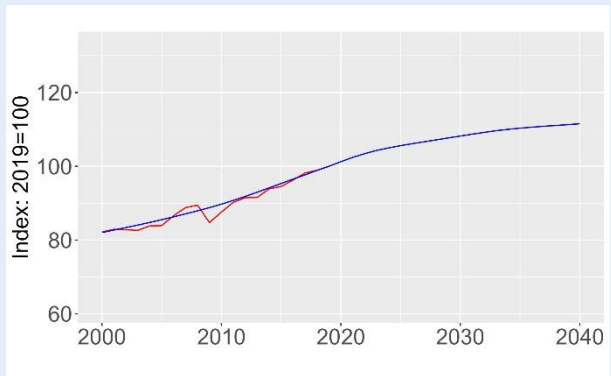
GVA — Trend GVA

Source: VGRdL, own calculation.

Capital also has a key role to play as a growth driver. Its contribution has been particularly evident in the Saxon part of the Central German mining area and in the non-assisted areas. Relatively high investment rates are observed for both regions.

On the other hand, labour as a production factor is an element that limits growth in all regions. This essentially reflects the declining working-age population.

This factor is particularly pronounced in the Brandenburg part of Lusatia, whereas the negative labour contribution in the Saxon part of Lusatia is relatively low, indicating strong heterogeneity within Lusatia. The labour factor is observed to have an on average small positive contribution for this period in the non-assisted areas only, suggesting a comparatively weaker decline in the working-age population here than in the counties of the mining areas.

Fig. 6-2:   Mean growth decomposition of potential output, 2020-2040
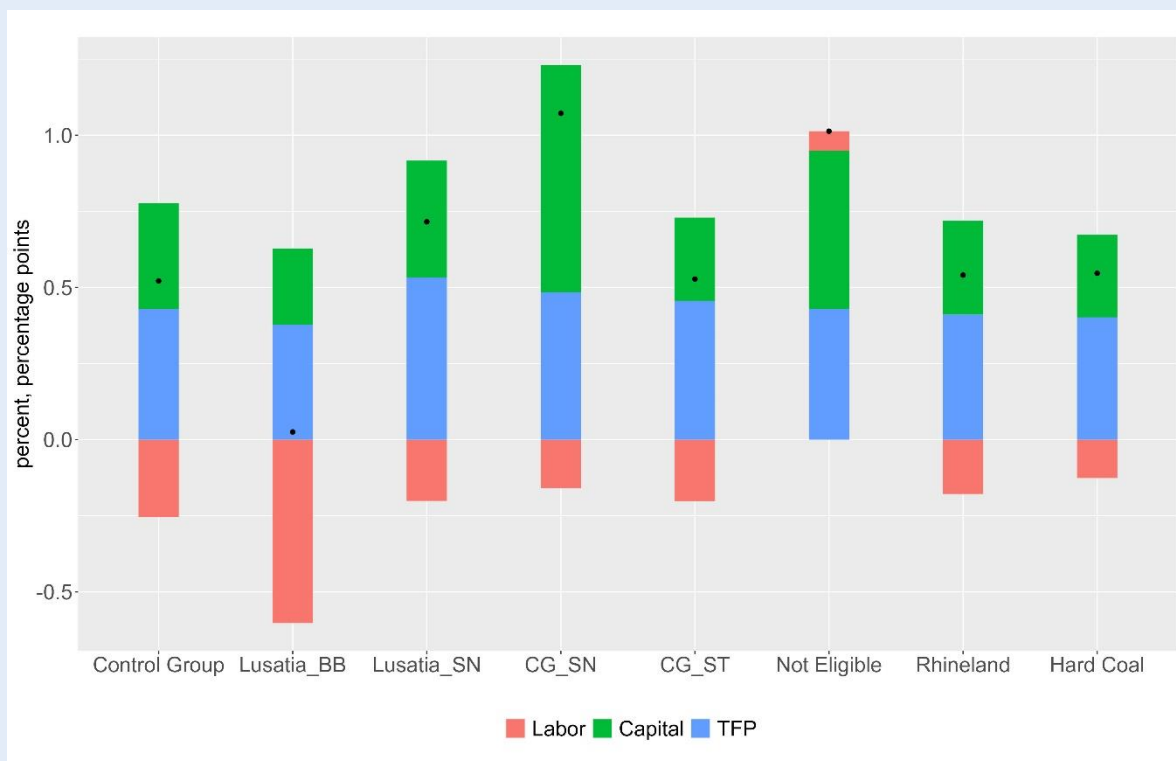
Notes: BB – Brandenburg,   SN – Saxony,   ST – Saxony-Anhalt.   CG – Central   German   mining   area.   Not Eligible – aggregated counties in Germany that are not assisted areas. Hard Coal – counties mentioned as eligible in the InvKG, Chapter 2, sec. 12.

Sources: VGRdL, own calculation.

6.3 Basic projections vs actual development

In order to compare the projection of potential output with national projections, the projection can be compared here with the forecast by the Joint Economic Forecast Project Group (*Projektgruppe Gemeinschaftsdiagnose*) from spring 2020. The Joint Economic Forecast Project Group (01/2020) forecasts annual average growth in potential output of 1.3 percent for Germany as a whole for the years 2019 to 2024. [31] The projection method used here estimates annual average growth in potential output of 1.5 percent for Germany as a whole for this period and is thus slightly above the forecast by the Joint Economic Forecast Project Group. However, the comparability of the projection results with each other is limited since they are based on different data statuses and the methods used to extrapolate the trends differ. Whilst the Joint Economic Forecast Project Group's projection of the participation rate is based on an age cohort model, the participation rate in this report is defined as the employment rate of persons aged 15 to 74.

Table 6-1 presents the annual average change in projected output and its determinants broken down into different time periods for each region considered. The growth rate of output averaged over the respective period is declining in all regions, with estimated average output growth in the period between 2020 and 2040 in many cases only about half of the averaged growth in the period between 2001 and 2019. What is particularly striking here is the decline in growth in the Brandenburg part of Lusatia from 1.1 percent between 2001 and 2019 to mean growth of 0 percent between 2020 and 2040. In all regions, except for the counties that do not belong to the assisted areas of the InvKG, the mean contribution of the labour production factor is negative and thus contributes the largest share to the comparatively low growth in the 2020s and 2030s. The strong negative contribution of labour is based on the projections for regional population growth.

Since data on employees subject to social security contributions at regional level are already provided by the Federal Employment Agency up to the year 2022, it is possible to compare our projection for employment for the years 2019 to 2022 with the actually reported number of employees subject to social security contributions. These employees only make up a portion of the workforce, which also includes self-employed and marginally employed persons.

Fig. 6-3 shows the development of the employment projection and the development of employees subject to social insurance contributions. While the projection indicates gradual growth in labour force of more or less 2 percent during these years, the number of employees subject to social security contributions decreases in 2020 in all regions compared to 2019, which can be explained by the slump in the economy during the Covid-19 pandemic, especially in 2020. A subsequent recovery of the labour market to 2019 levels can be seen in all regions. The strongest growth in the number employees subject to social security contributions can be seen in the Rhineland and in the Saxon part of the Central German mining area, with up to 4 percent compared to 2019. Since the extrapolation of the labour force is based on trends, it is not possible to map short-term fluctuations due to cyclical influences.

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[31]   See Projektgruppe Gemeinschaftsdiagnose 01/2020, p. 61: Table 3.1

Table 6-1: Production and its determinants: Annual average change in percent

	Variable	2001-2019	2020-2029	2030-2040	2020-2040
Lusatian mining area, BB	Potential output	1.1	0.2	-0.1	0.0
	Capital stock	1.7	0.7	0.6	0.6
	FP	0.9	0.3	0.4	0.4
	Labour	-0.8	-0.7	-1.3	-1.0
	Working population	*-0.3*	*-0.7*	*-1.3*	*-1.0*
	Work volume	*-0.5*	*0.0*	*0.0*	*0.0*
Lusatian mining area, SN	Potential output	1.4	1.2	0.3	0.7
	Capital stock	1.1	1.0	1.2	1.1
	TFP	1.6	0.7	0.4	0.5
	Labour	-0.8	0.3	-0.8	-0.3
	Working population	*-0.3*	*0.3*	*-0.8*	*-0.3*
	Work volume	*-0.5*	*0.0*	*0.0*	*0.0*
Central German mining area, SN	Potential output	2.20	1.3	0.9	1.1
	Capital stock	2.2	2.2	2.3	2.2
	FP	1.3	0.6	0.4	0.5
	Labour	0.2	0.0	-0.4	-0.2
	Working population	*0.7*	*0.0*	*-0.4*	*-0.2*
	Work volume	*-0.5*	*0.0*	*0.0*	*0.0*
Central German mining area, ST	Potential output	0.7	0.8	0.2	0.5
	Capital stock	1.1	0.8	0.6	0.7
	FP	0.8	0.5	0.4	0.5
	Labour	-0.9	0.0	-0.6	-0.3
	Working population	*-0.4*	*0.0*	*-0.6*	*-0.3*
	Work volume	*-0.5*	*0.0*	*0.0*	*0.0*
Rhenish mining area	Potential output	1.2	0.7	0.4	0.5
	Capital stock	1.0	0.8	0.8	0.8
	FP	0.4	0.4	0.4	0.4
	Labour	0.6	0.0	-0.6	-0.3
	Working population	*0.7*	*0.0*	*-0.6*	*-0.3*
	Work volume	*-0.1*	*0.0*	*0.0*	*0.0*
Hard coal mining areas	Potential output	0.8	0.7	0.4	0.5
	Capital stock	0.8	0.8	0.7	0.8
	FP	0.5	0.4	0.4	0.4
	Labour	0.1	0.1	-0.4	-0.2
	Working population	*0.3*	*0.1*	*-0.4*	*-0.2*
	Work volume	*-0.2*	*0.0*	*0.0*	*0.0*
Control group	Potential output	1.0	0.7	0.3	0.5
	Capital stock	1.2	1.1	0.9	1.0
	FP	0.6	0.4	0.4	0.4
	Labour	0.1	-0.1	-0.6	-0.4
	Working population	*0.3*	*-0.1*	*-0.6*	*-0.4*
	Work volume	*-0.2*	*0.0*	*0.0*	*0.0*
Non-assisted areas	Potential output	1.4	1.3	0.7	1.0
	Capital stock	1.4	1.5	1.3	1.4
	FP	0.5	0.4	0.4	0.4
	Labour	0.6	0.5	-0.2	0.1
	Working population	*0.7*	*0.5*	*-0.2*	*0.1*
	Work volume	*-0.1*	*0.0*	*0.0*	*0.0*

Source: VGRdL and own calculation.

Fig. 6-3: Employment projection vs. employees subject to social security contributions, 2019-2022

Rhenish mining area
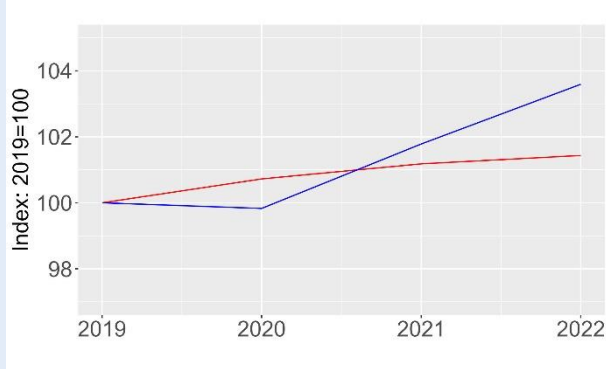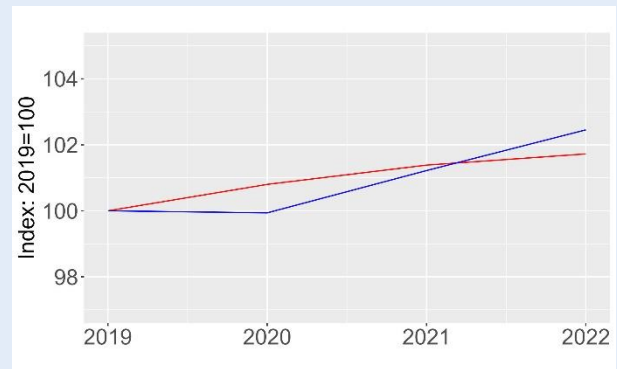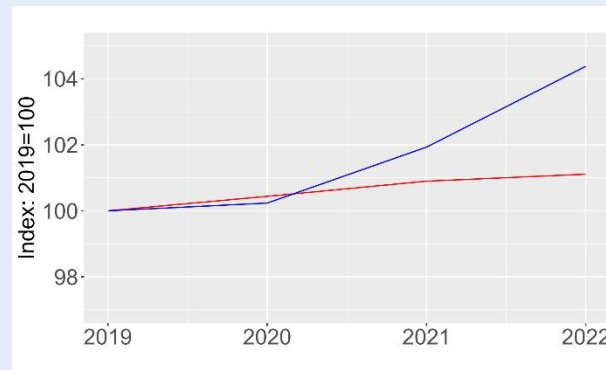
Hard coal regions

Central German mining area (Saxony)

Central German mining area (Saxony-Anhalt)
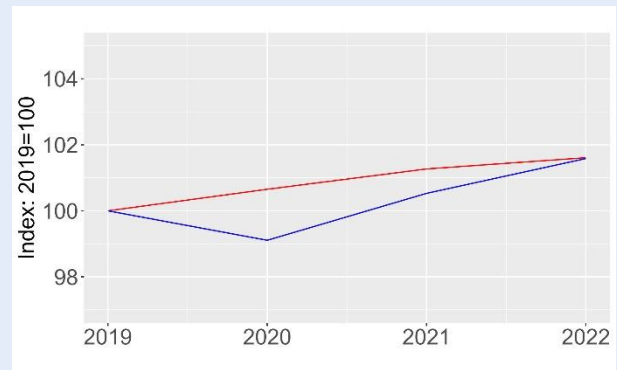
Lusatian mining area (Saxony)
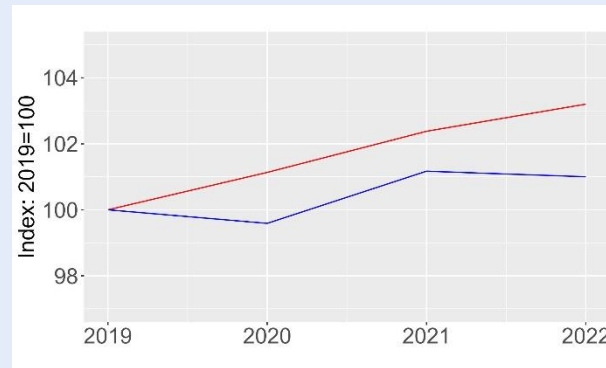
Lusatian mining area (Brandenburg)
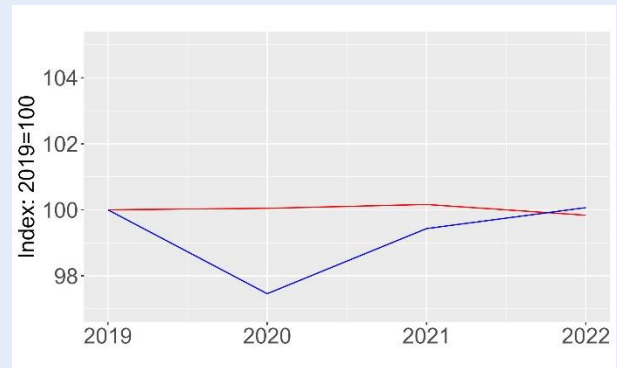
Not eligible for funding under the InvKG
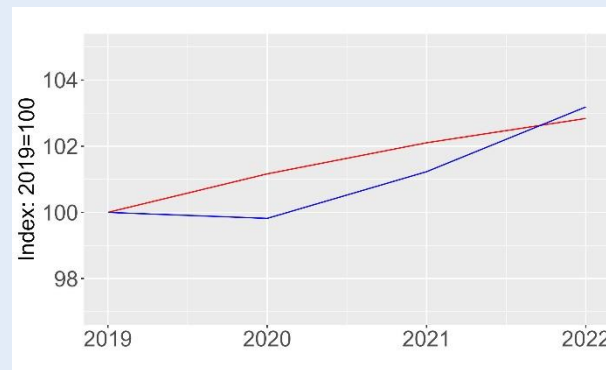
Counties of the control group in the event study design
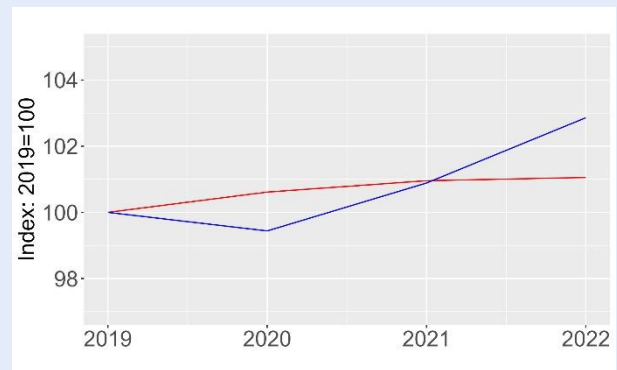
Note: There the red line depicts projections for employees while the blue line depicts the actual development.
Source: VGRdL, own calculation.

7 Short-term impact of funding under the InvKG

The effect of a policy measure or a set of different measures, as in the InvKG, can be measured in different ways. There is no generally applicable method for this since the possible effects depend on the type of individual measure, and measure specific effects can differ noticeably from one another, especially in the case of bundles of measures. This interim report primarily focuses on approaches to measure the effectiveness of the InvKG at the aggregated regional level based on the use of quantitative data. The counties in the assisted area (and in the rest of Germany) serve as the regional level of analysis. In addition, indicators are also be analysed at the level of mining areas and federal states.

This chapter is divided into three sections. First, section 7.1 presents basic considerations for the analysis of the impacts of the InvKG measures with regard to the target variables and the characteristics of the individual InvKG interventions. Section 7.2 provides a simple descriptive analysis in the context of a before-and-after comparison focusing on indicators for which data are already available. Section 7.3 presents an in-depth descriptive analysis in the form of a so-called event study design which compares the development of target variables of the InvKG areas with those of a control group.

7.1 Preliminary considerations

The InvKG itself contains a number of target variables in sec. 1 and 26 InvKG. They specifically cover the following areas and the associated sets of indicators:[32]

1. Economic growth (such as development of GDP in assisted areas, both absolute and per capita)

2. Value added (such as development of gross value added, public and private investment, research and development expenditure and business start-ups)

3. Labour market situation (such as unemployment rate, employment rate and training situation, inbound and outbound migration of working-age population and median income)

4. Municipal tax revenue (tax revenue of municipalities, breakdown of tax revenue by type)

5. Balance of economic power (development of GDP per capita relative to the national average or relative to other regions with a similar economic structure)

6. Greenhouse gas neutrality, resource efficiency, sustainability (emissions in the regions, number of registered vehicles, development of public transport provision and use, energy refurbishment, development of new (residential and non-residential) buildings, development of energy mix and power generation by type of generation)

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[32] The federal states themselves evaluate the measures of Pillar 1 on their own. In the respective federal state-specific context, it may make sense from the federal states' perspective to omit certain indicators from the Federal Government's set of indicators and/or to add others (see, for instance, Markwardt, Rettig and Zundel 2023). The set of indicators used in this report is based on the requirements that the Federal Government sets for its own evaluation.

The success of the InvKG can be measured by the degree to which the stated goals are achieved. One of the aims of the InvKG is to support *economic growth* in the assisted areas (see sec. 1 (1) InvKG). Success in achieving this goal can be assessed using indicators such as the development of absolute GDP, GDP per capita or GVA per person employed. In contrast, the above-mentioned indicators from the *labour market situation* category can be used to assess the achievement of goals with regard to securing employment in the assisted areas during the course of the phase-out of lignite coal mining and power generation from lignite coal (see sec. 1 (2) InvKG). Their joint consideration provides a comprehensive picture of possible effects which form the basis for an initial evaluation of the impacts of the InvKG.

In this context, it is important to note that the success of the measures under the InvKG can also vary in time. As explained in Chapter 4, the various funding projects allow the hypothesis that short-, medium- and long-term impacts can occur parallel. The impact of certain funding measures (for instance, infrastructure projects) in the assisted areas may only become noticeable after some time. Other projects (such as the establishment of public authorities) may contrary have an immediate (regional) impact since larger volumes of funds are spent relatively quickly in the assisted areas.

Given the outflows of funds, the type of projects started so far (see Chapter 5) and the extent of structural change to be achieved in the assisted areas, the aim of the study is to assess the long-term success of the InvKG measures. This is to ensure that a measure (or bundle of different measures) leads to sustainable change. However, only about two years have passed between the coming into effect of the Act on 14 August 2020 and the data on which the evaluation is based (31 December 2022). The following sections therefore only allow initial statements regarding the short-term impacts of the funding, while subsequent reports will focus more on the medium to long-term effects.

Due to the complexity of the InvKG measures, several indicators and evaluation methods must be used in order to provide a comprehensive picture of the impact of funding. The choice of evaluation methods depends on the type of measure, the goals of funding and the available data. The aim of our study is to develop a research design that ultimately models a cause-effect relationship between the InvKG measures and their impacts to determine whether it was in fact the measures that have actually led to the observed changes in the assisted areas or whether other factors are responsible.

7.2   Before-and-after comparison of the development of the target variables of the InvKG

In a first step of the impact analysis, a simple before-and-after comparison of the development of the target variables of the InvKG is to be made. A before-and-after comparison is a method that compares two or more points in time to analyse changes in the target variables under consideration during this period. For this purpose, the initial state (level) or the development of a target variable (growth) is looked at before funding starts and then the (preliminary) state after funding, comparing the differences between them. The years up to 2019 serve as the period before the start of funding (depending on availability of the indicator) since strong pandemic-related special effects occurred in 2020 and thereafter. The values from 2021 onwards are assigned to the 'after' period. In the following, we analyse how various indicators have changed at the level of federal states and mining areas. The before-and-after comparison allows first insights into the dimensions in which the regions have improved or deteriorated. However, it does not allow any conclusions to be drawn about a causal effect of InvKG

funding on the target variables under consideration. The following analyses focus primarily on those indicators for which data that can be meaningfully evaluated are already available at this point in time. This mainly concerns numbers 3 and 4 in section 7.1.[33]

7.2.1 Employment

Employment is the key source of income for private households. It contributes to independent livelihood security and enables social participation. In the following, we look at the development of the number of employees subject to social security payments in the regions. Employees subject to subject to social insurance contributions include all employees who are subject to health insurance, pension insurance, care insurance and/or contributions under employment promotion law or for whom parts of contributions to statutory pension insurance or under employment promotion law are payable. Employees subject to social insurance contributions do not include civil servants, self-employed persons, family members helping out, professional and temporary soldiers, as well as those in military or civilian service.

Table 7-1 shows that all mining areas as well as the regions according to sec. 11 and 12 InvKG are characterised by a positive rate of change in employment between the last quarter of 2019 and the third quarter of 2022. This means that the number of employees has increased in all mining areas compared to the level before the pandemic broke out. Employment growth is highest in the Saxon part of the Central German mining area at 1.6 percent, and in the Rhenish mining area at 1.4 percent. The lowest growth rate of 0.4 percent is found in the Lusatian mining area of Saxony. At the same time, the before-and-after comparison shows that all regions are developing less dynamically due to the pandemic. In this regard, the average annual growth rate since 2019 is in most cases significantly below the short-term or medium-term development of employment before the start of the InvKG. Particularly strong negative deviations are evident for the Lusatian mining area (SN) and the regions according to sec. 11 and 12 InvKG. A comparison of the development of employment in the mining areas with the general development of employment in the non-assisted area in East and West Germany shows mostly higher values for the mining areas compared to overall regional development. The exception is again the Lusatian mining area (SN) and the regions according to sec. 11 and 12 InvKG. However, it should also be noted that all East German mining areas, with the exception of the Saxon part of the Central German mining area, lag behind employment development in the West German counties.

The middle section of Table 7-1 represents the development of human capital-intensive employees in the mining areas. This indicator, which is relevant for the regional structural change towards a knowledge society, is approximated by the number of employees with an academic degree who are subject to social insurance payments. Here, too, there is a positive rate of change compared to December 2019, analogous to the general development of employment in the mining areas. At the same time, human capital-intensive employment shows a much more positive development than the general employment trend. The before-and-after comparison also shows the pandemic-related loss of momentum in employment development. The highest growth rates are found with an average of 4.6 percent for the Rhenish mining area, with the level of the growth rate clearly exceeding that of the

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[33] The indicators mentioned under numbers 1, 2 and 5 in section 7.1 are dealt with in section 3.1. Regarding number 6, there are no indicators currently available at county level suitable for a comprehensive evaluation.

other mining areas. In the East German mining areas, the Saxon part of the Central German mining area (3.9 percent) and Brandenburg Lusatia (2.5 percent), in particular, are developing at an above-average rate. In contrast, below-average momentum is again found in the Lusatian mining area (SN) and the Central German mining area (ST). Although growth here is positive, it is between 0.9 and 1.2 percentage points lower than in the non-assisted area of East Germany.

The lower part of Table 7-1 allows insights into the development of female employment subject to social security contributions. This is less dynamic in the East German mining areas than the general development of employment in these regions. The differences in growth rates amount to around 0.4 to 0.5 percentage points in each case. The Lusatian mining area (SN) is the only mining area to show a zero growth for female employment compared to 2019. The highest growth rates in a comparison of all mining areas are found in the Rhenish mining area with 1.7 percent. This value also exceeds the development in the West German outside the assisted area. The before-and-after comparison again shows that momentum in employment in all mining areas remains below the pre-pandemic development or stagnates at a low level (Central German mining area (ST)).

In addition to the formal qualification level of employees in Germany, the level of requirements they have to meet is also an indicator of the human capital stock and its development. The requirement level of an occupation reflects the different degrees of complexity of the underlying task. In this context, geographical differences in the activity profile can result from the increasing functional specialisation of the employees in a region. The occupational classification of the Federal Employment Agency (Classification of Occupations 2010 [KldB 2010, *Klassifikation der Berufe 2010*], see Paulus and Matthes 2013) distinguishes between four levels of requirements to reflect the degree of complexity of an occupational activity. The underlying assumption is that a certain level of skills, abilities and knowledge must be present in order to practice a certain profession. While the requirement levels are based on formal vocational education qualifications, they also allow for the qualities needed to perform an occupation to be achieved through work experience or learning-by-doing.

Table 7-1:   Development of the number of employees subject to social security contributions

Coal mining area	Rate of change in the number of employees subject to social security contributions (measured at the place of work)		
	12/2013 - 12/2019 (average annual rate of change in percent)	12/2016 - 12/2019 (average annual rate of change in percent)	12/2019 - 12/2022 (average annual rate of change in percent)
All employees			
Lusatian mining area (BB)	1.1	1.0	0.9
Lusatian mining area (SN)	1.2	1.2	0.4
Central German mining area (SN)	2.2	1.8	1.6
Central German mining area (ST)	0.9	0.8	0.8
Rhenish mining area (NRW)	2.2	2.1	1.4
Regions according to sec. 11 and 12 InvKG	1.5	1.7	0.8
Other counties in West Germany (w/o Berlin)	2.1	2.0	1.3
Other counties in East Germany (w/o Berlin)	1.1	0.9	0.6
Employees with an academic degree			
Lusatian mining area (BB)	2.9	2.8	2.5
Lusatian mining area (SN)	1.8	1.4	1.1
Central German mining area (SN)	4.5	3.9	3.9
Central German mining area (ST)	2.1	1.6	1.4
Rhenish mining area (NRW)	6.0	6.0	4.6
Regions according to sec. 11 and 12 InvKG	4.4	4.6	3.2
Other counties in West Germany (w/o Berlin)	6.4	6.0	4.8
Other counties in East Germany (w/o Berlin)	2.8	2.3	2.3
Women			
Lusatian mining area (BB)	0.9	0.8	0.5
Lusatian mining area (SN)	1.0	0.9	0.0
Central German mining area (SN)	1.7	1.4	1.1
Central German mining area (ST)	0.4	0.3	0.3
Rhenish mining area (NRW)	2.4	2.0	1.7
Regions according to sec. 11 and 12 InvKG	1.6	1.5	0.9
Other counties in West Germany (w/o Berlin)	2.2	2.0	1.3
Other counties in East Germany (w/o Berlin)	0.8	0.5	0.2

Source: Raw data: Federal Employment Agency. Own calculation.

Table 7-2 distinguishes the development of the number of employees subject to social insurance contributions according to the job requirement profile in terms of helpers, skilled workers, specialists and experts. Clear differences can be seen in the development of employment between and within the respective job profiles. Employment with 'specialist' and 'helper' requirement profiles, for instance, shows the highest growth rates since 2019. This is followed by jobs with the 'expert' requirement profile, with slightly negative growth rates found for the 'skilled workers' employment group. The development of employment with the 'expert' job profile appears particularly interesting. This profile includes highly complex tasks that usually go hand in hand with the formal qualification requirements of a university degree. The upper part of Table 7-2 shows clear differences between the mining areas. The Central German mining area (SN) shows a very dynamic development in the employment of people with this requirement profile in a before-and-after comparison (2.5 percent per year). This puts it well above the value of the non-assisted area in the East and almost on par with the value of the non-assisted area in West Germany. With an average growth of 2.4 percent, the Rhenish mining area is slightly below this development. Of the other East German mining areas, the Lusatian mining area (BB), in particular, still records positive development corresponding to that of the non-assisted area in East Germany. The Lusatian mining area (SN) and the C German mining area (ST) are clearly lagging behind in this respect, with the Lusatian mining area (SN) characterised by a negative employment trend. Both values also fall significantly behind the medium-term and short-term development of the indicator before the start of funding measures.

7.2.2   Unemployment rate

The *unemployment rate* is an indicator for the analysis of the regional employment situation and serves to measure the underutilisation of labour supply. It reflects the share of people registered as unemployed in the total labour force. In order to enable a consistent calculation of the unemployment rate over time and at the level of the mining areas, we calculate the weighted average of the unemployment rate at the level of each mining area.[34]

The analysis starts from the unemployment rate in the mining areas which is sometimes significantly higher than in the non-assisted areas in East and West Germany (see Table 7-3). Within the last six years before InvKG funding started, the East German mining areas, in particular, show a significant reduction in regional unemployment rates, so that these (with the exception of the Central German mining area ST) essentially correspond to the non-assisted area in East Germany. The Rhenish mining area and the regions according to sec. 11 and 12 InvKG do not fully follow this trend. Starting from relatively high regional unemployment rates (compared to the non-assisted area in West Germany), both regions show declines in the regional unemployment rates by 31 December 2019, but these still remain above the unemployment rates of the non-assisted area in West Germany.

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[34]   The weighting variable used is the share of the number of unemployed people in the coal mining area in the total number of unemployed people in the respective coal mining area.

Table 7-2: Development of the number of employees subject to social insurance contributions according to the job requirement profile

Coal mining area	Rate of change in the number of employees subject to social security contributions (measured at the place of work)		
	12/2013 - 12/2019 (average annual rate of change in percent)	12/2016 - 12/2019 (average annual rate of change in percent)	12/2019 - 12/2022 (average annual rate of change in percent)
Experts			
Lusatian mining area (BB)	1.4	1.8	1.2
Lusatian mining area (SN)	0.6	0.6	-0.4
Central German mining area (SN)	2.7	2.5	2.5
Central German mining area (ST)	0.5	0.6	0.0
Rhenish mining area (NRW)	3.1	3.6	2.4
Regions according to sec. 11 and 12 InvKG	2.0	2.4	1.3
Other counties in West Germany (w/o Berlin)	3.6	3.8	2.8
Other counties in East Germany (w/o Berlin)	1.2	1.3	1.2
Specialists			
Lusatian mining area (BB)	0.7	1.5	3.5
Lusatian mining area (SN)	0.8	1.2	3.3
Central German mining area (SN)	2.2	2.8	4.3
Central German mining area (ST)	0.1	0.3	3.8
Rhenish mining area (NRW)	2.0	2.0	4.5
Regions according to sec. 11 and 12 InvKG	1.2	1.5	4.5
Other counties in West Germany (w/o Berlin)	2.3	2.2	4.6
Other counties in East Germany (w/o Berlin)	1.0	1.1	4.1
Skilled labour			
Lusatian mining area (BB)	0.8	0.5	-0.4
Lusatian mining area (SN)	0.9	1.1	-0.6
Central German mining area (SN)	2.0	1.6	0.0
Central German mining area (ST)	0.6	0.4	-0.4
Rhenish mining area (NRW)	1.7	1.6	-0.1
Regions according to sec. 11 and 12 InvKG	1.0	1.4	-0.7
Other counties in West Germany (w/o Berlin)	1.6	1.5	-0.5
Other counties in East Germany (w/o Berlin)	0.6	0.5	-0.3
Helpers			
Lusatian mining area (BB)	3.9	2.4	4.0
Lusatian mining area (SN)	5.2	2.3	3.3
Central German mining area (SN)	3.3	1.4	4.2
Central German mining area (ST)	3.7	2.4	4.1
Rhenish mining area (NRW)	4.4	2.6	3.8
Regions according to sec. 11 and 12 InvKG	3.9	2.8	3.7
Other counties in West Germany (w/o Berlin)	4.0	2.4	3.5
Other counties in East Germany (w/o Berlin)	3.9	2.0	3.7

Source: Raw data: Federal Employment Agency. Own calculation.

It is worth highlighting that at the current examination margin (here 31 May 2023), all of the mining areas have a higher unemployment rate compared to December 2019. The percentage increases exceed the values of the respective non-assisted area in East and West Germany, the only exception being the Lusatian mining area (BB) where the unemployment rate is almost the same as before the start of the pandemic. The lowest unemployment rate of the mining areas in May 2023 is found in the Lusatian mining area (BB), at around 6.2 percent. This is followed by the Central German mining area (SN, 6.6 percent) and the Rhenish mining area (6.9 percent). Contrary to the general trend, the unemployment rate in the regions according to sec. 11 and 12 InvKG has risen much more sharply (+1.2 percent), and is still well above the figures for all other mining areas. Above-average values are also found for the Central German mining area (ST, 8.1 percent).

The unemployment rate can also be analysed for sub-groups. The data for the groups of women and foreigners can be found in the middle of Table 7-3 and in the lower part. The unemployment rates for women are lower than the general unemployment rates. From a dynamic perspective, it is also evident that the development of female unemployment differs only insignificantly from the general development, whereby the increase in values between 2019 and 2023 is always slightly above the general development of the unemployment rate. Only the Lusatian mining area (BB) and the Rhenish mining area (NRW) are exceptions in this regard.

The development of the unemployment rate for foreigners can be seen as one driver of regional differences in the general unemployment rate. Increases in the unemployment rates of foreigners can be found here after periods of strong immigration. However, these are usually much stronger in the East German regions (with the exception of the Central German mining area [ST]) than in the West German regions. Since the start of InvKG funding, the Lusatian mining area, in particular, and primarily the Saxon part, has seen an above-average increase in the unemployment rate. In the other mining areas, however, the unemployment rate of foreigners increased only slightly.

Table 7-3: Unemployment rate

Coal mining area	Regional unemployment rate in percent				Δ Unemployment rate 12/2019-05/2023 in %
	31 December 2013	31 December 2016	31 December 2019	30 May 2023	
All employees					
Lusatian mining area (BB)	10.9	8.4	6.1	6.2	+0.1
Lusatian mining area (SN)	10.5	8.2	6.2	7.1	+0.9
Central German mining area (SN)	9.9	7.6	5.7	6.6	+0.9
Central German mining area (ST)	11.4	9.5	7.3	8.1	+0.8
Rhenish mining area (NRW)	8.1	7.0	6.2	6.9	+0.7
Regions according to sec. 11 and 12 InvKG	11.2	10.4	8.9	10.1	+1.2
Other counties in West Germany (w/o Berlin)	6.6	6.0	5.2	5.8	+0.6
Other counties in East Germany (w/o Berlin)	9.8	7.9	6.1	6.5	+0.5
Women					
Lusatian mining area (BB)	10.8	8.0	5.6	5.7	+0.1
Lusatian mining area (SN)	10.2	7.8	5.7	6.7	+1.0
Central German mining area (SN)	9.3	7.0	5.1	6.3	+1.2
Central German mining area (ST)	11.1	9.1	6.7	7.6	+0.9
Rhenish mining area (NRW)	8.1	6.9	5.9	6.7	+0.7
Regions according to sec. 11 and 12 InvKG	11.2	10.2	8.7	10.1	+1.5
Other counties in West Germany (w/o Berlin)	6.5	5.7	4.9	5.7	+0.8
Other counties in East Germany (w/o Berlin)	9.5	7.4	5.5	6.1	+0.6
Foreigners					
Lusatian mining area (BB)	9.3	14.8	15.3	22.6	+7.2
Lusatian mining area (SN)	22.1	26.9	20.4	30.8	+10.5
Central German mining area (SN)	21.1	25.2	16.9	22.0	+5.2
Central German mining area (ST)	19.2	31.4	22.0	24.2	+2.2
Rhenish mining area (NRW)	17.5	18.0	15.2	16.7	+1.5
Regions according to sec. 11 and 12 InvKG	24.0	28.3	22.9	25.1	+2.1
Other counties in West Germany (w/o Berlin)	15.3	17.1	13.7	15.8	+2.1
Other counties in East Germany (w/o Berlin)	16.5	23.1	18.6	23.5	+5.0

Source: Raw data: Federal Employment Agency. Own calculation.

7.2.3   Employment rate

The *employment rate* measures the share of employed persons of working age in the resident population of the same age and is a key indicator for assessing the level of employment in the mining areas. The share of the working-age population in employment is subject to a variety of influences that vary from region to region. These include, for instance, the population's propensity to work, the situation of firms and the interplay between labour supply and demand. The employment rate indicates the extent to which socio-demographic conditions – especially the number and structure of the population – affect employment. It is influenced by migration and commuter flows, but also by birth trends and life expectancy in the long term. We first analyse the general employment rate for all employees. This information is supplemented by the regionally differentiated presentation of the share of employees aged 55 years and older subject to social insurance contributions as a percentage of all employees subject to social insurance contributions. Table 7-4 additionally considers various socio-demographic subgroups (especially women and foreigners) (Grimm 2021).

Table 7-4 shows that the vast majority of mining areas are characterised by steadily rising employment rates. That being said, the employment rates in the East German coalfields, also from a historical perspective, are already significantly higher than those of the Rhenish mining areas and the regions according to sec. 11 and 12 InvKG. Since 31 December 2019, the employment rate has continued to increase in all mining areas except the Lusatian mining area (SN). In the East German mining areas, it is roughly on par with the regional benchmark, with minor deviations. For the Rhenish mining area and the regions according to sec. 11 and 12 InvKG, employment rates have so far also been below average compared to the non-assisted area in West Germany.

At the same time, the mining areas differ significantly in terms of the demographic structure of the workforce. While both parts of the Lusatian mining area are characterised by the highest shares of employees aged 55 years and older as a proportion of all employees (over 28 percent in each case), the Saxon part of the Central German mining area shows significantly lower values (22 percent), also by regional comparison. The values for the remaining mining areas are roughly on par with the value for the non-assisted area in East and West Germany. Looking at the development of employment rates for women and foreigners, we first see regional differences in the level of employment rates. While, analogous to the general employment rates, the women-specific data also show a continuous increase for the most part (again with the exception of the Lusatian mining area (SN) and the Central German mining area (ST)), the level in the West German mining areas continues to be significantly below the values of the East German mining areas, but also generally below the values of the non-assisted area in West Germany. At the same time, especially in the East German mining areas, the employment rate of women differs only slightly from the general employment rates, which suggests an approximately equal labour force participation of men and women. In the West German mining areas, on the other hand, these differences are significant and remain stable over time.

Table 7-4: Employment rates

Coal mining area	Employment rates				Share of employees subject to social security contributions aged 55 years and older (WO)
	12/2013	12/2016	12/2019	06/2022	in percent
All employees					
Lusatian mining area (BB)	57.1	60.3	64.6	64.9	28.2
Lusatian mining area (SN)	59.4	62.3	66.2	65.8	28.5
Central German mining area (SN)	58.7	61.4	64.6	65.3	21.9
Central German mining area (ST)	57.2	60.3	64.0	64.4	26.2
Rhenish mining area (NRW)	52.1	55.4	58.8	59.8	23.3
Regions according to sec. 11 and 12 InvKG	51.1	53.3	57.5	58.4	23.4
Other counties in West Germany (w/o Berlin)	55.5	58.2	61.7	62.7	22.8
Other counties in East Germany (w/o Berlin)	58.7	61.5	64.9	65.0	26.4
Women					
Lusatian mining area (BB)	57.0	60.4	64.3	64.4	No data
Lusatian mining area (SN)	59.2	62.7	66.4	65.7	No data
Central German mining area (SN)	59.1	62.0	64.4	64.5	No data
Central German mining area (ST)	56.4	59.8	62.7	62.6	No data
Rhenish mining area (NRW)	47.0	50.9	54.2	55.4	No data
Regions according to sec. 11 and 12 InvKG	46.7	49.8	53.3	54.2	No data
Other counties in West Germany (w/o Berlin)	51.2	54.6	57.8	58.7	No data
Other counties in East Germany (w/o Berlin)	58.8	62.0	64.9	64.5	No data
Foreigners					
Lusatian mining area (BB)	29.0	30.6	39.3	52.8	No data
Lusatian mining area (SN)	28.5	28.9	42.1	51.4	No data
Central German mining area (SN)	28.2	30.1	40.4	50.1	No data
Central German mining area (ST)	23.9	28.5	43.4	53.7	No data
Rhenish mining area (NRW)	36.1	37.1	45.6	52.5	No data
Regions according to sec. 11 and 12 InvKG	32.0	33.5	40.7	46.6	No data
Other counties in West Germany (w/o Berlin)	41.0	43.8	51.3	57.4	No data
Other counties in East Germany (w/o Berlin)	29.2	31.4	42.3	53.0	No data

Source: Raw data: Federal Employment Agency. Own calculation. No data = no information possible. WO = Employee's place of residence. The employment rate indicates the share of employees subject to social insurance contributions in the group (total, women, and foreigners) in the working-age population of the group.

The employment rates of foreigners also show positive development momentum. This is where the strongest increases over time can be found in a group comparison, whereby the East German mining areas, in particular, have now clearly caught up with the values of the non-assisted area in West Germany after low initial values in 2013. In 2021, the regions according to sec. 11 and 12 InvKG have the lowest values in a territorial comparison.

7.2.4 Number of vacancies

The data regarding the *development of the number of vacancies* contain information on the unsatisfied demand for labour and provides an insight into the emergence of possible imbalances on the labour market. A vacancy is defined as a newly created, unfilled or soon to be vacant paid position. Table 7-5 illustrates that the mining areas are characterised by different dynamics in the area of vacancies. While all mining areas were characterised by an increase in the number of vacancies by the end of 2019, this increase was concentrated in the East German mining areas and the regions according to sec. 11 and 12 InvKG. The Rhenish mining area was characterised by the smallest increase in vacancies during this period. This trend has reversed since 2019. Still, all regions are characterised by an increase in vacancies. However, there is a geographical shift, so that the Lusatian (BB) and the Rhenish mining areas now record the highest growth rates, exceeding the values of the non-assisted area in East and West Germany, respectively.

This development is also reflected in the number of positions to be filled immediately. Whereas before 2019 the values of this indicator were negative for the Lusatian (BB) and the Central German mining area (ST), these values are now positive everywhere. They are particularly pronounced in the Rhenish mining area (NRW), the Central German mining area (SN), the regions according to sec. 11 and 12 InvKG and the Lusatian mining area (BB). When looking at the development of vacancies by requirement level, it is also evident that this development particularly affects the area of human capital-intensive employment where the rate of change in vacancies compared to vacancies overall is again significantly higher. In the Lusatian (BB), the Central German (SN) and the Rhenish mining areas in particular, the development exceeds the comparative values in the East and West German regions outside the assisted areas. A sharp decline in this context is seen in the Saxon part of Lusatia.

Table 7-5:   Number of vacancies

Coal mining area	Total vacancies		Change in the number of vacancies (average annual change in percent) Positions to be filled immediately		Vacancies with 'expert'/'specialist' requirement level	
	12/2016 - 12/2019	12/2019 - 11/2022	12/2016 - 12/2019	12/2019 - 11/2022	12/2016 - 12/2019	12/2019 - 11/2022
Lusatian mining area (BB)	3.7	9.8	-1.7	14.7	4.9	11.9
Lusatian mining area (SN)	5.3	0.6	7.4	4.5	7.3	1.8
Central German mining area (SN)	8.2	6.0	13.9	19.0	9.8	7.1
Central German mining area (ST)	4.9	4.3	-0.5	12.2	8.0	5.4
Rhenish mining area (NRW)	0.7	7.4	1.9	20.7	1.7	7.8
Regions according to sec. 11 and 12 InvKG	10.4	6.6	10.3	17.4	11.5	7.6
Other counties in West Germany (w/o Berlin)	1.2	7.0	0.7	13.7	1.9	7.7
Other counties in East Germany (w/o Berlin)	2.9	5.0	4.8	10.5	4.2	6.4

Source: Raw data: Federal Employment Agency. Own calculation.

7.2.5   Median wages

The wage statistics are part of the employment statistics and provides an insight into the *gross monthly wage of* employees subject to social insurance contributions. The wage information is taken from employer data reported to social insurance organisations. The following analysis considers wages before taxes and social security contributions. In order to obtain comparable data, wages are standardised to a uniform monthly period and related to full-time employees of a core group who are subject to social insurance contributions.[35]

Table 7-6 maps the development of median wages in absolute terms and in relation to the national average for the period from 2016 to 2021. This shows a continuous increase in wages in all mining areas over time. In order to better interpret this development – especially against the background of relatively high inflation in the recent past – the lower part of the table puts median wages in relation to the national average of the respective year. As a first – expected – result, clear differences in levels are found between the East and West German regions. Within the East German mining areas, median wage is lowest (69.1 percent in 2016) in the Lusatian coalfield (SN). This converges with the national average by 4.4 percentage points between 2016 and 2021. This is followed by the Lusatian mining area (BB) and the Central German mining area (ST). These two regions are characterised by almost identical median

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[35]   It must be noted that employers only have to report gross monthly wages subject to social security contributions up to the income threshold for pension insurance. Due to the limitation of the income distribution at the upper margin, the calculation of the arithmetic mean is methodologically pointless since actual gross monthly wage above the income threshold is not known. Quantiles are a suitable means of characterising the dispersion of wages. The wage statistics usually consider the median which divides wages into two halves: One half of the employees earns wages below the median, while wages of the other half is above the median.

wages and development dynamics. Both regions have median wages of around 82 percent of the national average in 2021 (growth of 3.8 and 4.1 percentage points, respectively). In terms of their growth momentum, however, both mining areas lag slightly behind the non-assisted area in East Germany. Highest median wages of the East German mining areas are found in the Central German mining area (SN), with growth totalling between 81.2 and 86.1 percent of the national average (+4.9 percentage points).

Table 7-6:   Development of median wages

Coal mining area	2016	2017	2018	2019	2020	2021
Development of median wages in euro						
Lusatian mining area (BB)	2,434.6	2,497.0	2,603.3	2,710.1	2,765.9	2,866.1
Lusatian mining area (SN)	2,165.1	2,239.8	2,342.1	2,449.6	2,483.0	2,583.7
Central German mining area (SN)	2,543.1	2,632.5	2,755.3	2,868.8	2,918.1	3,028.3
Central German mining area (ST)	2,437.9	2,522.2	2,618.2	2,735.2	2,786.4	2,878.8
Rhenish mining area (NRW)	3,160.0	3,238.7	3,321.7	3,398.1	3,418.6	3,499.0
Regions according to sec. 11 and 12 InvKG	3,036.7	3,104.1	3,176.8	3,273.8	3,289.7	3,360.7
Other counties in West Germany (w/o Berlin)	3,329.1	3,406.2	3,505.1	3,601.5	3,617.3	3,700.9
Other counties in East Germany (w/o Berlin)	2,415.3	2,498.6	2,599.8	2,709.6	2,762.4	2,871.5
Development of median wages compared to the national average (Germany = 100)						
Lusatian mining area (BB)	77.7	77.8	78.8	79.7	80.7	81.5
Lusatian mining area (SN)	69.1	69.8	70.9	72.0	72.5	73.5
Central German mining area (SN)	81.2	82.0	83.4	84.4	85.1	86.1
Central German mining area (ST)	77.8	78.6	79.2	80.4	81.3	81.9
Rhenish mining area (NRW)	100.9	100.9	100.5	99.9	99.8	99.5
Regions according to sec. 11 and 12 InvKG	96.9	96.7	96.1	96.3	96.0	95.6
Other counties in West Germany (w/o Berlin)	106.3	106.1	106.1	105.9	105.6	105.3
Other counties in East Germany (w/o Berlin)	77.1	77.9	78.7	79.7	80.6	81.7

Source: Raw data: Federal Employment Agency. Own calculation. No data = no information possible. WO = Employee's place of residence. The employment rate indicates the share of employees subject to social insurance contributions in the group (total, women, and foreigners) in the working-age population of the group.

A fundamentally different development emerges for the Rhenish mining area and the regions according to sec. 11 and 12 InvKG which are characterised by significantly higher median wages compared to the East German mining areas. At the same time, however, the two regions are linked by negative development momentum. Accordingly, the values for the Rhenish mining area fall from just above the national average in 2016 (100.9 percent) to just below the national average in 2021 (99.5 percent, -1.4 percentage points overall); the same can be seen for the regions according to sec. 11 and 12 InvKG. Median wage also falls by 1.3 percentage points relative to the national average.

7.2.6 Migration rate

Geographically differentiated *migration movements* are a driver of population development. In principle, the number of inhabitants in a region can change due to natural population movements as well inbound and outbound migration. Inbound and outbound migration is closely related to the economic situation and the attractiveness of the regions of origin and destination. Net migration is the difference between inbound and outbound migration across the borders of an administrative territorial unit (counties) in a given year. The migration rate refers to inbound and outbound migration per 1,000 inhabitants. The analysis of the migration rate by mining area shows that the migration balance is not positive in all regions. At the same time, different trends can be identified between the East and West German mining areas (see Fig. 7-1).

The Central German mining area (SN), for instance, is characterised by a persistently positive immigration rate and thereby differs from the rest of the region. It varies with the periods of increased (refugee) migration to Germany but is also positive in times of low external migration balances. The indicator is different in the other three mining areas in East Germany which are characterised by negative migration rates at the beginning of the period under consideration and only turn positive from 2015 onwards. Since then, the Lusatian mining area (BB) has recorded the highest migration gains, which have continued to increase since 2020. In contrast, the Lusatian mining area (SN) and the Central German mining area (ST) have only achieved slightly positive or slightly negative values since 2015, which have only led to positive migration rates since 2020 and increasingly in 2021. The Rhenish mining area and the regions according to sec. 11 and 12 InvKG are characterised by persistently positive net migration rates, but these are significantly lower than those in the Central German mining area. They show similarities to the values of the non-assisted area in West Germany, with slight deviations especially in the years of strong immigration to Germany in 2015/2016. In principle, however, it can be stated that all mining areas have shown positive migration rates since 2018, which also contrasts positively with the previous medium-term development of the migration rate (especially in the East German mining areas).

Fig. 7-1:   Migration rate
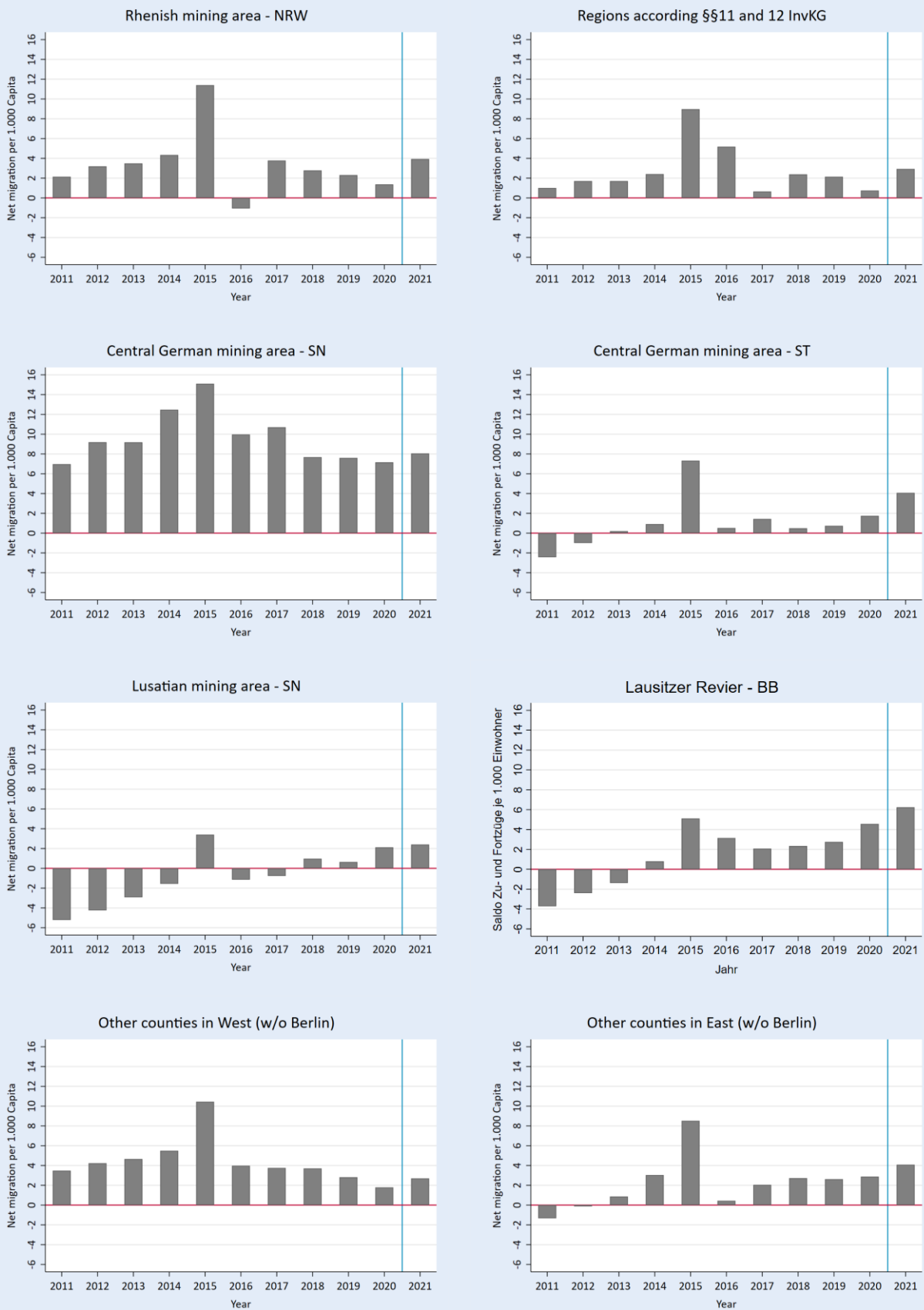
Source: Raw data from the regional database Germany. Own calculation.

7.2.7 Private investment

With regard to the assessment of *private investment activity of companies* in the mining areas, we use information from the manufacturing sector. The 'investment intensity' indicator, for instance, shows the investments per person working in this sector and allows conclusions to be drawn about the development of capital input in production. Table 7-7 shows the development of the values for the period from 2013 to 2021. It should be noted in the explanations that only very limited information is currently available for the Rhenish mining area (NRW) and that only information for the year 2021 can serve as initial indications of the development of investment intensity after the start of funding.

Table 7-7: Development of private investment (investment per person employed in the manufacturing sector)

Coal mining area	Average annual investment per person employed in the manufacturing sector in euro			
	2013 - 2019	2016 - 2019	2020	2021
Lusatian mining area (BB)	12,122	12,191	18,425	17,259
Lusatian mining area (SN)	9,605	9,059	12,083	7,455
Central German mining area (SN)	12,395	10,799	10,779	12,917
Central German mining area (ST)	12,933	14,076	13,762	16,085
Rhenish mining area (NRW)	No data	No data	No data	No data
Regions according to sec. 11 and 12 InvKG	11,622	11,737	7,635	9,357
Other counties in East Germany (w/o Berlin)	10,061	10,153	9,599	10,844
Germany as a whole (with assisted area)	9,979	10,337	9,636	9,929

Notes: The most recent data status of the county results is the year 2021 as per 30 June 2023. No data for the Rhenish mining area since the results of the investment survey in the manufacturing sector for North Rhine-Westphalia had to be subjected to more extensive quality assurance at short notice. The results were therefore removed or blocked from all IT.NRW publications. So far, only data for 2021 are available, but data are missing here for the counties of Düren, Euskirchen and Heinsberg. The regions according to sec. 11 and 12 InvKG therefore also consist only of the Altenburger Land, the Rostock county, the Hanseatic and University City of Rostock, the Saarbrücken regional association, the Saarlouis county and the City of Wilhelmshaven.

Source: Raw data from the regional database Germany. Own calculation.

Looking at the characteristics of the indicator, it becomes clear that the mining areas are predominantly characterised by above-average to strongly above-average investment intensities. Only the Lusatian mining area (SN) shows below-average investment intensity in the manufacturing sector at the current margin (2021) and from a medium-term perspective (2016-2019) compared to East Germany but also Germany as a whole. The development of investment intensity in the regions according to sec. 11 and 12 InvKG is similar. While these still showed above-average values in investment intensity from a long-term perspective, this clearly decreases when looking at the short and medium term. This development is also seen in the Lusatian mining area (SN). The following years will have to show whether short-term developments are driving this development or whether they can be attributed to structural developments. This is all the more important as the mining areas with the highest investment intensity

(the Lusatian mining area (BB) and the Central German mining area (ST)) show significant increases in investment intensity during the same period of the study. This is evident from both a short-term and a medium-term perspective. A relatively constant investment intensity can be seen in the Central German mining area (SN) where investment intensity is approaching the long-term average at the current margin.

7.2.8 Start-up activity

Start-ups implement new ideas, products, services and business models. They keep competitive pressure high and promote the need to innovate in the respective industries. This makes them an essential element when it comes to modernising the (regional) economic structure. In the following we look at the development of business registrations and the balance of business registrations as well as deregistrations per 10,000 employees as an indicator of economic momentum in the mining areas and beyond. It should be noted, however, that these indicators do not allow any direct statements to be made about any differences in the quality of start-ups between the regions. This must be left to more in-depth analyses.

Start-up intensity in Germany has been declining since the financial crisis, and this trend continued until 2019. Following a slight recovery in business registrations in 2021, 2022 again shows a decline in business registrations in the counties outside the assisted area of the InvKG (see Table 7-8 above). Within the mining areas of the InvKG, the development of business registrations is more differentiated. In the Lusatian region (BB), for instance, business registrations declined until 2021, accompanied by an increase in start-up activities at the current margin. In contrast, the Lusatian, (SN), Central German (ST) and Rhenish mining areas (NRW) and the regions according to sec. 11 and 12 InvKG are characterised by further declines in start-up activities, with clear differences in levels remaining between the mining areas. The Rhenish mining area (NRW) records the highest average annual number of business registrations per 10,000 employees. The values for the Lusatian mining areas (BB) and (SN) and the Central German mining area (SN) also continue to be above those of the non-assisted area in East Germany.

A look at the balance of business registrations and deregistrations shows a more favourable assessment of start-up activity. The Rhenish mining area (NRW), for instance, is consistently characterised by a positive balance of business registrations and deregistrations, which in its level and development momentum also roughly corresponds to that of the non-assisted area in West Germany. The picture for the East German mining areas is more mixed, with only the Central German mining area (SN) consistently recording a positive balance of business registrations and deregistrations. The regions according to sec. 11 and 12 InvKG also show predominantly positive balances. The other East German mining areas only show a positive balance in 2021 and 2022. In the Lusatian mining area (BB) and in the Central German mining area (ST), positive values are found which are clearly above (Lusatian mining area [BB]) and clearly below (Central German mining area [ST]) the development in the non-assisted area of East Germany. The Lusatian mining area (SN), on the other hand, is the only area that shows negative balances throughout the entire period under consideration and thus develops contrary to the trend of the reference categories.

Table 7-8:   Development of start-up activities

Coal mining area	Development of start-up activities			
	2014 - 2016	2017 - 2019	2021	2022
Average annual number of business registrations per 10,000 employees				
Lusatian mining area (BB)	184.6	166.8	158.4	177.5
Lusatian mining area (SN)	215.1	206.1	184.5	178.3
Central German mining area (SN)	217.4	190.7	185.3	179.3
Central German mining area (ST)	155.2	141.2	134.5	132.3
Rhenish mining area (NRW)	296.5	266.0	253.7	252.5
Regions according to sec. 11 and 12 InvKG	226.5	206.0	199.2	191.5
Other counties in West Germany (w/o Berlin)	230.0	205.1	211.4	196.8
Other counties in East Germany (w/o Berlin)	178.2	159.0	163.1	158.1
Average annual balance of business registrations and deregistrations per 10,000 employees				
Lusatian mining area (BB)	-11.0	-7.1	16.1	19.8
Lusatian mining area (SN)	-9.9	-8.4	-7.7	-1.7
Central German mining area (SN)	14.0	8.3	37.0	25.8
Central German mining area (ST)	-26.0	-21.0	7.8	3.3
Rhenish mining area (NRW)	14.7	8.8	52.5	36.4
Regions according to sec. 11 and 12 InvKG	-4.6	2.2	41.0	26.3
Other counties in West Germany (w/o Berlin)	11.9	16.4	53.5	34.5
Other counties in East Germany (w/o Berlin)	-16.2	-15.5	14.5	9.1

Source: Raw data from the regional database Germany. Own calculation.

7.2.9   Tax revenue

Taxes are the central source of revenue for the Federal Government, the federal states and municipalities. Municipalities can independently determine the amount of property and business taxes within certain limits by setting the respective assessment rates. A comparison of the tax collection capacity of municipalities becomes possible if differences in assessment rates are eliminated through standardisation and a homogeneous assessment rate at the same level is assumed. We use three measures to analyse tax revenue in the municipalities of the mining areas. These include real tax collection capacity, municipal tax revenue capacity and the business tax assessment rate.

Real tax collection capacity is the sum of collection capacity for real estate tax A, real estate tax B and business tax. The collection capacity figures are calculated by multiplying the basic amounts per tax and municipality by the weighted national average assessment rates per tax. This procedure gives a fictitious real tax revenue that eliminates the effect of different assessment rates at municipal level. In contrast,

municipal tax collection capacity is another measure for assessing the economic performance of municipalities. It results from real tax collection capacity plus the municipal share of income tax (target) and sales tax minus the business tax levy (target). We use a second normalisation per inhabitant in order to make these figures comparable for regions of different sizes.

Table 7-9 describes the development of tax revenue in the mining areas. Analogous to what was explained earlier, clear differences can be seen between the regions. In a comparison of all regions, the Lusatian mining area (BB) has the highest average real tax collection capacity over the entire period under study. This has risen again at the current margin after the start of funding under the InvKG. This is followed by the Rhenish mining area (BB) and the Central German mining area (ST). Significantly lower values are found in the Lusatian mining area (SN) and in the Central German mining area (SN). The Lusatian mining area in Saxony is the only region that was permanently below the values of the non-assisted areas in East Germany before funding started. The same applies to the Rhenish mining area (NRW) as well as to the regions according to sec. 11 and 12 InvKG. In terms of real tax revenue collection capacity, these are also in part very clearly behind the value of the non-assisted areas in West Germany.

This perspective does not change significantly when considering municipal tax collection capacity. In this regard, the regional variance in revenue flows, which results from adding the municipal shares in income tax (target) and sales tax minus the business tax levy (target), is very low in the East German mining areas, with a slightly increased relative tax collection capacity in the Central German mining area (SN) and the Lusatian mining area (BB). Relative gains in importance are more evident in the East-West comparison, as the Rhenish mining area and the regions according to sec. 11 and 12 InvKG experience significantly higher gains here compared to the East German regions. It is also evident that the development of tax revenue improved in 2021: In all mining areas, the values for 2021 exceed the average values from 2016 to 2020. Only in the Central German mining area, we can observe a value for real tax collection capacity in 2021 that is only slightly above the medium-term average.

Table 7-9: Development of tax revenue

Coal mining area	2016	2017	2018	2019	2020	2021
Real tax collection capacity						
Lusatian mining area (BB)	722.0	904.8	860.9	930.4	710.1	1024.0
Lusatian mining area (SN)	379.5	444.3	440.0	479.7	409.2	705.6
Central German mining area (SN)	503.2	516.2	540.0	582.4	469.4	638.1
Central German mining area (ST)	848.3	619.3	623.1	569.9	521.7	564.0
Rhenish mining area (NRW)	625.1	759.2	722.7	724.4	636.0	696.6
Regions according to sec. 11 and 12 InvKG	487.0	550.8	560.0	525.4	456.5	558.4
Other counties in West Germany (w/o Berlin)	854.2	883.0	928.1	921.4	788.2	1001.8
Other counties in East Germany (w/o Berlin)	460.9	500.0	522.7	538.9	477.5	579.4
Tax collection capacity						
Lusatian mining area (BB)	1,004.3	1,200.0	1,193.5	1,285.8	1,079.0	1,399.0
Lusatian mining area (SN)	638.2	722.9	742.1	805.7	738.3	1034.4
Central German mining area (SN)	794.2	829.9	888.7	954.4	843.5	1038.6
Central German mining area (ST)	1,068.5	886.6	915.2	889.7	853.4	909.6
Rhenish mining area (NRW)	1,043.2	1,192.6	1,202.6	1,240.5	1,186.0	1,283.5
Regions according to sec. 11 and 12 InvKG	819.4	906.8	948.3	947.9	902.2	1,023.0
Other counties in West Germany (w/o Berlin)	1,279.5	1,357.0	1,432.3	1,476.7	1,386.6	1,624.9
Other counties in East Germany (w/o Berlin)	749.1	812.2	865.2	905.5	847.7	969.7
Trade tax assessment rate						
Lusatian mining area (BB)	316	326	326	326	328	327
Lusatian mining area (SN)	401	397	401	399	399	399
Central German mining area (SN)	432	433	433	434	434	434
Central German mining area (ST)	349	361	361	369	378	387
Rhenish mining area (NRW)	467	469	470	472	472	472
Regions according to sec. 11 and 12 InvKG	459	462	463	463	463	463
Other counties in West Germany (w/o Berlin)	400	402	403	404	403	404
Other counties in East Germany (w/o Berlin)	387	389	390	390	392	393

Source: Raw data: www.regionalstatistik.de. Municipal tax collection capacity indicates the tax revenues with standardised adjustment of the assessment rates. It is calculated from the sum of standardised real estate taxes A and B, standardised trade tax, the municipal shares in income tax and turnover tax as well as other municipal taxes minus the trade tax levy and divided by the number of inhabitants.

Finally, the weighted averages of the local business tax assessment rates are analysed in the lower part of Table 7-9. In view of the increasing mobility of companies, many countries and regions are reducing taxes in order to attract investment and jobs. In mining areas too, the question is whether and how to respond to tax competition and adjust tax rates on corporate profits. A comparison of trade tax rates shows that the Lusatian mining area (BB) has the lowest values in a regional comparison, but also with regard to the assessment rates in the non-assisted area. Although a medium-term increase in assessment rates is seen during the period under review, the value still remains clearly below the level of the other regions. The second lowest values are found in the Central German mining area (ST). However, this mining area has also seen the strongest increase in tax rates over time and also since funding began. In the other regions, the business tax collection rate remains relatively constant over time, with the levels in the Rhenish mining area and the regions according to sec. 11 and 12 InvKG clearly above the value of the East German regions and also above those of the non-assisted areas in West Germany.

7.3 Comparison of the development of the InvKG regions with counties outside the assisted area

As discussed above, the measures under the InvKG are implemented in complex environments. These include, above all, the phase-out of (lignite) coal-fired power generation, which has or will have a complementary negative shock on the regional development of the InvKG regions due to the regional distribution of power plant locations and mining sites (see Chapter 6). It must also be examined whether other factors (such as the regional impacts of the pandemic or the war in Ukraine) as well as the impacts of other policy measures, such as the joint Federal/Länder programme for improving regional economic structures (GRW) or the IPCEI (Important Project of Common European Interest), have an impact on the mining areas or other regions. It is precisely the parallelism of these events (pandemic, Ukraine war, other large-volume funding programmes) that presents a major challenge for the analysis of the impacts of funding under the InvKG. The expected regional impacts of the phase-out of (lignite) coal-fired power generation are modelled in Chapter 6. Section 7.2 provides an initial insight into the development of the InvKG target figures before and after funding started. This section now specifically addresses the links between the InvKG and regional development in the assisted areas which must be interpreted in view of the expected negative impacts of the coal phase-out on the assisted areas. It is to be expected, for instance, that the affected companies (and regions) are already adapting their strategies, for example by reducing the number of new hires or apprenticeship places and by changing their funding priorities. It must also be considered that the funding programme was launched right in the middle of the Covid-19 pandemic. Against this background, the following analyses – with a conservative interpretation – only allow statements about an overall effect, i.e., an overall effect of the measures under the Coal-fired Power Generation Termination Act and the InvKG given the funding landscape in the assisted areas and beyond.

In future, the goal must be to isolate the specific effect of the InvKG from these other effects, specifically from the coal phase-out. Only then will it be possible to determine precisely whether the measures under the InvKG were in fact the reasons for the subsequent development of the assisted areas. Without a credible causal research design, correlations could be misinterpreted as causalities. Just because two phenomena (such as InvKG measures and positive economic development of the assisted areas) occur at the same time does not necessarily mean that they are linked. The following research design is

intended to help avoid these misinterpretations and to enable a sound assessment of the impacts of the measures under the InvKG.

We use an event study design to evaluate the achievement of the goals of the InvKG. This approach has proven successful in recent studies on the impacts of place-based policies, such as the regional impacts of GRW funding (see Siegloch, Etzel and Wehrhöfer 2022). An event study design examines how an event (in this case the entry into force of the InvKG) influences the development of the mentioned target variables by using a control group of other regions. The control group in this case consists of similar counties in Germany, which are, however, not the subject of funding under the InvKG. By comparing the development of the target variables between the two groups of regions, we can find indications for the actual impact of InvKG funding.

The design of the control group is of crucial importance for the validity of the results. It helps to understand the (causal) relationship between InvKG funding and the changes observed. The event study design for analysing the correlations between the economic policy targets of the InvKG can be implemented as follows:

1. Selection of the treatment time or funding event, respectively:

    *   Entry into force of the InvKG on 14 August 2020, i.e., the treatment date corresponds to the third quarter of 2020 for quarterly data or the year 2020 for annual data

2. Selection of the assisted areas:

    *   Level of analysis: Counties (level of policy intervention, the law defines assisted areas at the level of the counties)
    *   Identification of assisted areas according to sec. 2 InvKG (22 counties)
    *   Additional consideration of eligible municipalities and municipal associations according to sec. 11 and 12 InvKG (ten counties as structurally weak locations of hard coal-fired power plants as well as two further counties [Helmstedt and Altenburger Land] with reference to lignite coal)

3. Selection of the comparison group:

    *   Identification of a suitable control group of counties
    *   Structural characteristics as similar as possible to the assisted areas, but not affected by InvKG funding

4. Period of analysis:

- Depending on data availability, different periods of analysis, covering the periods before and after funding starts
- Period before funding starts: the last four years before funding started[36] (16 quarters, start of the study period: second quarter of 2016)
- Period after funding started: currently at least two years after entry into force of the InvKG (≥ 8 quarters, end of the study period depending on data availability, currently third quarter of 2022)

5. Statistical analysis:

- Determination of the impacts on the basis of a two-way fixed effects model[37]
- Use of different control variables (such as Covid-19 situation, human capital availability, sectoral specialisation, region size, etc.) for the estimates
- Consideration of the impact of funding over time

While steps one and two of the implementations rely on the legal framework (InvKG), the make-up of the control group depends on the evaluation design. The following analysis uses the comparison group defined in section 2.3. The analysis examines whether the selected counties in the control group have undergone similar developments as the InvKG-assisted areas in the past with regard to the target variable. The four-year period before the start of funding described above is used for this purpose. This can of course be extended depending on data availability. The approach enables a comparison of the impacts of InvKG funding and the impacts of the coal phase-out on the assisted areas by comparing the development with regions that face similar structural challenges but do not receive funding under the InvKG.

The study follows the approach by Clarke and Tapia-Schythe (2022) to estimate the impacts of funding and uses the following econometric approach (15):

$$y_{rt} = \alpha + \sum_{j=1}^{J} \beta_j \, (\text{Lead } j)_{rt} + \sum_{k=2}^{K} \gamma_k \, (\text{Lag } k)_{rt} + \mu_r + \lambda_t + X'_{rt}\Gamma + \varepsilon_{rt} \tag{15}$$

where index r represents the region (counties) and index t represents the time variable (quarters). The variable y represents the target variable of interest. The variables μ and λ absorb events that do not change over time for each individual region and that are time-variable but affect all regions simultaneously, i.e., impacts that are fixed for regions and in time. X stands for variables that change

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[36] Siegloch, Etzel and Wehrhöfer (2022) also use this time span in their study on the impacts of GRW funding. In addition, the data series for individual target variables only start in 2016 and distortions caused by events such as the refugee crisis in 2015 are reduced.

[37] By using fixed effects for the different regions (counties and county-free cities) and time periods (quarterly or annual data, depending on the reporting cycle of the underlying data), the model enables the control of unobserved, time-independent heterogeneity. This takes into account potential influences that are constant over time and/or may vary between regions. As with any econometric analysis, endogeneity problems can potentially occur. Unobserved time-varying factors related to the regions or time periods may influence the estimation of the coefficients and distort the results. It is therefore important to use appropriate control variables and to address potential endogeneity problems.

over time in the regions. They are considered as control variables in the estimation. Finally, the variable ε denotes the error term.

The 'Lead' and 'Lag' variables are dummy variables that represent a point in time in comparison of before or after the event, i.e., the entry into force of the InvKG. The reference category in our setting is $k=1$, i.e., the third quarter of 2020. The indices j and k thus each represent a certain number of quarters before and after the coming into force of the InvKG.[38] The coefficients of interest are β and γ. They show whether the development of a target variable differs at a point in time relative to the event between the InvKG counties and the counties of the control group. In order for the results to be interpreted in terms of causality, there may be no differences in the development between the InvKG counties and the counties of the control group before the event occurred.

The present study now focuses primarily on labour market-relevant target variables, since data on these indicators are already available for 2022 or 2023[39] and, as discussed in Chapter 4, impacts of funding can be assumed at an early stage. Under the set of different labour market objectives, the analysis focuses on the development of employees subject to social security payments, the regional unemployment rate as well as the immediate vacancies to be filled in the regions. The study also considers various control variables that (may) change differently over time between the counties and at the same time influence the target variable. These include regional structural weakness (operationalised via a standardised rank based on the GRW structure indicator), the share of highly qualified employees, the sectoral specialisation of the regions (measured via the Herfindahl index) as well as agglomeration effects (mapped via employment density). Since the study period directly coincides with the peak phase of the Covid-19 pandemic, the regional infection incidence is also included in the estimation. The descriptive statistics of the three target variables and the five control variables are shown in Table 7-10.

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[38] The dummies for the periods before and after the event are all coded with zero in the data set for the counties in the control group and are thus the reference category in the estimation equation.

[39] No evaluable data are so far available for indicators of economic growth and value added, tax revenue and environmentally relevant target variables. The impacts of these indicators can only be expected with a considerable time lag anyway.

Table 7-10: Descriptive statistics

Variable		Number of observations	Mean value	Standard deviation	Minimum	Maximum
Target variables						
Employees (logarithmised)	InvKG counties	572	11.3	0.5	10.4	12.6
	Control counties	2,496	10.7	0.6	9.5	12.6
Unemployment rate	InvKG counties	572	0.07	0.02	0.04	0.12
	Control counties	2,496	0.06	0.02	0.02	0.15
Total vacancies (logarithmised)	InvKG counties	572	7.4	0.6	6.2	9.2
	Control counties	2,496	6.9	0.6	5.2	8.9
Control variables						
Rank score	InvKG counties	572	0.74	0.22	0.16	1.00
	Control counties	2,496	0.67	0.15	0.12	1.00
Share of highly qualified employees	InvKG counties	572	0.13	0.04	0.08	0.26
	Control counties	2,496	0.11	0.05	0.05	0.36
Herfindahl index	InvKG counties	572	0.10	0.01	0.08	0.12
	Control counties	2,496	0.12	0.03	0.08	0.23
Density	InvKG counties	572	180.9	246.0	17.0	976.7
	Control counties	2,496	173.2	238.4	11.1	1,116.9
Number of infections	InvKG counties	572	3,957.6	10,977.8	0.0	113,019.0
	Control counties	2,496	2,125.5	6,182.7	0.0	85,156.0

Source: Own presentation.

The following illustrations visualise the estimation results for the three target variables of interest. Each illustration presents three specifications: 1) without control variables, 2) with regional control variables and 3) additionally considering regional infection incidence.

Regarding the development of employment, Fig. 7-2 shows that the InvKG regions developed similarly to the counties in the control group in the quarters before the coming into force of the InvKG, regardless of the specification. However, the quarterly impacts do not fully absorb all seasonal differences between the InvKG regions and the counties of the control group. As regards the quarters after the coming into force of the InvKG, we do not see any significant difference in the change in employment subject to social security contributions between the counties of the InvKG-assisted area and their control group when the phase-out of thermal utilisation of (lignite) coal begins (i.e., employment reduction in the coal industry), again independent of the specification. This finding should be discussed against the background of the aspects mentioned above.

Firstly, the coal phase-out is taking place in a regionally heterogeneous manner, i.e., with a time lag in the mining areas – in the Rhenish mining area, it was brought forward, while in the Central German and Lusatian mining areas, it is taking place as scheduled according to current knowledge. An opposing trend is also emerging with the intensified use of lignite coal due to the energy crisis in the wake of the Ukraine war at the current end point of the study period. Here, some power plant capacities in the Lusatian and Rhenish mining areas re-entered again, at times in conjunction with an increase in employment in the respective mining areas.

Secondly, the theoretical analysis in Chapter 4 as well as the descriptive study in Chapter 5 showed that so far only a relatively small amount of project funds was spent in relation to the total budget and that the impact of a large number of projects, due to their nature and design, must be expected to be considerably delayed. Given the outflow of funds, the temporal availability of various possible target variables and an impact period of currently 2 to 2.5 years at the most, it is not surprising that the development of employment in the InvKG-assisted area does not differ from the counties in the control group.
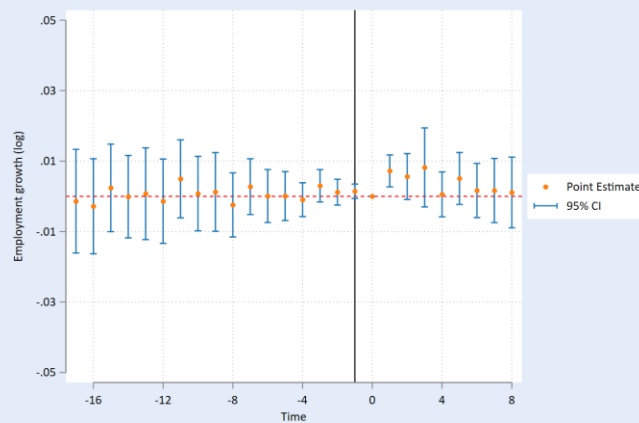
It should also be emphasised that no causal interpretation of the effectiveness of the InvKG can yet be derived from these findings since the impact of funding cannot yet be isolated from the impact of the coal phase-out. Future studies will attempt to provide a comprehensive discussion of this circumstance, for instance, by analysing not only non-cumulative values (number of employees), but also the composition of employment (such as groups of employees by job profile or sector) and associated cumulative values (number of new hires, number of terminations of employment relationships) at a more disaggregated level.

In addition to the development of employment, the following illustrations also show the results for the development of unemployment rates as well as vacancies. The development of the unemployment rate (see Fig. 7-3) shows that it is slightly higher in the InvKG areas in the quarters before the official start of the programme than in the counties of the control group and shows a decreasing trend. In other words, the unemployment rate falls more in InvKG-assisted regions before the event occurs than in non-assisted InvKG regions. However, this effect is limited to years 3 and 4 before the InvKG came into force. In the quarters after the coming into force of the InvKG, there are no differences in the development of the unemployment rate between InvKG counties and those of the control group. Consequently, an analogous interpretation of the results applies to the development of the unemployment rate as to the development of employment. The development of the unemployment rate does not differ between the assisted area and the control group.

Finally, Fig. 7-4 shows the development of vacancies to be filled immediately. In this case too, differences can be seen in the development of this target figure in the InvKG-assisted areas compared to the counties in the control group before the start of the InvKG programme. The number of vacancies is lower and shows a positive trend compared to the control group. In the first four quarters after the coming into force of the InvKG, the development of vacancies in the InvKG counties follows that in the control counties and then drops somewhat. However, the differences are not significant.

Fig. 7-2: Employment development in the mining areas compared to the control group

1) Basic specification without control variables

2) Consideration of regional control variables: GRW structure indicator, share of highly qualified employees, Herfindahl index, density

3) Consideration of regional control variables and Covid-19 infection numbers: specification 2) + number of infections

Notes: The horizontal axis represents the quarters relative to the coming into force of the InvKG in August 2020 – operationalised via the third quarter of 2020 (time 0). The vertical axis shows the growth of employment in the InvKG counties relative to the coming into force of the law compared to the counties in the control group (red horizontal line). The black vertical line represents the time t-1, i.e., one quarter before the coming into force of the InvKG (second quarter of 2020).
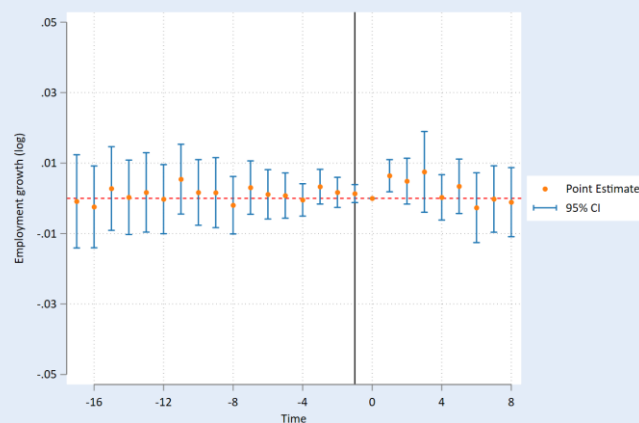
1) Basic specification without control variables

2) Consideration of regional control variables: GRW structure indicator, share of highly qualified employees, Herfindahl index, density

3) Consideration of regional control variables and Covid-19 infection numbers: specification 2) + number of infections
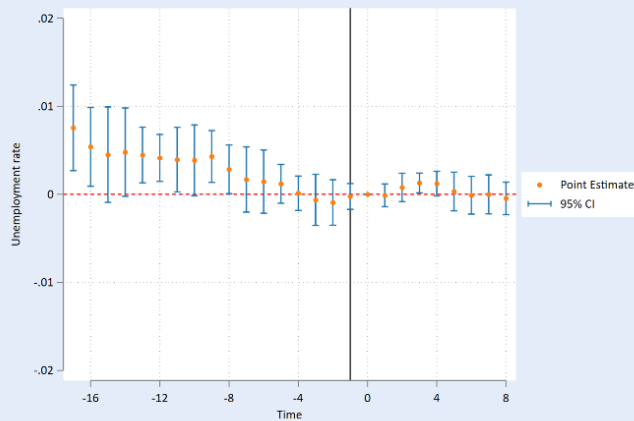

Notes: The horizontal axis represents the quarters relative to the coming into force of the InvKG in August 2020 – operationalised via the third quarter of 2020 (time 0). The vertical axis shows the growth of employment in the InvKG counties relative to the coming into force of the law compared to the counties in the control group (red horizontal line). The black vertical line represents the time t-1, i.e., one quarter before the coming into force of the InvKG (second quarter of 2020). – The vertical axis is scaled in absolute values. The values multiplied by 100 show the difference to the control group relative to the time of the 'event' in percentage points.

Sources: Raw data: Labour market data: Federal Employment Agency, demarcation of assisted areas: BMWK, Covid-19 infection numbers: www.healthcare-datenplattform.de; calculations: IWH; diagrams: Stata Tool *eventdd.*

Fig. 7-4: Development of the availability of vacancies to be filled immediately relative to the control group

1) Basic specification without control variables

2) Consideration of regional control variables: GRW structure indicator, share of highly qualified employees, Herfindahl index, density

3) Consideration of regional control variables and Covid-19 infection numbers: specification 2) + number of infections

Notes: The horizontal axis represents the quarters relative to the coming into force of the InvKG in August 2020 – operationalised via the third quarter of 2020 (time 0). The vertical axis shows the growth of employment in the InvKG counties relative to the coming into force of the law compared to the counties in the control group (red horizontal line). The black vertical line represents the time t-1, i.e., one quarter before the coming into force of the InvKG (second quarter of 2020).
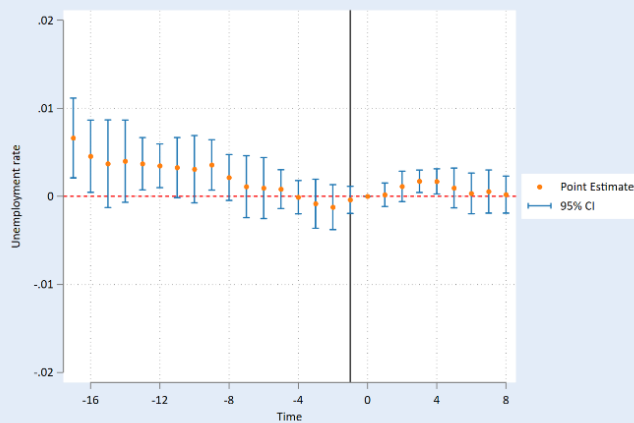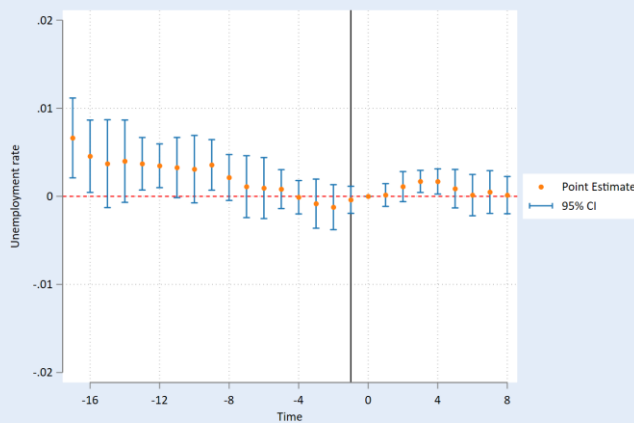
Sources: Raw data: Labour market data: Federal Employment Agency, demarcation of assisted areas: BMWK, Covid-19 infection numbers: www.healthcare-datenplattform.de; calculations: IWH; diagrams: Stata Tool *eventdd.*

In summary, it can be said that for all three target variables considered, the development of the InvKG-assisted areas essentially follows that of the counties in the control group. Further research will address a temporal extension of the research design, open up a more deeply disaggregated level of analysis (municipalities) and analyse the mechanisms behind the developments in more detail.

8 Adjustment needs in the InvKG programme

Since August 2020, the legal framework has been in place to allocate federal funding to regions affected by the phase-out of lignite mining and (lignite) coal-fired power generation. This report addresses the impacts of the InvKG since its entry into force until 31 December 2022. The first step during this phase was to build up the necessary infrastructure to prepare, select and implement projects. In the meantime, a large number of projects have been initiated to strengthen structural change in the coal regions. Since the majority of the projects for the transformation of coal regions are long-running projects, this report is inevitably limited to initial analyses of the formal incidence as well as the short-term impact of the funding. Given this implementation status, it can be shown that the InvKG regions have so far not performed worse than before funding started for a large number of indicators. At the same time, it must be stated that InvKG-assisted areas have so far not developed differently from regions with similar structural weaknesses in Germany. On the one hand, this allows a positive interpretation in the sense that the ongoing coal phase-out has not led to the InvKG areas falling further behind. However, positive effects of the initiated measures cannot be expected at this early stage of implementation and due to the delay in data provision. It is therefore not possible at present to make a conclusive statement about the impacts of the funding.

This also means that no robust findings are so far available regarding fundamental adjustment needs in the InvKG programme. However, a number of aspects in the administrative implementation of the InvKG as well as its content suggests that readjustments are necessary. Flexibility for expenditure is required in the administrative implementation of the measures. Due to the size of the planned measures as well as the time needed for administrative planning processes, the expenditures should not differ fundamentally from other funding measures. Measured against the available budget, the ongoing projects have so far absorbed relatively few funds respectively only a small fraction of amounts has received eligible areas. There is hence a risk that too restrictive funding periods may be counterproductive, for instance, if time and spending pressures influence project selection, so that rather than approving the best projects, only those projects that serve to fully exploit the budget in the programming period would be approved. This can lead to inefficiencies. It should hence be examined whether flexibilisation over time can remedy this situation. In this context, cross-period budgets could be an option, as has been the case for some time in the EU programming periods with the 'n+' rule.

As regards the content of the InvKG, it is to be expected that the current strong increase in prices and thus costs will lead to greater selection pressure for the projects to be funded. It is therefore unlikely that all of the projects planned will receive funding since the programme budgets are fixed. Here, the focus should logically be on those projects that have the greatest long-term impact on the target variables. In this context, a focus on strengthening the research and development and education capacities seems key to further strengthening the human capital base in the assisted areas. It is also important to ensure that the measures of the InvKG are also perceived by the citizens in the assisted areas so that they can actively participate in the process of structural change in the regions. In case study research, the creation of transparency was repeatedly identified as a critical point for the local population to have confidence in structural change (see, for instance, Bartl, Heinisch, Holtemöller and Schult 2022; Bartl, Heinisch, Holtemöller, Sackmann and Schult 2022; Barrett 2022).

At the same time, these considerations lead to another central point for the discussion on whether the substantive focus of InvKG funding should be readjusted. The studies have shown that the declining labour force potential in parts of the InvKG-assisted area (especially in the Lusatian mining area and in the Saxony-Anhalt part of the Central German mining area) is already an obstacle to growth. The measures under the InvKG should focus more on this aspect in the coming programming periods and strengthen all areas that serve to secure labour and strengthen the attractiveness of the regions to better attract labour. The measures should cover the entire range of possible areas of action, i.e., from improving (pre-)school education to vocational training and improving local conditions for highly qualified employees. This also includes measures to improve the physical accessibility of the areas in order to reach big labour markets as well as measures to raise previously unused workforce potentials (see, for instance, the regional differences in women's labour participation as well as the comparatively high unemployment rates among foreigners). At the same time, the need for more immigration of skilled labour from abroad is an issue that deserves increased efforts. The latter, in particular, requires a 'welcoming culture' for all forms of immigration to the InvKG-assisted areas.

Finally, there is also a clear need to catch up in the collection and consolidation of administrative data on project implementation, especially for the measures in Pillar 2. The InvKG contains a whole bundle of different measures, with different departments involved in the processes. Although the individual measures may be well documented for the projects at department level, the data have yet to be harmonised and centralised. This applies not only to measures that receive funding through the InvKG, but also to those that are not funded through it.

First and foremost, the programmes within the framework of the Federal Funding System for Structural Development Regions (GFS, Gesamtdeutsches Fördersystem für strukturschwache Regionen) should be considered. The same applies to other industrial policy measures that directly or indirectly influence the assisted areas. The studies revealed an almost complete overlap between the InvKG-assisted areas and those based on the GRW demarcation. In order to be able to map the exact 'dose' of financial aid, this information is essential for the analyses. The following reports will deal in detail with the data required to analyse the impact of the InvKG.[40]

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[40]   Brachert, Giebler and Titze (2023) have designed such a monitoring system for the measures implemented by the federal state of Brandenburg under Pillar 1.

9   Summary and outlook

Reducing greenhouse gases is of great importance for climate protection as a legal imperative. Achieving the emission reduction targets poses major challenges for the economy and society. The energy industry can make a substantial contribution to this. The focus of this sector is on phasing out the thermal utilisation of (lignite) coal.

Putting an end to mining and power generation entails economic and social adjustments. Although the coal sector hardly plays a role in production and employment at national level, this picture changes when the regional level comes into focus. Due to natural conditions, the coal industry has a high regional concentration. This means that certain regions are particularly affected by the phase-out measures in economic and social terms. German policymakers were aware of this trade-off and, after extensive social negotiation processes, adopted compensatory measures (Act on Structural Change in Coal Mining Areas (StStG, *Strukturstärkungsgesetz Kohleregionen*)) parallel to the coal phase-out (Coal-fired Power Generation Termination Act, KVBG, *Kohleverstromungsbeendigungsgesetz*)) in order to make the process economically and socially acceptable.

The core of the StStG is the Coal Regions Investment Act (InvKG, *Investitionsgesetz Kohleregionen*), through which the Federal Government provides EUR 41.09bn for measures to cushion the economic and social consequences of the coal phase-out. Under Pillar 1, the federal states have EUR 14bn at their disposal. On top of this comes EUR 1.09bn for the hard coal-fired power plant sites as well as the former Helmstedt mining area and the Altenburger Land. The Federal Government is responsible for the use of the remaining EUR 26bn in Pillar 2, whereby the federal states exercise a right of proposal here. The legislator has limited access to the InvKG programme to an area of 34 counties and county-free cities. At the same time, the InvKG regions are located in areas that are already characterised by structural weaknesses.

The evaluation of relevant macroeconomic variables shows that the InvKG regions had developed quite positively before the law came into force. The gross domestic product growth rates per capita are above average, and unemployment rates have fallen noticeably. However, these analyses already indicate that – especially in (Brandenburg's) Lusatia and in the Saxony-Anhalt part of the Central German mining area – availability of qualified labour is a major challenge for further regional development. The most important determinant of the declining availability of labour is the dramatic demographic change. The growth decomposition has shown that the decline in the availability of labour has in the past already slowed down economic development in the areas mentioned.

The phase-out of lignite coal mining and its thermal utilisation did not begin with the passing of the KVBG and the InvKG but had already begun in the 1990s. Immediately after the German re-unification, a first major wave of reduction in production took place in the East German mining areas. Output stabilised in the first decade of the 2000s and then fell steadily in the 2010s. However, production in the Lusatian and Rhenish mining areas have increased again somewhat since 2020 due to the energy crisis as a consequence of the Ukraine war. The situation is similar with employment which has fallen continuously across all mining areas since the 2000s until 2020.

The measures provided for in the InvKG are very diverse, addressing different economic impact channels and developing their impacts in different time horizons. In order to be able to estimate the impacts of this multitude of individual measures, a categorisation is necessary. It should be kept in mind that categorisation can never be completely objective. Statistical methods can help to make categorisation less 'arbitrary'. This is difficult for a programme that has just started since data on project characteristics are very limited. For this reason, clusters of measures were formed on the basis of (regional) economic literature. The following eight clusters proved to be suitable: 1: accessibility, 2: education, 3: culture, 4: health, 5: business locations, 6: research and development, 7: climate and sustainability, 8: social capital. This opens up the possibility of comparing the priorities in the regions across Pillar 1 and Pillar 2 (and in the overall picture as well).

In order to support the transformation process in the coal regions with public measures over a period of 18 years, the appropriate structures and authorities first had to be created to develop, plan and implement suitable projects. This is why very few projects have been completed so far. However, the evaluation of the funding statistics available so far (data status as per 31 December 2022) for Pillar *1* shows that the federal states in the lignite coal regions – with the exception of NRW – have well exhausted the budgets of the first funding period with their projects in the pipeline. What all the federal states have in common is that one focus of their measures is on improving locational conditions for businesses, especially in the federal state of Saxony-Anhalt. The federal states of Brandenburg, Saxony and North Rhine-Westphalia also focus their funding measures on education as well as research and development. Improving accessibility plays a major role in the federal states of Brandenburg and North Rhine-Westphalia as well as in the Saxon part of the Central German mining area.

With a view to the use of funds in Pillar 2, all the federal states focus on improving accessibility. The federal states of Brandenburg and Saxony also focus on education as well as research and development in this pillar. Pillar 2 formally includes the federal STARK programme. Here, all four lignite coal states focus on improving local conditions for companies. The federal states of Brandenburg, Saxony and Saxony-Anhalt additionally focus on projects in research and development.

In addition, basic projections of potential output and growth contributions of the production factors labour, capital and total factor productivity for the counties of the coal regions were prepared in this report. The projections are based on economic development until 2019, the year before the start of the InvKG programme and provide indications of what would happen without the coal phase-out and the InvKG measures. The forecast period covers the period from 2020 to 2040. The calculations reveal that the development of endowment with qualified labour is a challenge for all regions. Especially for the Brandenburg part of the Lusatian mining area, declining workforce is an obstacle to growth. While potential output is expanding in all other regions, it is largely stagnating here.

The final investigations in this report describe labour market development (employed, unemployed and vacancies) after the start of the InvKG as a comparison between the assisted regions against a suitable control group of counties. At the current stage of research, it is not yet possible to make a conclusive evaluation regarding the causal relationships. However, it is evident that labour market development in the InvKG-assisted area and the control counties has hardly differed since funding started. Any interpretation of these results is also significantly complicated by the fact that economic developments

in 2020 and 2021 were heavily distorted by the Covid-19 pandemic and in 2022 by the energy crisis. Further analysis will only be possible when, with the passage of time and more comprehensive data availability, it will be possible to 'look past' these events.

Against the background of the research conducted so far, the report gives recommendations for possible adaptation needs in the funding process. These currently exist in administrative terms and also in terms of content. Necessary readjustments for administrative processes result, for instance, from the fact that the expenditure margins are defined too narrowly in terms of time. The analyses showed that approval processes and the implementation of the projects take some time and that so far only relatively few funds – measured against the total budget available – have actually been disbursed. One possible consequence could be that not all funds will be drawn down in the programming period. In order to fully utilise the budgets in these cases, granting authorities might be inclined to select projects that can be implemented in the short term, but which do not make the highest contribution to meeting the InvKG targets. For the EU programming period, the 'n+' rule has been established, which allows for the spreading of expenditure over several funding periods. According to current knowledge, there is a need for adjustment in terms of content, especially with regard to expanding and securing the availability of labour, which is proving to be a key obstacle to growth in some regions of the assisted area. Measures under the InvKG should place greater emphasis on this aspect in the future, across the board, starting with (pre-)school education through tertiary education, tapping into previously inactive labour market potentials, improving accessibility to reach big labour markets and controlled migration of (foreign) skilled labour.

The further work of the accompanying research will improve and expand the database on the specific measures at project level. This data will then be used to conduct analyses at a more regionally and sectorally disaggregated level. The other criteria of the Federal Budget Code (BHO, *Bundeshaushaltsordnung*) will also be taken into account. It should be noted that any positive impacts on the assisted areas as a whole can only be expected in the medium to longer run.

References

Acemoglu, D.; Aghion, P.; Zilibotti, F. (2006): Distance to Frontier, Selection, and Economic Growth, In: Journal of the European Economic Association 4(1), p. 37-74.

Ahlfeldt, G. M.; Feddersen, A. (2018): From periphery to core: measuring agglomeration effects using high-speed rail. In: Journal of Economic Geography 18, p. 355-390.

Alm, B.; Fisch, G. (2014): Aufgaben, Instrumente und Perspektiven der Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur". In: Eberstein, H.-H.; Karl, H.; Untiedt, G. (eds.): Handbuch der regionalen Wirtschaftsförderung (Grundwerk mit Fortsetzungsbezug für mindestens 2 Jahre), part C, section III.

Bade, F.-J.; Bornemann, H.; Breuer, A.; Rautenberg, R. (2012): Ansätze für ein besseres Monitoring und eine verbesserte Erfolgskontrolle der Infrastrukturförderung innerhalb der Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur". Expert opinion commissioned by the Federal Ministry for Economic Affairs and Climate Action. Endbericht. Berlin et al.

Barrett, T. (2022): D3.2 Lusatia Case Study Report. This report is delivered in the framework of the European Commission H2020 funded project – ENergy TRANsitions from Coal and carbon: Effects on Societies – ENTRANCES, G.A. 883947. The Lusatia Case Study report is the Deliverable 3.2 of the project developed in Task 3.1.

Bartl, W.; Heinisch, K.; Holtemöller, O.; Sackmann, R.; Schult, C. (2022): D3.4 Central Germany Case Study Report. This report is delivered in the framework of the European Commission H2020 funded project – ENergy TRANsitions from Coal and carbon: Effects on Societies – ENTRANCES, G.A. 883947. The Central Germany Case Study report is the Deliverable 3.4 of the project developed in Task 3.4.

Bartl, W.; Heinisch, K.; Holtemöller, O.; Schult, C. (2022): D3.3 Rhineland Case Study Report. This report is delivered in the framework of the European Commission H2020 funded project – ENergy TRANsitions from Coal and carbon: Effects on Societies – ENTRANCES, G.A. 883947. The Rhineland Case Study report is the Deliverable 3.3 of the project developed in Task 3.3.

Berger, W.; Lademann, S.; Schnellenbach, J.; Weidner, S.; Zundel, S. (2019): Standortpotentiale Lausitz: Study on behalf of Zukunftswerkstatt Lausitz. Online: https://zwlausitz.de/fileadmin/ user_upload/01-content/03-zukunftswerkstatt/02-downloads/studie-standortpotenziale-lausitz.pdf, accessed: 20 October 2022

Berkner, A. et al. (2022), Braunkohlenplanung, Strukturwandel und Kohleausstieg in Deutschland, Positionspapier aus der ARL 135, Akademie für Raumentwicklung in der Leibniz-Gemeinschaft, Hannover.

Bertenrath, R., C. Bähr, A. Kleissner and T. Schaefer (2018), Folgenabschätzung Klimaschutzplan und Strukturwandel in den Braunkohleregionen, IW Gutachten im Auftrag des Deutschen Braunkohlen-Industrie-Verein e. V., Institut der deutschen Wirtschaft, Köln.

Böhnisch, P.; Schneider, L. (2013): The social capital legacy of communism-results from the Berlin Wall experiment. In: European Journal of Political Economy 32, p. 391-411.

Brachert, M.; Giebler, A.; Titze, M. (2023): Handbuch B. Datenbedarfe für ein Monitoring des Förderprozesses der Kapitel-1-Maßnahmen des Investitionsgesetzes Kohleregionen (InvKG). IWH Technical Reports No. 2/2023.

Brachert, M.; Kubis, A.; Titze, M. (2021): The Impact of Placing Public Employment in Lagging Regions: Evidence from Germany. Mimeo. 68th North America Meetings of the Regional Science Association International. Denver, USA, November 13, 2021.

BMWK, Bundesministerium für Wirtschaft und Klimaschutz (2022): Zahlen und Fakten: Energiedaten. Nationale und internationale Entwicklung. Berlin.

Clarke, D.; Tapia-Schythe, K. (2021): Implementing the panel event study. In: The Stata Journal 21(4), p. 853–884. https://doi.org/10.1177/1536867X211063144.

Deaton, A. (2003): Health, Inequality, and Economic Development. In: Journal of Economic Literature Vol. XLI, p. 113–158.

Dehio, J. and T. Schmidt (2019), Gesamt- und regionalwirtschaftliche Bedeutung des Braunkohlesektors und Perspektiven für die deutschen Braunkohleregionen. Zeitschrift für Energiewirtschaft, 43, 1, 11-25.

Falck, O.; Fritsch, M.; Heblich, S. (2011): The phantom of the opera: Cultural amenities, human capital, and regional economic growth. In: Labor Economics 18, p. 755-766.

Fritsch, M. (2018): Marktversagen und Wirtschaftspolitik. Mikroökonomische Grundlagen staatlichen Handelns. 10th revised and amended edition. München.

Havik, K.; Mc Morrow, K.; Orlandi, F.; Planas, O.; Raciborski, R.; Roeger, W.; Rossi, A.; Thum-Thysen, A.; Vandermeulen, V. (2014): The production function methodology for calculating potential growth rates & output gaps. No. 535. Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Heinisch, K.; Holtemöller, O.; Schult, C. (2021): Power generation and structural change: Quantifying economic effects of the coal phase-out in Germany. In: Energy Economics, vol. 95.

Hodrick, R. J.; Prescott, E. C. (1997): Postwar US business cycles: an empirical investigation. Journal of Money, Credit, and Banking, p. 1-16.

Holtemöller, O.; Schult, C. (2019): Zu den Effekten eines beschleunigten Braunkohleausstiegs auf Beschäftigung und regionale Arbeitnehmerentgelte, in: IWH, Wirtschaft im Wandel, Vol. 25(1), 2019, 5-9.

IW Consult (2021), Wertschöpfungs- und Beschäftigungseffekte der Strukturföderung im Rheinischen Revier, Studie für das Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen (MWIDE). Institut der deutschen Wirtschaft Köln Consult GmbH.

Karl, H.; Lackmann, G.; Strotebeck, F.; Untiedt, G.; Zarth, M. (2012): Zur formalen und effektiven Inzidenz raumwirksamer Bundesmittel – konzeptioneller Schätzansatz und ausgewählte Ergebnisse. RUFIS Beiträge zur Ballungsraumforschung, Vol. 11. Bochum.

Kohlekommission (2019): Commission on Growth, Structural Change and Employment. Abschlussbericht.

Krueger, A.; Lindahl, M. (2001) Education for Growth: Why and for Whom? In: Journal of Economic Literature 39 (4), p. 1101-1136.

Kubis, A., Titze, M., und Brachert, M. (2008). Leuchttürme und rote Laternen – Ostdetusche Wachstumstypen 1996 bis 2005. IWH, Wirtschaft im Wandel, 04/2008.

Kuntze, P.; Kuckelkorn, B. (2021): Multifaktorproduktivität in den Volkswirtschaftlichen Gesamtrechnungen. Destatis, WISTA, 04/2021.

Lucas, Robert E. (1988): On the mechanics of economic growth. In: Journal of Monetary Economics 22, 3-42.

Maier, G.; Tödtling, F. (2006): Regional- und Stadtökonomik 1. Standorttheorie und Raumstruktur. 4th updated and amended edition. Springer: Wien (Vienna), New York.

Maretzke, S.; Ragnitz, J.; Untiedt, G. (2021): Anwendung von Regionalindikatoren zur Vorbereitung der Neuabgrenzung des GRW-Fördergebiets. Expert opinion commissioned by the Federal Ministry for Economic Affairs and Climate Action (BMWi). Ifo Dresden Studie 87. Dresden.

Markwardt, G.; Rettig, J.; Schnellenbach, J.; Titze, M.; Zundel, S. (2023): Statusbericht: Im Osten was Neues? Strukturwandel in der Lausitz – eine Zwischenbilanz. Study on behalf of the Brandenburg State Chancellery. Cottbus.

Markwardt, G.; Rettig, J.; Zundel, S. (2023): Handbuch A. Indikatorik der Regionalentwicklung. Ein Bild über die Entwicklungen in der Lausitz. Expert report on behalf of the Brandenburg State Chancellery. Cottbus.

Markwardt, G.; Schnellenbach, J.; Titze, M.; Zundel, S. (2022): Umsetzung der Hilfen für die Flankierung des Kohleausstiegs in der brandenburgischen Lausitz – eine Zwischenbilanz, ifo Dresden berichtet, 3 (07), p. 12-18.

Mincer, J. (1962): On-the-job Training: Costs, Returns, and some Implications. In: Journal of Political Economy 70(5), p. 50-79.

Nelson, R. R. (1973): Recent exercises in growth accounting: new understanding or dead end? The American Economic Review, 63(3), p. 462-468.

Neumark, D.; Simpson, H. (2015): Place-based policies. In: Duranton, G., Henderson, J.V., Strange, W. (eds.): Handbook of Regional and Urban Economics, vol. 5B, p. 1198-1287.

North, D. C. (1990): Institutions, Institutional Change and Economic Performance. New York: Cambridge University Press.

OECD (Organisation for Economic Co-operation and Development) (2001): Measurement of aggregate and industry-level productivity growth. OECD Manual.

Oei, P.-Y.; Brauers, H.; Herpich, P. (2019): Klimaschutz und Kohleausstieg: Politische Strategien und Maßnahmen bis 2030 und darüber hinaus. Study on behalf of the German Environment Agency (UBA), Dessau-Roßlau.

Oei, P.-Y.; Brauers, H.; Kemfert, C.; von Hirschhausen, C.; Schäfer, D.; Schmalz, S. (2017): Klimaschutz und Betreiberwechsel: Die ostdeutsche Braunkohlewirtschaft im Wandel. DIW Wochenbericht 84 (6-7): 103-113.

Oei, P.-Y.; Hermann, H.; Herpich, P.; Holtemöller, O., Lünenbürger, B.; Schult, C. (2020): Coal phase-out in Germany- Implications and policies for affected regions. In: Energy, vol. 196.

Oei, P.-Y.; Kemfert, C.; Reitz, F.; von Hirschhausen, C. (2014): Braunkohleausstieg Gestaltungsoptionen im Rahmen der Energiewende. Politikberatung kompakt 84. Berlin: DIW.

Paulus, W.; Matthes, B. (2013): Klassifikation der Berufe: Struktur, Codierung und Umsteigeschlüssel, FDZ-Methodenreport 201308, Institut für Arbeitsmarkt- und Berufsforschung (IAB), Nürnberg.

Prognos (2018), Zukünftige Handlungsfelder zur Förderung von Maßnahmen zur Strukturanpassung in Braunkohleregionen, study on behalf of BMWi, Prognos, Berlin.

Projektgruppe Gemeinschaftsdiagnose (2020): Wirtschaft unter Schock – Finanzpolitik hält dagegen. München, April 2020.

Ragnitz, J. (2021): Anmerkungen zur Umsetzung der Hilfen für die Flankierung des Kohleausstiegs in den ostdeutschen Bundesländern, ifo Dresden berichtet, 28 (06), p. 3-6.

Romer, P. (1990): Endogenous technological change. In: Journal of Political Economy 98(5), p. 71 p. 102.

Rothgang, M., B. Lageman und A. Scholz (2021): Why are there so few hard facts about the impact of cluster policies in Germany? A critical review of evaluation studies. In: Review of Evolutionary Political Economy, 2, 105-139

RWI (2018), Erarbeitung aktueller vergleichender Strukturdaten für die deutschen Braunkohleregionen. Final report of a study on behalf of BMWi. RWI Projektberichte. RWI, Essen.

RWI (2021): Beschäftigungs- und Wertschöpfungsverluste aufgrund einer vorzeitigen Beendigung der Kohleverstromung. Projektbericht für das Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen. RWI, Essen.

RWI (2022): Kurzgutachten zum Just Transition Fund. Projektbericht für das Ministerium für Wirtschaft, Innovation, Digitalisierung und Energie des Landes Nordrhein-Westfalen. RWI, Essen.

Sherman, L. W.; Gottfredson, D. C.; MacKenzie, D. L.; Eck, J.; Reuter, P.; Bushway, S. D. (1998): Preventing Crime: What Works, What Doesn't, What's Promising. In: National Institute of Justice. Research in Brief.

Siegloch; S.; Wehrhöfer, N.; Etzel, T. (2022): Spillover, Efficiency and Equity Effects of Regional Firm Subsidies. ECONtribute Discussion Paper No. 210, November 2022. https://www.econtribute.de/RePEc/ajk/ajkdps/ECONtribute_210_2022.pdf.

Solow, R. M. (1957): Technical Change and the Aggregate Production Function. In: Review of Economics and Statistics. Year 39(3), 312-320.

SRU, German Advisory Council on the Environment (Sachverständigenrat für Umweltfragen) (2017): Kohleausstieg jetzt einleiten. Stellungnahme. Berlin: SRU.

Statistik der Kohlenwirtschaft (2016): Der Kohlenbergbau in der Energiewirtschaft der Bundesrepublik Deutschland im Jahre 2015. Herne, Köln (Cologne).

Statistik der Kohlenwirtschaft (2023): Braunkohle im Überblick, Braunkohle – Statistik der Kohlenwirtschaft e. V. (kohlenstatistik.de), accessed 20 June 2023.

Weber, L. (2010): Demographic Change and Economic Growth. Simulations on Growth Models. Physica: Berlin, Heidelberg.

What Works Centre for Local Economic Growth (2022): Website of the initiative. https://whatworksgrowth.org/, Rubrik "Evidence Topics", accessed 13 December 2022.

Zukunftsagentur Rheinisches Revier (2021), Innovationsstudie 2021 – Leuchttürme im Rheinischen Revier, Zukunftsagentur Rheinisches Revier, Jülich.

List of Annexes

Annex 1: Overview of the Coal Phase-out Act

Coal Phase-out Act (KohleAusG, Federal Gazette I p. 1818 of 8 August 2020, amendment Federal Gazette I p. 2682 of 3 December 2020)

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Article 2: Amendment to the Greenhouse Gas Emissions Trading Act

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Part 1: General provisions

Part 2: Target level, tender volume and scope of statutory reduction

Part 3: Tenders to reduce hard coal-fired power generation

Part 4: Legal reduction of hard coal-fired power generation

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…

Part 8: Adjustment allowance

…

Sec. 44: Compensation for the decommissioning of brown coal-fired plants

…

Sec. 57: Adjustment allowance for employees

Source: Own presentation.

Annex 2: Regression results – Employment development

Dependent variable: Employment growth	(1)	(2)	(3)
Lead 8	-0.00244	-0.00198	-0.00195
	(0.00459)	(0.00410)	(0.00412)
Lead 7	0.00275	0.00302	0.00305
	(0.00400)	(0.00382)	(0.00383)
Lead 6	8.68e-05	0.00112	0.00113
	(0.00380)	(0.00353)	(0.00353)
Lead 5	8.41e-05	0.000764	0.000784
	(0.00351)	(0.00324)	(0.00324)
Lead 4	-0.000954	-0.000467	-0.000448
	(0.00242)	(0.00231)	(0.00232)
Lead 3	0.00299	0.00328	0.00330
	(0.00232)	(0.00249)	(0.00249)
Lead 2	0.00119	0.00169	0.00169
	(0.00185)	(0.00215)	(0.00215)
Lead 1	0.00144	0.00133	0.00134
	(0.00103)	(0.00129)	(0.00129)
Lag 1	0.00723***	0.00694***	0.00642***
	(0.00229)	(0.00219)	(0.00230)
Lag 2	0.00561*	0.00524	0.00488
	(0.00328)	(0.00326)	(0.00329)
Lag 3	0.00820	0.00776	0.00751
	(0.00566)	(0.00570)	(0.00579)
Lag 4	0.000559	0.000362	0.000272
	(0.00322)	(0.00324)	(0.00325)
Lag 5	0.00507	0.00476	0.00342
	(0.00372)	(0.00351)	(0.00390)
Lag 6	0.00165	0.000662	-0.00266
	(0.00388)	(0.00386)	(0.00500)
Lag 7	0.00165	0.000797	-0.000193
	(0.00460)	(0.00467)	(0.00476)
Lag 8	0.00110	-4.99e-05	-0.00109
	(0.00506)	(0.00487)	(0.00495)
GRW indicator rank		-0.0164	-0.0173
		(0.0190)	(0.0189)
Share of highly qualified employees		0.957**	0.933**
		(0.377)	(0.379)
Herfindahl index		0.510	0.506
		(0.498)	(0.498)
Density		0.000768***	0.000757***
		(0.000203)	(0.000205)
Corona case numbers			1.65e-07
			(1.50e-07)
Constant	10.79***	10.50***	10.50***
	(0.000486)	(0.0635)	(0.0632)
R2	0.999	0.999	0.999
adjusted R2	0.999	0.999	0.999
within R2	0.00274	0.161	0.162
Quarter-specific effects	Yes	Yes	Yes
Region-specific effects	Yes	Yes	Yes
Number of counties	118	118	118

Notes: Robust standard errors in brackets. – Standard errors clustered at county level. – For better readability, the coefficients of leads 9 to 17 are not shown. – Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Source: Own presentation.

Annex 3: Regression results – Development of the unemployment rate

Dependent variable: Change in unemployment rate	(1)	(2)	(3)
Lead 8	0.00284**	0.00213	0.00214
	(0.00139)	(0.00131)	(0.00132)
Lead 7	0.00168	0.00110	0.00110
	(0.00187)	(0.00177)	(0.00177)
Lead 6	0.00145	0.000939	0.000940
	(0.00181)	(0.00175)	(0.00175)
Lead 5	0.00119	0.000819	0.000820
	(0.00111)	(0.00111)	(0.00112)
Lead 4	0.000130	-0.000104	-0.000103
	(0.000986)	(0.000954)	(0.000956)
Lead 3	-0.000637	-0.000834	-0.000833
	(0.00146)	(0.00141)	(0.00141)
Lead 2	-0.000928	-0.00123	-0.00123
	(0.00130)	(0.00129)	(0.00129)
Lead 1	-0.000238	-0.000394	-0.000393
	(0.000737)	(0.000775)	(0.000776)
Lag 1	-0.000119	0.000180	0.000150
	(0.000652)	(0.000675)	(0.000654)
Lag 2	0.000777	0.00112	0.00110
	(0.000813)	(0.000871)	(0.000862)
Lag 3	0.00130**	0.00171***	0.00169***
	(0.000565)	(0.000642)	(0.000634)
Lag 4	0.00122*	0.00169**	0.00168**
	(0.000703)	(0.000725)	(0.000723)
Lag 5	0.000318	0.000946	0.000870
	(0.00111)	(0.00114)	(0.00110)
Lag 6	-9.75e-05	0.000331	0.000140
	(0.00109)	(0.00117)	(0.00118)
Lag 7	-3.79e-06	0.000542	0.000485
	(0.00112)	(0.00124)	(0.00123)
Lag 8	-0.000458	0.000197	0.000137
	(0.000931)	(0.00106)	(0.00107)
GRW indicator rank		-0.00316	-0.00321
		(0.00295)	(0.00295)
Share of highly qualified employees		0.247***	0.246***
		(0.0639)	(0.0642)
Herfindahl index		-0.0719	-0.0721
		(0.0666)	(0.0667)
Density		-8.14e-05***	-8.20e-05***
		(2.83e-05)	(2.82e-05)
Corona case numbers			9.48e-09
			(2.27e-08)
Constant	0.0617***	0.0581***	0.0584***
	(0.000227)	(0.00983)	(0.00994)
R2	0.966	0.967	0.967
adjusted R2	0.964	0.965	0.965
within R2	0.0503	0.0950	0.0951
Quarter-specific effects	Yes	Yes	Yes
Region-specific effects	Yes	Yes	Yes
Number of counties	118	118	118

Notes: Robust standard errors in brackets. – Standard errors clustered at county level. – For better readability, the coefficients of leads 9 to 17 are not shown. – Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Source: Own presentation.

Annex 4: Regression results – Development of vacancies to be filled immediately

Dependent variable: Change in vacancies to be filled immediately	(1)	(2)	(3)
Lead 8	-0.0820**	-0.0890**	-0.0888**
	(0.0381)	(0.0386)	(0.0386)
Lead 7	-0.0588	-0.0643	-0.0642
	(0.0424)	(0.0427)	(0.0427)
Lead 6	-0.0805**	-0.0849**	-0.0848**
	(0.0399)	(0.0400)	(0.0400)
Lead 5	-0.101***	-0.104***	-0.104***
	(0.0354)	(0.0358)	(0.0358)
Lead 4	-0.0792**	-0.0803**	-0.0802**
	(0.0354)	(0.0365)	(0.0365)
Lead 3	-0.0260	-0.0242	-0.0241
	(0.0366)	(0.0379)	(0.0379)
Lead 2	-0.0282	-0.0270	-0.0270
	(0.0333)	(0.0339)	(0.0339)
Lead 1	0.0116	0.0125	0.0126
	(0.0199)	(0.0204)	(0.0204)
Lag 1	0.0396**	0.0421**	0.0405**
	(0.0193)	(0.0199)	(0.0196)
Lag 2	0.000842	0.00227	0.00111
	(0.0246)	(0.0250)	(0.0246)
Lag 3	-0.0323	-0.0285	-0.0294
	(0.0299)	(0.0304)	(0.0301)
Lag 4	-0.0199	-0.0172	-0.0175
	(0.0316)	(0.0317)	(0.0315)
Lag 5	-0.0154	-0.0104	-0.0146
	(0.0334)	(0.0335)	(0.0332)
Lag 6	-0.0334	-0.0438	-0.0544
	(0.0366)	(0.0352)	(0.0427)
Lag 7	-0.0532	-0.0633	-0.0664*
	(0.0401)	(0.0398)	(0.0397)
Lag 8	-0.0541	-0.0618	-0.0651
	(0.0499)	(0.0509)	(0.0508)
GRW indicator rank		-0.300	-0.302
		(0.238)	(0.239)
Share of highly qualified employees		2.283	2.205
		(2.455)	(2.521)
Herfindahl index		1.459	1.447
		(2.784)	(2.789)
Density		-0.00238	-0.00242
		(0.00149)	(0.00149)
Corona case numbers			5.24e-07
			(1.37e-06)
Constant	7.029***	7.219***	7.236***
	(0.00542)	(0.529)	(0.541)
R2	0.941	0.942	0.942
adjusted R2	0.938	0.939	0.939
within R2	0.00917	0.0231	0.0232
Quarter-specific effects	Yes	Yes	Yes
Region-specific effects	Yes	Yes	Yes
Number of counties	118	118	118

Notes: Robust standard errors in brackets. – Standard errors clustered at county level. – For better readability, the coefficients of leads 9 to 17 are not shown. – Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Source: Own presentation.