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The Coal Phase-Out in Germany and Its Regional Impact on Economic Worries

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Abstract: Market-driven closures of coal mines have typically been associated with negative economic consequences for the affected regions. In Germany, structural policy directed towards ameliorating the negative effects of hard coal decline in the Ruhr area lagged behind the onset of decline, caused major political conflicts, and has been variously criticized for its reactive character that failed to generate a positive image of the future. The phase-out of lignite coal in Germany, in contrast, is policy-driven and accompanied from the outset by compensatory and investment policies that strive to facilitate regional structural change proactively. Against this backdrop, we investigate how the policies of lignite coal phase-out initiated in 2018 and the accompanying public discourse affect the economic worries of individuals in the remaining three lignite coal mining areas in Germany. We focus on the period 2016–2021, using a longitudinal multilevel design based on regional and individual data from the German Socio-Economic Panel (GSOEP). Overall, probabilities of strong economic worries decrease throughout the observed period. Results show that subjective economic worries do not significantly differ between residents of lignite mining regions and those in the rest of the country. Further robustness analyses confirm that the coal phase-out policy has not increased economic uncertainties in the populations of German lignite mining regions. Based on our results, we discuss the need for future research on the effects of policy designs of clean energy transitions on subjective perceptions of the future.

Keywords: lignite mining; coal phase-out; economic worries; imagined futures; politics of expectations; panel regression; regional disparities; regional policy; structural policy; clean energy transition

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1. Introduction

Commodified mining activities have a quasi-natural life cycle based on market competition. Closures of coal mines have typically been associated with negative economic consequences for the affected regions (Strambo et al. 2019; Diluiso et al. 2021), leading to low levels of trust and political efficacy (Abreu and Jones 2021). Often, academic research has identified governments as the most relevant stakeholders in coal mine closures but has struggled to evaluate policy effects early on.

In Germany, structural policy often failed to anticipate the negative socio-economic effects of mine closures, as can be learned from the coal decline in the hard coal mining Ruhr area since the late 1950s. The lagging structural policy reactions often caused major political conflicts and, thus, failed to generate positive images of the future in affected regions of the Ruhr area (Dahlbeck et al. 2021). Some decades later, the phase-out of lignite mining, initiated through the work of the so-called Coal Commission (officially: Commission on Growth, Structural Change and Employment, working from 6 June 2018, to 31 January 2019), should be accompanied by "preventive structural change" (Dahlbeck et al. 2021), hence with an explicit and positive orientation towards the future. The coal phase-out is legally foreseen to be completed by 2038 at the latest and is accompanied by

compensating policies for affected workers and investment policies for facilitating strategic structural change in the affected lignite mining regions. In 2022, the state government of North Rhine-Westphalia, where the mining area Rhineland is located, and the Federal Government of Germany agreed to accelerate the regional coal phase-out and complete it already by 2030, whereas the state governments responsible for the mining areas of Central Germany and Lusatia have objected to such an endeavor.[1] In this context, the phase-out policy has been designed to convey a positive outlook to the future and stimulate regional structural change.

Very little is known so far about the effects of the German phase-out policy on economic worries among residents of the affected lignite mining regions. This is surprising because, in contrast to the mostly market-driven mine closures in the Ruhr area, phase-out policies deliberately seek to terminate an established technology or practice in a gradual or stepwise process. They specify a time horizon for the termination of targeted elements, during which the anticipated closure of open-pit mines might lead to increased levels of subjective economic hardship. The present study closes this research gap based on longitudinal, multilevel analyses, thereby integrating theories of collectively imagined futures and individual worries.

The gradual transition process distinguishes phase-out from abrupt bans, as it gives involved actors the chance to adapt their expectations, strategies, and practices (Rinscheid et al. 2022, pp. 225–26). We conceive of the coal phase-out policy and the accompanying controversial public discourse (Markard et al. 2022, p. 130) as a process involving competing narratives about imagined futures that are put forward by different actors and groups (Beckert 2016; Knappe et al. 2019; Durdovic 2022). For the German coal phase-out in the lignite mining regions, it has been pointed out that there are various potential conflicts of interests among societal groups, such as regional stakeholders of lignite coal mining, climate activists, and the public (Krüger 2021; Mäding 2021; Haas et al. 2022; Köster et al. 2022; Kerker 2022), each of which faces particular uncertainties about potential losses and benefits in the course of the coal phase-out. However, empirical research on perceptions of economic risks among residents in the German lignite mining regions is scarce so far. Therefore, we will investigate how subjective economic worries of individuals in the affected German lignite mining regions develop in response to the phase-out policy and the accompanying public discourse. Furthermore, we study to what extent their economic worries differ from those of individuals living in the rest of Germany.

To our knowledge, this is the first study which, based on a nationwide sample, studies the effects of the coal phase-out on the development of subjective economic worries in the affected German lignite mining regions. Furthermore, our contribution is the first approach to offer a conceptual framework for the study of individual effects of the German coal phase-out. Although we focus on the German coal phase-out and its possible effects on subjective economic worries, we will later (Section 6) discuss our results and open questions in broader terms (Pike et al. 2023).

In the following section, we describe the ongoing phase-out policies in the three remaining lignite mining regions. Then, we lay out a conceptual framework which combines two perspectives: the approach of imagined futures (Beckert 2016) on the one hand and the approach of subjective well-being on the other hand (Diener et al. 2018). We argue that economic worries can be conceived of as articulations of pessimistic imaginations of the future, which signal individuals' evaluation of planned or actual compensation policies. Next, we describe our data and analytical strategy and present the results of our longitudinal analyses. These analyses are based on data from the German Socio-Economic Panel (GSOEP) (Goebel et al. 2019), spanning the years from 2016 to 2021. We use descriptions of time-trends of subjective economic worries and hierarchical linear models (Hox 2010). Finally, we discuss our results as well as future research questions.

2. Multilevel Governance of the German Coal Phase-Out

Political and institutional work has been performed at different social levels to reduce worldwide CO2 emissions, as well as mitigate the negative economic and societal effects of clean energy transitions. Generally, the political aims of climate change mitigation have been formally set at the international level in the Kyoto Protocol of 1997 (UNFCCC 1997) and in the Paris Agreement of 2015 (UN 2015). Both documents were ratified by the European Union (EU) and Germany. To compensate for the possible negative effects of climate change mitigation policies, the EU put in place the Just Transition Mechanism, running from 2021 to 2027, which is expected to mobilize 55 billion euros for the most affected regions of the transition towards a climate-neutral economy (European Commission n.d.).

Systematic reviews of past coal mine closures identified several societal and economic challenges to be met by stakeholders in affected regions, such as rising unemployment and the creation of a sense of justice as the main political challenges to be navigated (Diluiso et al. 2021; Strambo et al. 2019). Political costs associated with fossil fuel phase-outs seem to be limited by elaborated social welfare systems (Egli et al. 2023). Various countries tried to ameliorate potential conflicts of interests and procedurally create a sense of justice through stakeholder commissions (Gürtler et al. 2021; Heffron 2021, pp. 43–85; Hauenstein et al. 2023). Yet, it is unclear if such a policy succeeds in creating a positive outlook to the future. If, for example, emigration is used as an indicator of revealed future expectations, the case of Spain shows that carbon-intensive regions lost 27.3% of their population between 1991 and 2021 due to a decarbonization process that accelerated during the last two decades and is still ongoing (Singh Garha 2022). Comparable regions did not face the same population decline. Other mining regions in Europe have faced population decline as well (Holman 2023, pp. 56–57).

In Germany, several studies have been conducted that quantified the expected economic effects of a clean energy transition (e.g., Oei et al. 2020; Hoch et al. 2021; Haywood et al. 2021; Luderer et al. 2021). Although negative effects on output, income, and population were to be expected, it was concluded that a faster phase-out accompanied by structural change programs would lead to a quicker economic recovery (Oei et al. 2020). Another analysis concluded that while accelerating the coal phase-out from 2038 to 2030 would increase lifetime welfare costs due to job losses for the affected workers, promoting career switches and setting up a wage insurance scheme could alleviate these losses (Haywood et al. 2021).

The Commission on Growth, Structural Change and Employment, also known as the Coal Commission, was created in June 2018 following the federal government's Climate Action Plan 2050 of November 2016 (Barrett 2022, p. 46). Its 28 members discussed various scenarios and possible consequences of the coal phase-out in the three German lignite mining regions (Kohlekommission 2018) and presented their policy recommendations in January 2019. The political process in the run-up to the formation of the Coal Commission was embedded in increasingly heated public debates that were most controversial in the year 2018, when the commission was formed, and reached their peak in 2019, after the commission had presented their results (Markard et al. 2022, p. 130; Bartl et al. 2022a, p. 106). In public discourse, the energy transition narrative became deradicalized and dominant (Buschmann and Oels 2019). The Coal Commission's recommendations aimed at creating a societal consensus for phase-out, especially in the lignite mining regions. Although the polarization of public debate decreased (Markard et al. 2022, p. 130), the commission's work was questioned because the proposed policy targets were seen as not ambitious enough when weighed against the overall cost of the accompanying structural adjustment program for the affected regions (Löw Beer et al. 2021; Hauenstein et al. 2023).

However, in August 2020, the German Bundestag passed a legislative package of three acts, which we will refer to together as the Coal Phase-Out Act, ruling to phase out lignite coal production in Germany until 2038, compensating power plant companies and affected workers (from age 58), and initiating significant investments in mining regions (Brachert et al. 2023, p. 17).[2] Subject to this decision are in particular the three still-active

lignite mining regions in Germany, located in the Rhineland (*Rheinland*), Central Germany (*Mitteldeutschland*), and Lusatia (*Lausitz*). In 2022, the federal state government of North Rhine-Westphalia, where the mining area of Rhineland is located, and the Federal Government of Germany agreed to accelerate the regional coal phase-out and complete it by 2030. However, the federal state governments of Brandenburg, Saxony, and Saxony-Anhalt, which are responsible for the mining areas of Central Germany and Lusatia, have objected to such an endeavor.

The regional structural policy elements of the legislative package allocated up to 14 billion euros to the lignite mining regions until 2038 for investments facilitating their structural change. Furthermore, the federal government will also support the coal mining regions with another 26 billion euros until 2038 through its own measures (Bartl et al. 2022a, p. 50) (Table 1). Since the lignite mining areas are not autonomous political territories, the funds have been allocated by a politically negotiated key (measuring the relevance of workplaces in lignite mining and coal-fired power plants for the regional economy) to the German federal states where open-pit mines are located. Part of the total budget comes from the EU's Just Transition Fund (JTF). The coal phase-out funds top up to older place-based policies in Germany for which the mining regions had already been eligible (Brachert et al. 2023, p. 19).

Table 1. Distribution of total budget of the Coal Phase-Out Act on federal states and lignite mining regions (billion EUR).

State	Mining Area	Distribution Key (%)	Under the Authority of the States	Under the Authority of the Federal Government	Total Budget	Part of the Budget that Comes from the JTF
		%	Billion EUR	Billion EUR	Billion EUR	Billion EUR
Brandenburg	Lusatia	25.8	3.612	6.708	10.320	0.668
North-Rhine Westphalia	Rhineland	37.0	5.842	9.620	15.462	0.580
Saxony	Lusatia, Central Germany	25.2	3.528	6.552	10.080	0.548
Saxony-Anhalt	Central Germany	12.0	1.680	3.120	4.800	0.309
Total		100.0	14.662	26.000	40.661	2.106

Source: Brachert et al. (2023, p. 70); authors' calculations.

Accompanying the legislative procedure, the affected federal states developed strategic visions (*Leitbilder*) for transforming the lignite mining regions that became part of the Coal Phase-Out Act (BGBl 2020, pp. 1803–8). Lignite mining regions, although historically existing without formal boundaries, were created as demarcated spaces of policy intervention along administrative boundaries of counties only through the Coal Phase-Out Act (Ribbeck-Lampel et al. 2023, p. 35). Two of the three lignite mining regions (Lusatia and Central Germany) are located in more than one federal state (first and second columns of Table 1), and new governance structures had to be set up to manage project approval and implementation. These governance structures differ between regions (Barrett 2022, pp. 46–49; Bartl et al. 2022a, pp. 49–52, 2022b, pp. 52–55). The opportunities for public participation have been rather limited in these regional governance processes (cf. Herberg et al. 2020).

The implementation of regional structural policy in the form of projects requires the mobilization of regional actors and expertise (Büttner and Leopold 2016). Furthermore, infrastructure projects develop in several stages, from application to planning and actual creation to use (Fritsch 2018; Brachert et al. 2023, p. 58). The problem for the evaluation

of actual effects of the compensatory part of the Coal Phase-Out Act is that these will be measurable only with a considerable time lag. Projects begin and end at different times; the causal mechanisms by which they produce their effects vary, and lags might also be due to delays in statistical reporting (Brachert et al. 2023, p. 59). Table 2 shows that while states made early-stage announcements of project applications (as marked "without objections") to the responsible Federal Office for Foreign Affairs and Export Control (BAFA) that are slightly above the actual total budget for the first funding period, these projects will not necessarily be approved in the end. Furthermore, states vary considerably in the extent to which they made these early-stage announcements, indicating that the implementation of the regional structural policy differs significantly between regions. This is also confirmed regarding those projects that have been approved (Table 2, column 4) and for which financial resources have already been allocated (column 6). The largest difference is between the states with the smallest and the largest budget. While Saxony-Anhalt has already approved projects that make up 43% of its budget, North Rhine-Westphalia has approved none.

Table 2. Use of the budget of the Coal Phase-Out Act by federal states as of 31 December 2022.

State	Mining Area	Budget for the First Funding Period (2020–2026)	Ex-Ante Announcements of States to BAFA on Project Applications Marked with "No Objections"		Reports of the States on Approved and Completed Projects			
			Announced Budget Need	Share of the Budget (%)	Approved Projects	Share of the Budget	Transferred Project Monies	Share of Approved Projects' Budget
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Million EUR	Million EUR	%	Million EUR	%	Million EUR	%
Brandenburg	Lusatia	1419.0	1934.7	136.3	163.5	11.5	22.0	13.5
Saxony	Lusatia	1386.0	900.4	96.3	178.5	18.3	11.0	6.1
	Central Germany		434.4		74.8		8.8	11.8
Saxony-Anhalt	Central Germany	660.0	1082.0	163.9	283.7	43.0	5.3	1.9
North-Rhine Westphalia	Rhineland	2035.0	1395.3	68.6	0.0	0.0	0.0	0.0
Total		5500.0	5786.8	105.2	700.4	12.7	47.2	6.7

Source: Brachert et al. (2023, p. 72); authors' calculations.

In summary, the policy design of regional structural change is intended to encourage positive expectations toward the future and according activities. This is most clearly visible in the constitution of regional units to which this policy is targeted, the creation of new governance structures, and the provision of public funds for regional structural change that are added to existing programs of regional economic policy. However, it is still unclear how individual representations of the future have changed in response to the phase-out policy process that has been implemented already. Cross-sectional surveys in 13 coal- or carbon-intensive regions in the EU compared, for example, the economic hardship experienced by the regional population. Respondents in Rhineland and Central Germany assessed economic hardship at more than one standard deviation lower than the average of all 13 regions (Barrett 2022, p. 31; Bartl et al. 2022a, p. 33; 2022b, p. 36). A survey on the perception of climate change mitigation policies in the German population in general showed remarkable differences according to the income situation of respondents (Mau et al. 2023, pp. 205–43).

These surveys did not analyze how economic expectations in lignite mining regions have developed over time, i.e., whether they have worsened following the initiation of the coal phase-out process or not. Furthermore, it remains unclear to what extent economic expectations and worries among residents of the remaining German lignite mining regions

differ from those of other German regions. In the following section, we lay out a conceptual framework for empirical analyses concerning these still-unanswered research questions.

3. Conceptual Framework for Studying Economic Worries in Lignite Mining Regions

As a starting point for our framework, we bring together sociopsychological considerations on well-being and subjective economic worries (Diener et al. 2018) with the sociological concept of imagined futures (Beckert 2016). We conceptualize subjective economic worries to articulate pessimistic views on the future development of lignite mining regions during clean energy transition processes. Later, we will conclude this section by presenting two research hypotheses that will be tested based on regional and individual data from the German lignite mining regions as well as other German regions during the initial phase of the German coal phase-out.

3.1. Imagined Futures and Recoding Rule Sets

Actors develop expectations about the future to be able to act, coordinate, and cooperate with others (Beckert 2016). They do so against the backdrop of (implicit) knowledge about social structures, such as the distribution of resources, discursive cultural frames, networks, institutions, normative obligations, and deliberate attempts to create expectations, for example, based on formal projections of future developments (Beckert 2016, p. 60; Groves 2017). Specifying such deliberate attempts, it has been argued that policies that try to align energy transitions and (spatial) social equity involve reimagining existing collective representations of the future on the one hand and recoding rule sets for the transition towards these reimagined futures on the other hand (Hoffman et al. 2021). During the formation stage of a phase-out policy, proponents and opponents debate about the legitimacy of the focal technology (cf. Markard et al. 2022, p. 122).

Academic scholarship, mass media, and political institutions such as parliaments are important arenas for reimagining "sustainable futures" in general (David and Gross 2019; Knappe et al. 2019; Durdovic 2022) and coal phase-out policies in particular (Müller-Hansen et al. 2021; Markard et al. 2022). Although the political economy of coal mining varies between countries (Brauers and Oei 2020; Brauers et al. 2020), typically, "environmental NGOs, social movements and scientists have been observed to argue in favor of phase-out, while utility companies, coal producers and unions seek to avert or delay phase-out" (Markard et al. 2022, p. 120). The political cleavage between economic and ecological interests that is articulated by economic stakeholders of lignite coal mining on the one hand and climate activists on the other hand (Kalt 2021; Krüger 2021; Dörre 2022; Haas et al. 2022; Köster et al. 2022) is a quest for the legitimate technology of energy production of the future. Once the phase-out policy has been adopted, it fulfills not only an instrumental but also a symbolic function by delegitimizing ongoing investments in the established system and reorienting involved actors towards the ultimate end-point of the desired transition (Rinscheid et al. 2022, p. 240).

We described significant elements of the collective reimagination of the future and the recoding of rule sets during the German coal phase-out policy in Section 2. However, while social representations of the future take place at different social levels that interact with each other (Cranach 1992), the effects of deliberate political attempts to shape future expectations on subjective perceptions of the future have rarely been studied (Beckert and Suckert 2021).

Due to the significant uncertainties in the formation of positive and negative expectations about the future, expectations are more volatile than actual events. While this could be seen as a downside, it actually means that they are on the pulse of social change, which makes them relevant, for example, as leading indicators of business cycles (Strigel 1977; Abberger and Nierhaus 2007). We want to approve this feature for our regional analysis. In economic sociology, inflationary positive expectations have been attributed a crucial role, especially in the emergence of financial crises (Emunds 2018; Kraemer and Nessel 2015). Yet, generalized negative expectations about the future, e.g., economic worries, might also

lead to deflationary tendencies and a business environment that is hostile to innovation. Such deflationary tendencies on a regional scale would counteract the structural adjustment of the regional economy in mining areas that is politically intended by the investment elements of the German coal phase-out policy (cf. Brachert et al. 2023).

In the following section, we will extend our analytic framework by a theoretical concept that allows for the explanation of possible differences in the actors' susceptibility to the narrative of the German coal phase-out and the accompanying public discourse. We refer to the sociopsychological concepts of well-being and subjective worries as a foundation for our later research hypotheses (Section 3.3).

3.2. Subjective Economic Worries

Subjective economic worries have originally been conceptualized as a dimension of subjective well-being (Diener et al. 2018). Boehnke and colleagues defined worries as a cognition that a state of an object in a certain domain "will become (become more, or remain) discrepant from its desired state, evaluated on a range from not at all to extremely disturbing" (Boehnke et al. 1998). Although worries have often been conceptualized as either a cognition or an affect, they seem to defy such an opposition because they are both cognitive and affective in nature (Rohrer et al. 2021, p. 333). Worries can refer to different objects on a micro or macro level, and they can be addressed towards different domains of social life, with the economic domain being one of them.

Thus, we argue that economic worries can be conceived as individual articulations of imagined futures in the context of phase-out policies in the remaining German lignite mining regions. In particular, economic worries are future-oriented in the sense that individuals articulate positive or negative feelings, i.e., hopes or fears, towards social, economic, and political developments in regions affected by current coal phase-out policies which are unforeseeable from the actors' points of view (cf. Glatzer 2015).[3]

The Social Indicators Movement has strived to create a standardized information base for policy formulation, implementation, monitoring, and evaluation that includes not only objective indicators from official statistics but also subjective indicators (Land and Michalos 2018). As such, indicators of worries about different objects and domains are an attempt to increase the responsiveness of the political system by providing a potential form of feedback, a form of "statistical citizenship" (Hannah 2001). This is also the reason why standardized questions about economic worries have been developed to be included in many social monitoring projects worldwide (e.g., in Germany: Bulmahn 2001; Iglauer et al. 2021).

However, two domains—worries about the general economic situation of the country and individual economic worries about the private economic situation—have to be differentiated (Luhmann et al. 2010). In Germany, worries about the general economic situation peaked from 2003 to 2006 and from 2009 to 2010 before stabilizing at a comparatively low level since 2014. This development correlates with the peak of unemployment in Germany in the 2000s and the global financial crisis from 2008 to 2010 (Rohrer et al. 2021, p. 334). Subjective economic worries about the private situation are stronger in the eastern part of Germany than in the western part, while there are no major differences between these regions regarding worries about the general economic situation (Lueders 2024). Worries about the private economic situation increase for all income groups due to rising income inequality (Roth et al. 2017); they are negatively correlated to income and age but positively correlated to neuroticism (Luhmann et al. 2010, p. 759). Worries about the general economic situation among Germans increase with age until a peak around 50 and decline afterward (Rohrer et al. 2021, p. 338).

Often, changes in subjective economic worries are affected by critical macroeconomic or life-course events. The Survey of Economic Risk Perceptions and Insecurity during the Great Recession in the USA showed that experiences of economic shocks in at least one domain as well as personal wealth as a potential buffer were important predictors of economic worries about one's private economic situation (Hacker et al. 2013). Other studies found that economic worries do not depend so much on the general economic situation or the general

unemployment rate but on the occupation-specific risk of job loss (Kayran 2020). This is in line with a study showing that during the Great Recession, economic worries in Germany did not increase in general but only for certain subgroups (Hower and Pförtner 2017).

3.3. Hypotheses

In conclusion, current research could not find any clear effects of macroeconomic events on subjective economic worries about one's private economic situation. In particular, little is known so far about the specific effects of recent coal phase-out policies on the development of individual economic worries in the remaining German lignite mining regions. Thus, we formulate two competing hypotheses concerning the possible effects of public debates during the clean energy transition on the subjective economic worries among residents of the remaining German lignite mining regions.

On the one hand, based on the negative effects of market-driven phase-outs of coal that are documented in the literature and that have been picked up by critics of the termination of coal-fired energy production, it would make sense to assume that expectations about their private economic situation deteriorate among residents of the lignite mining regions. Thus, we would assume that personal economic worries will increase among residents of the lignite mining regions as a reaction to the constitution of the Coal Commission in 2018 and its recommendations in early 2019, compared to residents of other regions:

H1. *The probability of developing strong personal economic worries over time is significantly higher in lignite mining regions than in other German regions.*

On the other hand, as a result of the institutional work that has been invested by different actors in reimagining future clean energy supply, it is reasonable to assume that public discourses on clean energy transition yield optimistic imagined futures among several stakeholders in phase-out policies. Consequently, the compensatory as well as preventive elements of the phase-out policy to support the structural change of the affected regions might result in a mitigation of subjective worries about one's private economic situation among residents of the German lignite mining regions, compared to those of other regions:

H2. *The probability of developing strong personal economic worries over time is significantly lower in lignite mining regions than in other German regions.*

Before we test these hypotheses, we describe our data, variables, and statistical methods in the following section. In this context, we also lay out our rationale for adding several control variables to our longitudinal analyses.

4. Data and Methods

4.1. Data

For our analyses, we use data from the German Socio-Economic Panel (GSOEP). The GSOEP is a nationwide panel study, with most of its subsamples being designed as two-stage stratified probability samples (Goebel et al. 2019, p. 348). The panel was formed in 1984, and since then, several sample updates have been implemented. It now contains nearly 15,000 households with about 30,000 persons in the most current waves, making it one of the most useful databases to study the long-term effects of socio-economic transitions on subjective attitudes and living conditions (Hartmann and Preisendörfer 2021; Goebel et al. 2019).

We used data from the years 2016 to 2021 to capture the effects of the creation of the Commission on Growth, Structural Change and Employment in June 2018, which discussed possible sociopolitical and economic scenarios and consequences of the coal phase-out in the three German coal regions (Oei et al. 2020).

The year 2016 is a useful benchmark for measuring development of socio-economic and climate worries in the context of the increasing public debates on coal phase-out policies since 2018. This reference year has also been chosen for a study that strives to evaluate the structural effects of the coal phase-out policy (Brachert et al. 2023). By then, the most serious effects of the worldwide Great Recession on the German labor market and on individual socio-economic worries in Germany had mostly worn off (Gehrke et al. 2019).

The full sample contained 69,441 persons with 274,812 person-years. After the deletion of missing values, our final analysis sample consists of 41,387 persons with 141,708 person-years, resulting in 3.4 observed panel waves per person. Percentages of missing values amount to about 40% for persons ($n_{missing}$ = 28,054) and 48% for person-years ($n_{missing}$ = 133,104). Most of the missing values result from large numbers of gaps in the participants' biographies, which are used to measure divorce events (46% missing person-years) and job-loss events (37% missing person-years) as control variables (see Section 4.2). However, estimates in random-effects and fixed-effects regressions, which we will use in our later analyses (see Section 4.3), are fairly robust against this type of missing data (Young and Johnson 2015). Furthermore, we excluded those participants in the GSOEP who reported that they had moved their residence from a mining region to another region or vice versa between 2016 and 2021 (n = 294). However, we studied whether movers and stayers in lignite mining regions differ regarding subjective economic worries. For these robustness checks, see Section 5.3 and Table A4.

4.2. Variables

Our dependent variable of interest relies on an ordinal measure of subjective worries about the private economic situation (coding: 0 = no worries, 1 = some worries, 2 = many worries). For our analyses, we calculated a dichotomous measure which is used in several other studies dealing with socio-economic or climate change worries (Hartmann and Preisendörfer 2021; Rohrer et al. 2021). Thus, the respective coding of our dependent variable is: 0 = some or no worries, 1 = many worries.

We used the GSOEP regional dataset at the county level to measure whether interviewees resided either in one of the three lignite mining regions or in another region in Germany (Knies and Spiess 2004). We combined this information from the GSOEP regional dataset with data from the German Federal Office for Building and Regional Planning to identify the geographical boundaries of each mining region (Ribbeck-Lampel et al. 2023). Table 3 shows the counties which make up each mining region and each county's numbers of persons and person-years. In our sample, most of the respondents lived in non-coal regions (92%). However, the total number of cases in coal regions (3328 persons with 12,059 person-years) and a sum of 401 districts are sufficient for our hierarchical linear models (Hox 2010).

Earlier studies indicated that several life events increase the risk of lowered general and economic well-being due to associated material hardships and socioeconomic insecurities (Luhmann et al. 2012). For example, divorce, separation, or death of a partner leads to severed economic hardships, which then result in increasing subjective worries (Andreß and Bröckel 2007; Infurna and Mayer 2019). An increasing effect on subjective economic worries is also valid for subjective experiences of unemployment (Luhmann et al. 2014). Thus, we control for each of these life stages by implementing two time-varying dummy variables, with the first measuring whether persons experience spells of divorce, separation of registered civil partnership, or death of a spouse or partner (coding: 0 = no, 1 = yes), and the second measuring whether persons changed into unemployment during our period of analysis (0 = no, 1 = yes). In our total sample, 16% of all person-years are those in separation, divorce, or widowhood, and about 4% are person-years spent in unemployment (see Table 4).

Table 3. Territorial composition of lignite mining and other regions in the sample.

	Rhineland	Central Germany	Lusatia	Other	
	Aachen, city region Düren ** Heinsberg ** Mönchenglad-bach * Rhein-Erft-Kreis ** Rhein-Kreis Neuss **	Burgenlandkreis * Halle (Saale) * City of Leipzig * Leipzig ** Mansfeld-Südharz ** Nordsachsen ** Saalekreis **	Bautzen ** Cottbus * Dahme-Spreewald ** Elbe-Elster ** Görlitz ** Oberspreewald-Lausitz ** Spree-Neiße **	All other districts that are not located in mining regions	Total:
$n_{districts}$	6	6	7	382	401
$n_{persons}$	1351 (3.3%)	1205 (2.9%)	772 (1.9%)	38,059 (92.0%)	41,387 (100%)
$n_{person\text{-}years}$	4725 (3.3%)	4343 (3.1%)	2991 (2.1%)	129,649 (91.5%)	141,708 (100%)

Source: GSOEP 2016–2021. Note: Composition of regions is based on administrative districts at the local level (Ribbeck-Lampel et al. 2023). These are either city districts (*) or rural counties (**). The city region of Aachen is an exception because the city formed an administrative district with the surrounding county, although legally, it would have been entitled to autonomous city status.

Table 4. Description of analysis sample (person-years).

Variables	n	%
Worries about the private economic situation		
Many (1)	18,677	13.2
None or some (0)	123,031	86.8
Region		
Coal region (1)	12,059	8.5
Other region (0)	129,649	91.5
Marital status: divorced, widowed		
Yes (1)	22,641	16.0
No (0)	119,067	84.0
Labor status: unemployed		
Yes (1)	6149	4.3
No (0)	135,559	95.7
Age: younger than 40 years		
Yes (1)	47,120	33.3
No (0)	94,588	66.7
Age: 65 years and older		
Yes (1)	29,348	20.7
No (0)	112,360	79.3
Total	141,708	100.0

Source: GSOEP 2016–2021 (unbalanced panel). Coding is in parentheses.

Furthermore, it has been shown that entering retirement causes general life satisfaction to increase, especially among those adults who were employed instead of having been unemployed or out of employment before retiring (Schmälzle et al. 2019; Gorry et al. 2018). However, for countries such as Germany with strongly aging populations, transitioning into retirement is associated with rising financial worries (Hershey et al. 2010). To control for the effects of transition to retirement on subjective economic worries, we construct a time-varying dummy variable which measures whether a person reaches the age of 65 or older (coding: 1) during the years of analysis or is of younger age (coding: 0). In Germany, pension contributors who were born before 1947 were allowed to retire at the age of 65. Since 2012, the legal retirement age has increased stepwise to 67 years for pension contributors who were born later, between 1953 and 1964 (Deutsche Rentenverischerung Bund 2022). However, the factual retirement age was about 64 years in 2020 (Deutsche Rentenverischerung Bund 2022, p. 132). About 21% of the person-years are spent in the age range of 65 years or older during the time of analysis (see Table 4).

Life-course approaches indicate that building up an occupational career as well as investing in intimate relationships is often economically burdensome for young adults (Blossfeld and Huinink 1991; Mills et al. 2011). Thus, it can be assumed that subjective

economic worries are higher during emerging adulthood than during later life stages (Brauner-Otto and Geist 2018). We therefore implement another measure for life-course transitions from young to middle adulthood, which indicates whether a person is younger than 40 years (coding: 1) or 40 years or older (coding: 0). From the sample descriptions, it becomes clear that during analysis time, about one-third of the sample is younger than 40 years (see Table 4). Additionally, we use interaction terms between time-varying age dummies and our time-constant region dummy to study possible differences between individuals in lignite mining and other regions regarding the effects of transitioning into retirement during analysis time.

We also considered personal net income as a possible control variable (Boes and Winkelmann 2010). Due to large amounts of missing data on personal income, the total sample size would be reduced by 6767 respondents. An analysis which would have used personal net income as a covariate would, thus, not be as stable as those for our main models. However, we decided to conduct a robustness analysis based on our second model that included net income as a control variable (see Table A3 in the Appendix A and Section 5.3 for these and other robustness checks).

Additionally, to control for the effects of regional macroeconomic development and changing labor markets on subjective economic worries, we use two macro-structural variables: the region-specific level of gross domestic product (GDP) in 1000 euros per capita and the region-specific unemployment rate in percentage. We also control for the percentage of the regional workforce in the lignite industry, including mining and lignite-fired power plants (Statistik der Kohlenwirtschaft e.V 2023), which has been used by political decision-makers as an allocation formula for the compensation of lignite mining regions (cf. Bickman 1987). Descriptives of these macroeconomic indicators are presented in Section 5.1.

4.3. Analytical Strategy and Statistical Approaches

The main aim of our empirical analyses is the study of temporal developments of personal economic worries in the remaining lignite mining and other German regions. Furthermore, we compare the probabilities of strong subjective worries about the private economic situation of residents of lignite mining regions to those of other regions during the debates on German phase-out policies between 2016 and 2021. In the results section, we first describe the macro-structural characteristics of the regions under consideration, as well as the time patterns of subjective economic worries between 2016 and 2021. Throughout our descriptive analyses, we use design weights, which are delivered for each GSOEP wave (Goebel et al. 2019).

For our multivariate panel analyses, we used three-level random intercept logit regression analyses, which partially control for unobserved heterogeneity due to time-constant covariates of each participant. Therefore, we implement random intercepts at the participant and district levels (Arránz Becker and Hank 2022, p. 352). We report average marginal effects (AME), which show the average probability of the dependent variable to have a value of 1 (strong economic worries), given that the independent variable changes by one unit (Andreß et al. 2013).

We added year dummies to our models to control for time-trends of subjective economic worries in all of our regression models (reference year: 2016). Furthermore, we applied interaction terms between these year dummies and the region measure. Thereby, we could highlight possible region-specific effects of the coal phase-out policy and associated public debates on subjective economic worries (Andreß et al. 2013, p. 186). In the second multivariate model, we control for important life events (divorce and unemployment) as well as entering retirement, while in our third model, we additionally control for macro-structural developments (regional GDP per capita, regional unemployment rate).

In our robustness analyses (see Section 5.3 and Appendix A), we calculated a difference-in-difference regression to strictly test for the average treatment effect on the treated, here, persons living in mining regions during the working period of the Coal Commission (Hsiao

2014). Additionally, we calculated fixed effects regressions based on the (time-variant) measures of our hierarchical linear models to control for unobserved heterogeneity solely on the individual level (Allison 2009; Hox 2010). However, results from these computations did not differ profoundly from those of our main analyses (see Tables A1 and A2). Furthermore, we conducted robustness checks for personal net income on subjective economic worries and for differences between persons moving into or out of mining regions and those who stayed in these regions during the time of analysis (see Tables A3 and A4).

Our analytical strategy focuses on intraindividual changes of subjective economic worries among residents of the three German lignite mining regions, compared to those of other regions in Germany. This approach might, to some extent, suffer from the shortcomings of "methodological territorialism" (Faludi 2013), i.e., our analyses do not control for spatial dependency. These and other limitations of our method will be addressed in the final section of our contribution.

5. Empirical Results

5.1. Descriptive Analysis

The historical trajectory of coal regions leaves its traces in manifold regional differences (Obschonka et al. 2018). To a certain extent, structural disadvantages are also observable in the three German lignite mining regions (see Table 5). Most strikingly, average unemployment rates are higher in each of the remaining lignite mining regions than in the other German regions from 2016 to 2021. Also, GDP per capita in the lignite mining regions is lower than in the other German regions. With an average GDP per capita of about 33,600 euros, the Rhineland had the largest economic power among the lignite mining regions during the time of analysis. Besides challenges due to clean energy transition processes, these results indicate a long-known German east–west divide in economic power (Biewen 2000). Among the coal regions, the share of the workforce in the lignite industry is most relevant in Lusatia.

Extending on this macro-structural perspective, time patterns of subjective economic worries are important indicators of individual responses to the politics of expectations of different stakeholders during clean energy transitions (see Figure 1). Overall, in each of the lignite mining regions as well as in the other German regions, percentages of people who are strongly worried about their private economic situation show slightly negative trends between 2016 and 2021. In 2016, at the beginning of the analyzed period, Central Germany had the highest share of people (19%) who reported strong subjective worries about their private economic situation. Up to 2018, the year when the Coal Commission took up work, the percentages of strongly worried persons decreased to 13% in Central Germany and to about 10% each in the Rhineland, in Central Germany, and in non-lignite-mining regions. This is rather surprising, as the public discourse in the national press on the coal phase-out increased in this period, being most polarized in 2018 and peaking in 2019 (Markard et al. 2022, p. 130; Bartl et al. 2022a, p. 106). In 2019, the percentage of respondents with many economic worries only increased in the Rhineland region, from 10% to 17%. However, it decreased again to about 10% in 2020 and even further in 2021. In each other region, percentages remained mostly stable from 2018 to 2021.

All in all, there is no descriptive evidence for increased subjective economic worries in the German lignite mining regions during the period of heated public discourses on coal phase-out and clean energy transition. Furthermore, trajectories in each region approximately resemble slightly negative, linear trends, which is appropriate for the implementation of hierarchical linear regression models (Hox 2010).

Table 5. Regional GDP per capita, unemployment rates, and share of workforce in the lignite industry.

Variables	Mean	SD
Coal region: Rhineland		
Average GDP per capita (in 1000 euros) 2016–2021	33.6	4.8
Average unemployment rate (percent) 2016–2021	7.2	2.0
Share of workforce in the lignite industry (percent)	0.8	0.1
Coal region: Central Germany		
Average GDP per capita (in 1000 euros) 2016–2021	31.7	5.7
Average unemployment rate (percent) 2016–2021	7.9	1.7
Share of workforce in the lignite industry (percent)	0.3	0.0
Coal region: Lusatia		
Average GDP per capita (in 1000 euros) 2016–2021	28.7	3.9
Average unemployment rate (percent) 2016–2021	7.6	1.8
Share of workforce in the lignite industry (percent)	1.7	0.1
Other regions		
Average GDP per capita (in 1000 euros) 2016–2021	40.5	17.6
Average unemployment rate (percent) 2016–2021	5.8	2.7
Share of workforce in the lignite industry (percent)	0	0

Source: GSOEP 2016–2021 (including design weights). Coding is in parentheses. SD = standard deviation.

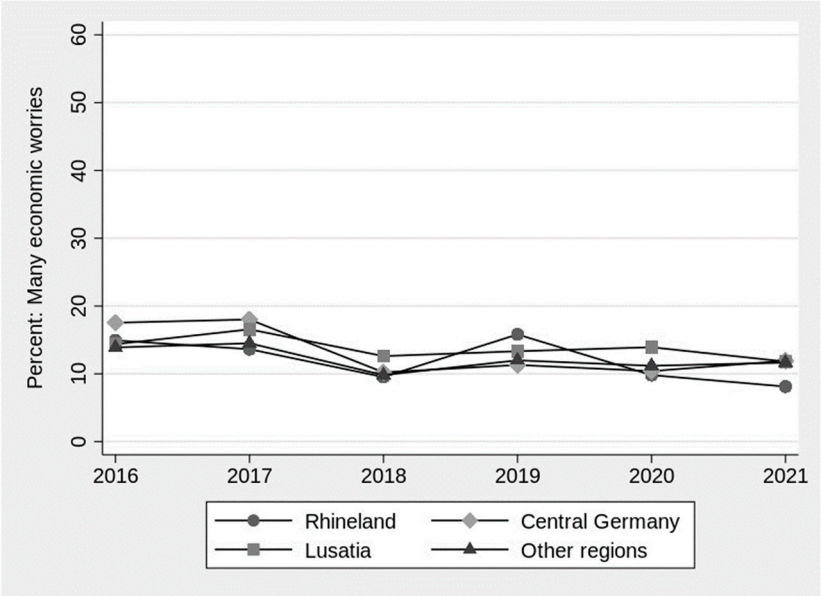

Figure 1. Worries about the private economic situation in lignite mining and other German regions. Source: GSOEP 2016–2021 (including design weights).

5.2. Multivariate Analyses

In our multivariate panel analyses, we test the assumption that public debates on the German coal phase-out policy, e.g., during the institutional work of the Coal Commission (from 6 June 2018 to 31 January 2019), caused subjective economic worries among residents in lignite mining regions to differ from those of residents in other German regions (see Table 6). To that end, we conduct three-level random intercept logit regression analyses with interactions between region and year dummies.

In accordance with the descriptive findings, the AMEs for the time dummies as well as for interaction terms between regions and the year dummies are negative for each year, compared to 2016. Thus, probabilities of strong worries about the private economic situation decrease during the time of analysis. These are indicated by negative (statistically insignificant) AMEs for interaction terms between each year of analysis and the dummy, measuring whether people live in coal mining regions (1) or not (0). Furthermore, the main

effect of our region dummy is fairly low and statistically not significant (AME = 0.014, $p = 0.189$). These results remain stable when control variables are included at the individual and district levels (see models 2 and 3 in Table 6). Thus, our first hypothesis (higher economic worries in coal regions than in other regions) as well as our second hypothesis (lower economic worries in coal regions than in other regions) have to be refuted. Our empirical analyses do not show any significant differences in the development of strong personal economic worries between residents of lignite mining regions and those of other German regions.

Next, we inspect estimates for our control variables. In accordance with well-being research (Luhmann et al. 2012), we find significant effects of critical life events on economic worries in our second model. Persons who experience phases of divorce, partnership dissolution, or death of their partner have a significantly higher probability of strong economic worries than those who are in a romantic relationship, in marriage, or who are single (AME = 0.050, $p < 0.001$). Individuals who transition into unemployment during the time of analysis have a significantly higher probability of strong personal economic worries (AME = 0.043, $p < 0.001$), while those who reach retirement age have a significantly lower probability of strong economic worries (AME = −0.087, $p < 0.001$). Furthermore, younger adults have slightly higher probabilities of high subjective economic worries than those who transition into middle adulthood (AME = 0.014, $p < 0.001$). However, there are no significant interaction effects, either in model 2 or model 3, for persons who live in a lignite mining region and who reach the age of 65 or 40.

In the third model, there is a significant positive effect of district unemployment rates on probabilities: the probability of strong economic worries increases by 0.004 AME-points ($p < 0.001$) with each percentage increase in district unemployment rates. There are no statistically significant associations between subjective economic worries and regional gross domestic product or shares of workforce in lignite mining, respectively. Furthermore, the year dummies in each model indicate significantly lower probabilities of yielding strong worries about one's private economic situation in each region compared to the reference year of 2016. All in all, we did not find any evidence that the adoption of the lignite phase-out policy and the accompanying public discourse affected subjective economic worries among residents of German mining regions, either to increase or to decrease. This result is in accordance with earlier international studies on effects of macrosocial shocks and subjective economic worries (Kayran 2020; Hower and Pförtner 2017). The evidence on effects of critical life phases as well as of regional unemployment rates is mostly in accordance with the current state of research in the respective fields of research, as well (Luhmann et al. 2012; Schmälzle et al. 2019; Infurna and Mayer 2019).

Table 6. Worries about the private economic situation in lignite mining regions, 2016–2021.

	(1)			(2)			(3)		
Variables	**AME**	**SE**	***p***	**AME**	**SE**	***p***	**AME**	**SE**	***p***
Mining region (Ref.: other)	0.014	(0.01)	0.189	0.012	(0.01)	0.297	−0.008	(0.02)	0.645
Mining region × Year (Ref.: other regions, 2016)									
Mining region × 2017	0.010	(0.01)	0.232	0.009	(0.01)	0.277	0.011	(0.01)	0.205
Mining region × 2018	−0.001	(0.01)	0.874	−0.001	(0.01)	0.883	0.001	(0.01)	0.887
Mining region × 2019	−0.003	(0.01)	0.742	−0.002	(0.01)	0.784	0.002	(0.01)	0.833
Mining region × 2020	−0.004	(0.01)	0.690	−0.004	(0.01)	0.633	0.001	(0.01)	0.938
Mining region × 2021	−0.009	(0.01)	0.355	−0.009	(0.01)	0.375	−0.007	(0.01)	0.514
Region GDP per capita							0.000	(0.00)	0.171
Region unemployment rate							0.004 ***	(0.00)	0.000

Table 6. *Cont.*

Variables	(1) AME	SE	p	(2) AME	SE	p	(3) AME	SE	p
Share of workforce in lignite industry							0.010	(0.01)	0.478
Marital status: divorced, separated, widow (Ref.: no)									
Yes				0.050 ***	(0.00)	0.000	0.050 ***	(0.00)	0.000
Labor status: unemployed (Ref. employed)									
Yes				0.043 ***	(0.00)	0.000	0.043 ***	(0.00)	0.000
Younger than 40 years (Ref.: no)									
Yes				0.014 ***	(0.00)	0.000	0.014 ***	(0.00)	0.000
65 years or older (Ref.: no)									
Yes				−0.087 ***	(0.00)	0.000	−0.088 ***	(0.00)	0.000
Mining region × Age < 40				0.009	(0.01)	0.314	0.009	(0.01)	0.312
Mining region × Age ≥ 65				−0.002	(0.01)	0.904	−0.002	(0.01)	0.901
Year dummies (Ref.: 2016)									
2017	0.000	(0.00)	0.846	0.001	(0.00)	0.693	0.003	(0.00)	0.296
2018	−0.044 ***	(0.00)	0.000	−0.043 ***	(0.00)	0.000	−0.039 ***	(0.00)	0.000
2019	−0.024 ***	(0.00)	0.000	−0.020 ***	(0.00)	0.000	−0.016 ***	(0.00)	0.000
2020	−0.027 ***	(0.00)	0.000	−0.024 ***	(0.00)	0.000	−0.023 ***	(0.00)	0.000
2021	−0.024 ***	(0.00)	0.000	−0.021	(0.00)	0.000	−0.030 ***	(0.00)	0.000
Constant	0.041 ***	(0.00)	0.000	0.043 ***	(0.00)	0.000	0.027 ***	(0.00)	0.000
Random Intercept Variances									
Level 3: Districts	0.263	(0.03)		0.247	(0.03)		0.204	(0.03)	
Level 2: Respondents	6.685	(0.18)		5.939	(0.16)		5.937	(0.16)	
n (districts)	401			401			401		
n (persons)	41,387			41,387			41,387		
n (person-years)	141,708			141,708			141,708		
Log likelihood	−46,944.41			−46,417.95			−46,401.13		
LR Chi^2 (df)	457.09 *** (14)			1421.52 *** (20)			1459.36 *** (23)		
AIC	93,916.81			92,875.90			92,848.27		
BIC	94,054.87			93,073.13			93,075.08		

Source: GSOEP 2016–2021. Three-level random intercept logit regressions with average marginal effects (AME). SE = standard error; p = exact significance. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5.3. Robustness Analyses

To check the robustness of our multivariate results, we calculated a difference-in-difference model which tested for average causal effects for persons who lived in one of the three coal-mining regions during the time of the implementation of the Commission on Growth, Structural Change and Employment (see Table A1 in the Appendix A). Additionally, we controlled for each of the individual and contextual variables from our main model. The average treatment effect on the treated for the region dummy is slightly negative, albeit statistically insignificant (Coef. = −0.005, $p = 0.840$). Except for the district-specific unemployment rate and the dummy indicating persons during emerging adulthood (younger than 40 years), which are each statistically insignificant, the effects of each other control variable remain stable.

Based on our main hierarchical regression models, we also conducted fixed effects logistic regression models as an additional robustness check to control for unit-specific unobserved heterogeneity solely (see Table A2 in the Appendix A). Thereby, we ignored the multilevel structure of our data but controlled for each possible time-constant covariate. However, these robustness checks did not show any remarkable alterations to the results

of our main analyses. Again, interaction effects between year dummies and the region dummy (persons living in or outside coal mining regions) are statistically insignificant, indicating no increases in probabilities of strong subjective economic worries during the implementation of the coal phase-out policy among residents of lignite mining regions compared to those of all other German counties.

We conducted another robustness check, which included personal net labor income as a time-varying covariate (measured in 1000 euros; see Table A3) in a logistic fixed-effects regression. The results of this robustness check turned out to be similar to the effect of employment status in our main analysis, with net income having a significant negative effect on probabilities of subjective economic worries (AME = −0.052, $p < 0.001$). Thus, decreasing personal labor income significantly affected the probabilities of strong subjective economic worries increasing between 2016 and 2021. Notice that the covariate which measured whether respondents experienced job loss had to be omitted from this robustness check due to collinearity with net labor income.

Finally, we studied whether people who moved from lignite mining to other regions between 2016 and 2021 systematically differed from those who stayed (Table A4). In our logistic random-effects regression, stayers are the reference category, with movers amounting to 294 persons (not depicted in Table A4). There is a slightly positive coefficient, indicating that movers have a somewhat higher probability than stayers to exhibit strong worries about their private economic situation; however, this coefficient is not statistically significant (AME = 0.001, $p = 0.944$). These results indicate that the coefficients in our main analyses are robust against the exclusion of movers from the analysis sample. However, based on larger samples, future studies should consider testing the effects of clean energy transitions and intraindividual changes in economic worries on spatial mobility for lignite-mining reasons.

6. Discussion and Conclusions

6.1. Main Findings and Practical Implications

Coal phase-out policies constitute an important element of clean energy transitions which poses severe economic and socio-structural challenges, especially in regions with a long tradition of energy production based on lignite mining, carbon-intensive industries, or both (Strambo et al. 2019; Diluiso et al. 2021; Abreu and Jones 2021). Based on theoretical literature on imagined futures and the recoding of rule sets, we studied the effects of the German coal phase-out policy on subjective economic worries in the three active German lignite mining regions. These regions are directly affected by the planned closures of the existing open pit mines but have also been formally constituted as spaces of policy intervention with newly created governance structures. They have been assigned significant public funds for initiating a regional structural transformation through innovative projects that come on top of existing regional policy funds for structurally weak regions (Brachert et al. 2023).

Against the backdrop of the visions for a regional structural transformation and the significant state support codified in the Coal Phase-Out Act, we formulated competing hypotheses about the subjective interpretation of the phase-out policy and the related public discourse. Interestingly, our results show no major differences in the development of individual worries about the private economic situation between residents of lignite mining regions and those in the rest of Germany. Thus, based on our empirical analyses, our two hypotheses which posited (contradictory) effects of the recent German coal phase-out policy on subjective economic worries have to be falsified.

According to our theoretical framework, the institutional work invested in the design of the phase-out policy by different actors might have contributed to the attenuation of the most severe economic burdens that lignite mining regions are confronted with during clean energy transitions. For example, the recoding of rule sets has preventively started to channel significant investments in the lignite mining regions to initiate alternative uses

of existing open-pit mining and coal-fired power stations in the German lignite mining regions.

Therefore, residents of other regions who might be subject to future energy transitions could profit from timely compensation programs, such as in the case we investigated. However, region- and period-specific circumstances of future sustainability transition policies should cautiously be taken into consideration by political decision-makers. For example, it is an open question whether the stability of subjective economic worries in lignite mining regions during the initiation of the coal phase-out policy is solely the result of compensatory programs for regional structural change. While lignite mining regions are part of the larger area for which regional structural policies have already existed, the public funds of the phase-out policy are specifically targeted to them. Therefore, the compensatory regional policy of the Coal Phase-Out Act could be interpreted as an example of a group-specific recognition mechanism that is based on spatial boundary-making, that is, the creation of new spatial units as targets for policy intervention. Research on the perception of labor market policies suggests, for instance, that policies that are perceived as targeted exclusively toward one's own group signal particular group recognition and are therefore more valued by the affected groups (Bürgisser et al. 2023, p. 6). However, to a certain extent, it could also be argued that the relative stability of economic worries in the affected regions reflects a generalized trust of the population in the German political economy. Clarifying the exact causal relationship between regional policies and subjective economic worries should be addressed in future studies.

Our results extend the empirical focus of current debates on a persisting conflict between ecological concerns and economic interests (e.g., Dörre et al. [2020] 2022). It appears that the perceived trade-off between environmental and general economic worries that was observed on an aggregate level in Germany for a long time, and that has disappeared since the early 2000s (Hartmann and Preisendörfer 2023), has also lost its relevance regarding personal economic worries. Apparently, environmental concerns and imaginations of clean energy supply might have come to be hegemonic in public discourse, thus mitigating personal economic worries in regions affected by the coal phase-out. This interpretation is supported by the fact that national public discourse became less polarized after the work of the Coal Commission and more supportive of the coal phase-out (Markard et al. 2022, p. 130). Scant evidence from surveys in Central Germany and Lusatia suggests that attitudes toward the phase-out have been more controversial at the regional level (MDR 2022, 2023).

However, regional developments do not tell the whole story. Critical life events, such as experiencing phases of partnership dissolution or the death of a partner, as well as phases of transitioning into unemployment, significantly increase the probability of strong personal economic worries. We used transitions into unemployment as an alternative to income variables. In this sense, our results are consistent with studies that showed differences in the evaluation of climate change mitigation policies according to income inequality (Mau et al. 2023). Furthermore, the probability of strong subjective economic worries increases for individuals who live in regions with rising unemployment rates. Interestingly, the probability of strong subjective economic worries decreases significantly among persons in lignite mining regions who reach the age of retirement compared to similar persons in other regions.

6.2. Future Research and Methodical Limitations

Lignite phase-out policies have been initiated in several European countries and will gradually unfold during the years to come, posing several challenges for the affected mining regions (Holman 2023). Therefore, a promising avenue for further research would be to conduct international comparisons of policy effects on individuals' economic situation at the regional level. While the survey program of EU statistics on income and living conditions (EU-SILC) contains information on material deprivation, the respective item captures the ability to "make ends meet" at the time of the interview, not economic worries

(Eurostat 2022, p. 155). Although it could be argued that such an item is more valid than future-oriented items on economic worries, items on material deprivation have the disadvantage that effects can be expected only with a considerable time lag. In Germany, for example, the regional phase-outs will be concluded in 2030 and 2038, respectively.

Future studies should also consider analyzing possible mechanisms that might lead to changing economic worries due to socially selective effects of compensation policies in lignite mining regions. Specifically, it is reasonable to assume that women who transition to retirement might be more vulnerable to economic uncertainties because they participate in the labor market to a lower degree than men (Madero-Cabib and Fasang 2016). Future studies should, thus, focus on gendered effects of clean energy transitions, especially in lignite mining regions, which might become relevant in the context of future closures of coal mines. Also, effects among other vulnerable groups, such as persons with low education or immigrants, should be considered in future studies. Therefore, qualitative analyses might be an appropriate way to study the repercussions of clean energy transitions among members of specifically vulnerable socio-demographic groups.

Furthermore, regarding the period analyzed in this article, it could also be the case that economic worries might have changed under the additional risk of energy shortages due to the full-scale Russian war against Ukraine that began on 24 February 2022. A survey from 2022 suggests at least that support for climate change mitigation policies has not decreased due to the Russian invasion (Rinscheid and Koos 2023). Based on more recent waves of the GSOEP than those which were available for the present study, future studies should take the possible period-effects of the war against Ukraine into consideration.

Our operationalization of lignite mining areas followed the territorial definition codified in the Coal Phase-Out Act. This is also consistent with other studies on this issue (e.g., Brachert et al. 2023). However, it might be argued that such a "methodological territorialism" (Faludi 2013; Walsh 2014) ignores the internal spatial heterogeneity of these regions (Ribbeck-Lampel et al. 2023, pp. 13–14). Future studies could address this desideratum. We stuck to the formal definition of lignite mining regions because it has objectively become a significant element of social reality, and this definition also provides for comparability with other studies using the same spatial scale. Further investigation of personal economic worries from a spatial perspective appears to be especially timely because spatial cleavages have regained political salience since the electoral successes of neo-nationalist parties (Kraemer 2018) were interpreted in geographic terms (Rodríguez-Pose 2018; Deppisch 2019; Bobzien 2021; Pike et al. 2023). In Germany, the popularity of the Alternative for Germany (*Alternative für Deutschland*, AfD), which capitalizes on dystopian images of a deindustrialized country due to the coal phase-out, should also be considered in future studies. Our results on personal economic worries are not easily compatible with ongoing debates on whether economic worries or other domain-specific attitudes such as worries about immigration might fuel the increasing popularity of the AfD among German voters (Arzheimer and Berning 2019; Baron and Görtz 2023).

Generally, the time of analysis was restricted to only the three years since the quasi-treatment event, the working period of the so-called German Coal Commission, had occurred. Replication studies which will make use of a longer time period since the event are, thus, very welcome. Analyses based on future waves of the GSOEP should take the aspects we discussed in this last section into consideration.

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Data Availability Statement: SOEP data access is constrained to researchers with an institutional affiliation having signed a data licence contract. Data access is free of charge and can be requested at: https://www.diw.de/en/diw_01.c.601584.en/data_access.html (accessed on 22 May 2024). Syntax files for Stata are available from the authors upon request.

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Appendix A

Table A1. Worries about the private economic situation in lignite mining regions, 2016–2021 (Difference-in-Difference Regression).

Variables	Coef.	SE	*p*
Mining region (Ref.: other)			
Coal region (average treatment effect of the treated)	−0.005	(0.02)	0.840
Region GDP per capita	0.000	(0.00)	0.422
Region unemployment rate	0.001	(0.00)	0.349
Marital status: divorced, separated, widow (Ref.: no)			
Yes	0.021 **	(0.01)	0.009
Labor status: unemployed (Ref. employed)			
Yes	0.036 ***	(0.00)	0.000
Younger than 40 years (Ref.: no)			
Yes	−0.006	(0.01)	0.356
65 years or older (Ref.: no)			
Yes	−0.016 *	(0.01)	0.012
Year dummies (Ref.: 2016)			
2017	0.005	(0.00)	0.053
2018	−0.039 ***	(0.00)	0.000
2019	−0.017 ***	(0.00)	0.000
2020	−0.023 ***	(0.00)	0.000
2021	−0.028 ***	(0.00)	0.000
n (person-years)	141,708		
n (persons)	41,387		

Source: GSOEP 2016–2021. Logistic difference-indifference regressions with average marginal effects (AME). SE = standard error; p = exact significance. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A2. Worries about the private economic situation in lignite mining regions, 2016–2021 (Fixed effects regressions).

	(1)			(2)			(3)		
Variables	**AME**	**SE**	***p***	**AME**	**SE**	***p***	**AME**	**SE**	***p***
Mining region × Year (Ref.: other regions, 2016)									
Mining region × 2017	0.050	(0.03)	0.081	0.049	(0.03)	0.090	0.053	(0.03)	0.073
Mining region × 2018	0.015	(0.03)	0.638	0.017	(0.03)	0.585	0.021	(0.03)	0.500
Mining region × 2019	0.000	(0.03)	0.945	0.006	(0.03)	0.849	0.010	(0.03)	0.764
Mining region × 2020	0.008	(0.03)	0.794	0.011	(0.03)	0.738	0.014	(0.03)	0.663
Mining region × 2021	−0.004	(0.04)	0.905	0.002	(0.04)	0.965	−0.001	(0.04)	0.985

Table A2. *Cont.*

Variables	(1) AME	SE	p	(2) AME	SE	p	(3) AME	SE	p
Region GDP per capita							0.001	(0.00)	0.594
Region unemployment rate							0.002	(0.00)	0.501
Share of workforce in the lignite industry							−0.055	(0.07)	0.452
Marital status: divorced, separated, widow (Ref.: no)									
Yes				0.065 **	(0.02)	0.002	0.066 **	(0.02)	0.002
Labor status: unemployed (Ref. employed)									
Yes				0.098 ***	(0.01)	0.000	0.098 ***	(0.01)	0.000
Younger than 40 years (Ref.: no)									
Yes				−0.030	(0.02)	0.149	−0.032	(0.02)	0.127
65 years or older (Ref.: no)									
Yes				−0.085 **	(0.03)	0.003	−0.087 **	(0.03)	0.003
Mining region × Age < 40				0.024	(0.05)	0.632	0.044	(0.06)	0.442
Mining region × Age ≥ 65				−0.056	(0.09)	0.510	−0.053	(0.09)	0.544
Year dummies (Ref.: 2016)									
2017	0.011	(0.01)	0.223	0.010	(0.01)	0.229	0.011	(0.01)	0.231
2018	−0.143 ***	(0.01)	0.000	−0.143 ***	(0.01)	0.000	−0.143 ***	(0.01)	0.000
2019	−0.064 ***	(0.01)	0.000	−0.063 ***	(0.01)	0.000	−0.062 ***	(0.01)	0.000
2020	−0.085 ***	(0.01)	0.000	−0.084 ***	(0.01)	0.000	−0.085 ***	(0.01)	0.000
2021	−0.091 ***	(0.01)	0.000	−0.090 ***	(0.01)	0.000	−0.098 ***	(0.01)	0.000
n (person-years)	35,604			35,604			35,604		
n (persons)	7902			7902			7902		
Log likelihood	−13,155.88			−13,112.44			−13,111.70		
LR Chi^2 (df)	425.40 *** (10)			512.30 *** (16)			513.77 *** (19)		
AIC	26,331.77			26,256.87			26,261.40		
BIC	26,416.57			26,392.56			26,422.52		

Source: GSOEP 2016–2021. Logistic fixed-effects regressions with average marginal effects (AME). SE = standard error; p = exact significance. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A3. Subjective economic worries, robustness check controlling for personal net income (individual level).

Variables	AME	SE	p
Mining region × Year (Ref.: other regions, 2016)			
Mining region × 2017	0.053	(0.04)	0.132
Mining region × 2018	0.010	(0.04)	0.803
Mining region × 2019	0.003	(0.04)	0.920
Mining region × 2020	−0.009	(0.04)	0.809
Mining region × 2021	−0.026	(0.04)	0.564
Personal net income (in 1000 euros)	−0.052 ***	(0.03)	0.000
Marital stat.: divorced, separated, widowed (Ref.: no)			
Yes	−0.046	(0.03)	0.082
Younger than 40 years (Ref.: no)			
Yes	−0.012	(0.02)	0.607
65 yrs. or older (Ref.: no)			
Yes	−0.063	(0.05)	0.198

Table A3. *Cont.*

Variables	AME	SE	*p*
Mining region × Age < 40	0.047	(0.06)	0.469
Mining region × Age ≥ 65	0.153	(0.16)	0.344
Year dummies (Ref.: 2016)			
2017	0.013	(0.01)	0.238
2018	−0.134 ***	(0.01)	0.000
2019	−0.047 ***	(0.01)	0.000
2020	−0.040 **	(0.01)	0.001
2021	−0.053 ***	(0.01)	0.000
n (person-years)	21,328		
n (persons)	5092		
Log likelihood	−7773.91		
LR Chi^2 (df)	319.12 *** (16)		
AIC	15,579.81		
BIC	15,707.30		

Source: GSOEP 2016–2021. Logistic fixed-effects regression with average marginal effects (AME). SE = standard error; *p* = exact significance. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A4. Worries about private economic situation among movers from lignite mining regions.

Variables	AME	SE	*p*
Movers (Ref.: stayers)			
Moved from lignite mining region to other region	0.001	(0.02)	0.944
Year dummies (Ref.: 2016)			
2017	0.001	(0.00)	0.579
2018	−0.042 ***	(0.00)	0.000
2019	−0.023 ***	(0.00)	0.000
2020	−0.026 ***	(0.00)	0.000
2021	−0.023 ***	(0.00)	0.000
Constant	−3.066 ***	(0.03)	0.000
n (person-years)	148,524		
n (persons)	42,403		
Log likelihood	−49,148.19		
LR Chi^2 (df)	451.39 *** (8)		
Rho	0.648		

Source: GSOEP 2016–2021. Logistic random-effects regression with average marginal effects (AME). SE = standard error, *p* = exact significance, CI = confidence interval. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Notes

1 The three still active lignite mining regions in Germany are the Rhineland (Rheinland), Central Germany (Mitteldeutschland), and Lusatia (Lausitz). Most of the smaller lignite mines around the town of Helmstedt in Lower Saxony have been active from the 1920s to the early 1990s. In this region, the only open-pit mine (Schöningen) that has been active recently closed down in 2016. Thus, the Helmstedt region is not counted as a lignite mining region in our analysis.

2 The legislative package consisted of the Act to Reduce and End Coal-Fired Power Generation (*Gesetz zur Reduzierung und zur Beendigung der Kohleverstromung)*, the Coal Regions Investment Act (*Investitionsgesetz Kohleregionen*), and the Structural Reinforcement Act for Mining Regions (*Strukturstärkungsgesetz Kohleregionen*).

3 While Glatzer categorized worries as an evaluation of present situations, semantically, the notion actually refers to the future. This becomes especially transparent with a view to the explicit wording of one of the first standardized items that introduced worries as a concept into social research: "What are your fears and worries about the future?" (Cantril and Free 1962, p. 9).

References

Abberger, Klaus, and Wolfgang Nierhaus. 2007. Das ifo Geschäftsklima: Ein zuverlässiger Frühindikator. *ifo Schnelldienst* 60: 25–30.
Abreu, Maria, and Calvin Jones. 2021. The Shadow of the Pithead: Understanding social and political attitudes in former coal mining communities in the UK. *Applied Geography* 131: 102448. [CrossRef]
Allison, Paul D. 2009. *Fixed Effects Regression Models*. Los Angeles: Sage.

Andreß, Hans-Jürgen, and Miriam Bröckel. 2007. Income and Life Satisfaction After Marital Disruption in Germany. *Journal of Marriage and Family* 69: 500–12. [CrossRef]
Andreß, Hans-Jürgen, Katrin Golsch, and Alexander W. Schmidt. 2013. *Applied Panel Data Analysis for Economic and Social Surveys*. Heidelberg: Springer.
Arránz Becker, Oliver, and Karsten Hank. 2022. Adult children's estrangement from parents in Germany. *Journal of Marriage and the Family* 84: 347–60. [CrossRef]
Arzheimer, Kai, and Carl C. Berning. 2019. How the Alternative for Germany (AfD) and their voters veered to the radical right, 2013–2017. *Electoral Studies* 60: 102040. [CrossRef]
Baron, Daniel, and Antonia Görtz. 2023. Sozioökonomische und einstellungsbezogene Ursachen für Wanderungen von CDU/CSU- und SPD-Wähler*innen zur AfD bei der Bundestagswahl 2017. *Politische Vierteljahresschrift* 64: 325–51. [CrossRef]
Barrett, Tristam. 2022. Lusatia Case Study Report. ENTRANCES D3.2. Available online: https://entrancesproject.eu/wp-content/uploads/2022/12/D3.2-Lusatia-Case-Study-Report.pdf (accessed on 22 May 2024).
Bartl, Walter, Katja Heinisch, Oliver Holtemöller, and Christoph Schult. 2022a. Rhineland Case Study Report. Energy Transitions from Coal and Carbon: Effects on Societies (ENTRANCES) D3.3. Available online: https://entrancesproject.eu/wp-content/uploads/2022/12/D3.3-Rhineland-Case-Study-Report.pdf (accessed on 22 May 2024).
Bartl, Walter, Katja Heinisch, Oliver Holtemöller, Reinhold Sackmann, and Christoph Schult. 2022b. Central Germany Case Study Report. Energy Transitions from Coal and Carbon: Effects on Societies (ENTRANCES) D3.4. Available online: https://entrancesproject.eu/wp-content/uploads/2022/12/D3.4-CentralGermany-Case-Study-Report.pdf (accessed on 22 May 2024).
Beckert, Jens. 2016. *Imagined Futures: Fictional Expectations and Capitalist Dynamics*. Cambridge: Harvard University Press.
Beckert, Jens, and Lisa Suckert. 2021. The future as a social fact. The analysis of perceptions of the future in sociology. *Poetics* 84: 101499. [CrossRef]
BGBl. 2020. Strukturstärkungsgesetz Kohleregionen. Vom 8. August 2020. *Bundesgesetzblatt Teil* I: 1795–817.
Bickman, Leonard. 1987. The functions of program theory. In *Using program theory in evaluation*. Edited by Leonard Bickman. New Directions for Program Evaluation 33. San Francisco: Jossey-Bass, pp. 5–18. [CrossRef]
Biewen, Martin. 2000. Income Inequality in Germany during the 1980s and 1990s. *Review of Income and Wealth* 46: 1–19. [CrossRef]
Blossfeld, Hans-Peter, and Johannes Huinink. 1991. Human Capital Investments or Norms of Role Transition? How Women's Schooling and Career Affect the Process of Family Formation. *American Journal of Sociology* 97: 143–68. [CrossRef]
Bobzien, Licia. 2021. The Role of Perceived Economic Inequality in the Formation of Political Preferences. Dissertation, Hertie School. Available online: https://opus4.kobv.de/opus4-hsog/frontdoor/deliver/index/docId/4177/file/Dissertation_Bobzien.pdf (accessed on 22 May 2024).
Boehnke, Klaus, Shalom Schwartz, Claudia Stromberg, and Lilach Sagiv. 1998. The structure and dynamics of worry: Theory, measurement, and cross-national replications. *Journal of Personality* 66: 745–82. [CrossRef] [PubMed]
Boes, Stefan, and Rainer Winkelmann. 2010. The Effect of Income on General Life Satisfaction and Dissatisfaction. *Social Indicator Research* 95: 111–28. [CrossRef]
Brachert, Matthias, Katja Heinisch, Oliver Holtemöller, Florian Kirsch, Uwe Neumann, Michael Rothgang, Torsten Schmidt, Christoph Schult, Anna Solms, and Mirko Titze. 2023. Begleitende Evaluierung des Investitionsgesetzes Kohleregionen (InvKG) und des STARK-Bundesprogramms. Zwischenbericht vom 30.06.2023: Gutachten im Auftrag des Bundesministeriums für Wirtschaft und Klimaschutz. Available online: https://www.iwh-halle.de/fileadmin/user_upload/publications/iwh_studies/iwh-studies_2023-06_de_InvKG_STARK.pdf (accessed on 22 May 2024).
Brauers, Hanna, and Pao-Yu Oei. 2020. The political economy of coal in Poland: Drivers and barriers for a shift away from fossil fuels. *Energy Policy* 144: 111621. [CrossRef]
Brauers, Hanna, Pao-Yu Oei, and Paula Walk. 2020. Comparing coal phase-out pathways: The United Kingdom's and Germany's diverging transitions. *Environmental Innovation and Societal Transitions* 37: 238–53. [CrossRef] [PubMed]
Brauner-Otto, Sarah R., and Claudia Geist. 2018. Uncertainty, doubts, and delays: Economic circumstances and childbearing expectations among emerging adults. *Journal of Family and Economic Issues* 39: 88–102. [CrossRef]
Bulmahn, Thomas. 2001. Globalmaße des subjektiven Wohlbefindens. In *Datenreport 1999: Zahlen und Fakten über die Bundesrepublik Deutschland*, 2nd ed. Edited by Statistisches Bundesamt. Bonn: Bundeszentrale für politische Bildung, pp. 420–30.
Buschmann, Pia, and Angela Oels. 2019. The overlooked role of discourse in breaking carbon lock-in: The case of the German energy transition. *Wiley Interdisciplinary Reviews: Climate Change* 10: e574. [CrossRef]
Bürgisser, Reto, Fabienne Eisenring, and Silja Häusermann. 2023. How Perceived Distributive Effects Shape Labor Market Policy Support. Equality of Opportunity Research Series 37. Available online: https://www.urpp-equality.uzh.ch/dam/jcr:21c1e50b-9669-42e0-b93e-005bc95465e4/37_Buergisser_Eisenring_Haeusermann_DistEffects.pdf (accessed on 22 May 2024).
Büttner, Sebastian M., and Lucia M. Leopold. 2016. A 'new spirit' of public policy? The project world of EU funding. *European Journal of Cultural and Political Sociology* 3: 41–71. [CrossRef]
Cantril, Hadley, and Lloyd A. Free. 1962. Hopes and Fears for Self and Country: The Self-Anchoring Striving Scale in Cross-Cultural Research. *American Behavioral Scientist* 6: 7–31.
Cranach, Mario von. 1992. The Multi-level Organisation of Knowledge and Action—An integration of Complexity. In *Social Representations and the Social Bases of Knowledge*. Edited by Mario von Cranach, Willem Doise and Gabriel Mugny. Lewiston: Hogrefe & Huber, pp. 10–22.

Dahlbeck, Elke, Stefan Gärtner, Benjamin Best, Jenny Kurwan, Timon Wehnert, and Jannis Beutel. 2021. Analysis of the Historical Structural Change in the German Hard Coal Mining Ruhr Area. Climate change 30/2021. Available online: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2021-12-08_cc_30-2021_case-study_analysis_historical_structural_change_ruhr_area.pdf (accessed on 22 May 2024).

David, Martin, and Matthias Gross. 2019. Futurizing politics and the sustainability of real-world experiments: What role for innovation and exnovation in the German energy transition? *Sustainability Science* 14: 991–1000. [CrossRef]

Deppisch, Larissa. 2019. "Wo sich Menschen auf dem Land Abgehängt Fühlen, hat der Populismus freie Bahn"–Eine Diskursanalyse zum Zusammenhang von AfD-Wahlentscheidungen mit Infrastrukturverfall, Abstiegsangst Oder Konservativismus. Thünen Working Paper 119. Available online: https://www.econstor.eu/bitstream/10419/193140/1/1049683927.pdf (accessed on 22 May 2024).

Deutsche Rentenverischerung Bund. 2022. *Rentenversicherung in Zeitreihen*. Berlin: Deutsche Rentenversicherung.

Diener, Ed, Richard E. Lucas, and Shigehiro Oishi. 2018. Advances and Open Questions in the Science of Subjective Well-Being. *Collabra. Psychology* 4: 15. [CrossRef] [PubMed]

Diluiso, Francesca, Paula Walk, Niccolò Manych, Nicola Cerutti, Vladislav Chipiga, Annabelle Workman, Ceren Ayas, Ryna Yiyun Cui, Diyang Cui, Kaihui Song, and et al. 2021. Coal transitions—Part 1: A systematic map and review of case study learnings from regional, national, and local coal phase-out experiences. *Environmental Research Letters* 16: 113003. [CrossRef]

Dörre, Klaus. 2022. Gesellschaft in der Zangenkrise. Vom Klassen- zum sozial-ökologischen Transformationskonflikt. In *Abschied von Kohle und Auto? Sozial-ökologische Transformationskonflikte um Energie und Mobilität*, 2nd ed. Edited by Klaus Dörre, Madeleine Holzschuh, Jakob Köster and Johanna Sittel. Frankfurt: Campus Verlag, pp. 24–69.

Dörre, Klaus, Madeleine Holzschuh, Jakob Köster, and Johanna Sittel, eds. 2022. *Abschied von Kohle und Auto? Sozial-Ökologische Transformationskonflikte um Energie und Mobilität*, 2nd ed. Frankfurt: Campus Verlag. First published 2020.

Durdovic, Martin. 2022. Emergent consequences of narrating futures in energy transitions. *Futures* 138: 102930. [CrossRef]

Egli, Florian, Nielja Knecht, Fride Sigurdsson, and Sebastian Sewerin. 2023. The politics of phasing out fossil fuels: Party positions and voter reactions in Norway. *Climate Policy 1–14*. [CrossRef]

Emunds, Bernhard. 2018. Did »it« happen again? Will »it« happen again? Eine Deutung der Globalen Finanzkrise und der heutigen Finanzwirtschaft im Lichte von Hyman P. Minskys Hypothese der finanziellen Instabilität. *Leviathan* 46: 474–92. [CrossRef]

European Commission. n.d. The Just Transition Mechanism: Making Sure No One is Left Behind. Available online: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en (accessed on 27 February 2023).

Eurostat. 2022. Methodological Guidelines and Description of EU-SILC Target Variables DocSILC065, 2022 Operation. Available online: https://circabc.europa.eu/d/a/workspace/SpacesStore/94141a49-a4a7-48bc-89f7-df858c27d016/Methodological%20guidelines%202022%20operation%20v4.pdf (accessed on 22 May 2024).

Faludi, Andreas. 2013. Territorial cohesion and subsidiarity under the European Union treaties: A critique of the "territorialism" underlying. *Regional Studies* 47: 1594–606. [CrossRef]

Fritsch, Michael. 2018. *Marktversagen und Wirtschaftspolitik: Mikroökonomische Grundlagen Staatlichen Handelns*, 10th ed. München: Verlag Franz Vahlen.

Gehrke, Britta, Wolfgang Lechthaler, and Christian Merkl. 2019. The German labor market during the Great Recession: Shocks and institutions. *Economic Modelling* 78: 192–208. [CrossRef]

Glatzer, Wolfgang. 2015. Worries and Pain–The Dark Side of Quality of Life. In *Global Handbook of Quality of Life*. Edited by Wolfgang Glatzer, Laura Camfield, Valerie Møller and Mariano Rojas. Dordrecht: Springer Netherlands, pp. 855–68.

Goebel, Jan, Markus M. Grabka, Stefan Liebig, Martin Kroh, David Richter, Carsten Schröder, and Jürgen Schupp. 2019. The German Socio-Economic Panel (SOEP). *Journal of Economics and Statistics* 39: 345–60. [CrossRef]

Gorry, Aspen, Devon Gorry, and Sita Nataraj Slavov. 2018. Does Retirement Improve Health and Life Satisfaction? *Health Economics* 27: 2067–86. [CrossRef]

Groves, Christopher. 2017. Emptying the future: On the environmental politics of anticipation. *Futures* 92: 29–38. [CrossRef]

Gürtler, Konrad, David Löw Beer, and Jeremias Herberg. 2021. Scaling just transitions: Legitimation strategies in coal phase-out commissions in Canada and Germany. *Political Geography* 88: 102406. [CrossRef]

Haas, Tobias, Jeremias Herberg, and David Löw-Beer. 2022. From carbon democracy to post-fossil capitalism? The German coal phase-out as a crossroads of sustainability politics. *Sustainability: Science, Practice and Policy* 18: 384–99. [CrossRef]

Hacker, Jacob S., Philipp Rehm, and Mark Schlesinger. 2013. The insecure American: Economic experiences, financial worries, and policy attitudes. *Perspectives on Politics* 11: 23–49. [CrossRef]

Hannah, Matthew G. 2001. Sampling and the Politics of Representation in US Census 2000. *Environment and Planning D: Society and Space* 19: 515–34. [CrossRef]

Hartmann, Jörg, and Peter Preisendörfer. 2021. Development and Structure of Environmental Worries in Germany 1984–2019. *Zeitschrift für Soziologie* 50: 322–37. [CrossRef]

Hartmann, Jörg, and Peter Preisendörfer. 2023. The relationship between ecology and economy in German public opinion, 1984–2019. *Environmental Politics* 33: 25–44. [CrossRef]

Hauenstein, Christian, Isabell Braunger, Alexandra Krumm, and Pao-Yu Oei. 2023. Overcoming political stalemates: The German stakeholder commission on phasing out coal. *Energy Research & Social Science* 103: 103203. [CrossRef]

Haywood, Luke, Markus Janser, and Nicolas Koch. 2021. The Welfare Costs of Job Loss and Decarbonization. Evidence from Germany's Coal Phase Out. IZA Discussion Papers 14464. Available online: http://hdl.handle.net/10419/236495 (accessed on 22 May 2024).
Heffron, Raphael J. 2021. *Achieving a Just Transition to a Low-Carbon Economy*. Cham: Springer.
Herberg, Jeremias, Jan-Hendrik Kamlage, Julia Gabler, Ute Goerke, Konrad Gürtler, Tobias Haas, David Löw Beer, Victoria Luh, Sonja Knobbe, Julia Reinermann, and et al. 2020. Partizipative Governance und Nachhaltiger Strukturwandel: Zwischenstand und Handlungsmöglichkeiten in der Lausitz und im Rheinischen Revier. Available online: https://www.rifs-potsdam.de/sites/default/files/2020-08/Herberg%20et%20al.%20Partizipative%20Governance_2020.pdf (accessed on 22 May 2024).
Hershey, Douglas A., Kène Henkens, and Hendrik P. van Dalen. 2010. What Drives Retirement Income Worries in Europe? a Multilevel Analysis. *European Journal of Ageing* 7: 301–11. [CrossRef]
Hoch, Markus, Jannis Lambert, Almut Kirchner, Richard Simpson, Myrna Sandhövel, and Tabea Mündlein. 2021. Jobwende: Effekte der Energiewende auf Arbeit und Beschäftigung. Available online: https://www.prognos.com/sites/default/files/2021-01/20191016_studie_jobwende_druckversion.pdf (accessed on 22 May 2024).
Hoffman, Jesse, Megan Davies, Thomas Bauwens, Philipp Späth, Maarten A. Hajer, Bleta Arifi, Amir Bazaz, and Mark Swilling. 2021. Working to align energy transitions and social equity: An integrative framework linking institutional work, imaginaries and energy justice. *Energy Research & Social Science* 82: 102317. [CrossRef]
Holman, Andrei. 2023. Multidimensional Taxonomy of Challenges and Coping Strategies. ENTRANCES D5.3. Available online: https://entrancesproject.eu/wp-content/uploads/2023/07/D5.3.-Multidimensional-Taxonomy.pdf (accessed on 22 May 2024).
Hower, Kira Isabel, and Timo-Kolja Pförtner. 2017. Changes in job insecurity and economic worries during the Great Recession in Germany. *European Journal of Public Health* 27 S3: 310–11. [CrossRef]
Hox, Joop J. 2010. *Multilevel Analysis. Techniques and Applications*. New York: Routledge.
Hsiao, Cheng. 2014. *Analysis of Panel Data*. Cambridge: Cambridge University Press.
Iglauer, Theresa, Jürgen Schupp, and Maximilian Priem. 2021. Subjektives Wohlbefinden und Sorgen. In *Datenreport 2021: Ein Sozialbericht für die Bundesrepublik Deutschland*. Edited by Statistisches Bundesamt, Wissenschaftszentrum Berlin für Sozialforschung and Bundesinstitut für Bevölkerungsforschung. Bonn: Bundeszentrale für politische Bildung, pp. 409–19.
Infurna, Frank J., and Axel Mayer. 2019. Repeated Bereavement Takes Its Toll on Subjective Well-Being. *Innovation in Aging* 3: igz047. [CrossRef] [PubMed]
Kalt, Tobias. 2021. Jobs vs. climate justice? Contentious narratives of labor and climate movements in the coal transition in Germany. *Environmental Politics* 30: 1135–54. [CrossRef]
Kayran, Elif Naz. 2020. Political Responses and Electoral Behaviour at Times of Socioeconomic Risk Inequalities and Immigration. Ph.D. thesis, Graduate Institute, Geneva, Switzerland. Available online: https://repository.graduateinstitute.ch/record/298818 (accessed on 22 May 2024).
Kerker, Nina. 2022. Stadt-Land-Disparitäten in der Energiewende–ein sozialer Konflikt (der Zukunft)? In *Umkämpfte Zukunft-Zum Verhältnis von Nachhaltigkeit, Demokratie und Konflikt*. Edited by Julia Zilles, Emily Drewing and Julia Janik. Bielefeld: Transcript, pp. 235–50.
Knappe, Henrike, Anne-Katrin Holfelder, David Löw Beer, and Patrizia Nanz. 2019. The politics of making and unmaking (sustainable) futures: Introduction to the special feature. *Sustainability Science* 14: 891–98. [CrossRef]
Knies, Gundi, and Katharina C. Spiess. 2004. Regional Data in the German Socio-Economic Panel Study (SOEP). DIW Berlin Data Documentation 17. Available online: http://www.diw.de/documents/publikationen/73/diw_01.c.55738.de/diw_datadoc_2007-017.pdf (accessed on 22 May 2024).
Kohlekommission. 2018. Ergebnisprotokolle 1.-9. Sitzung (26. Juni 2018–26. November 2018). Available online: https://media.fragden-staat.de/files/foi/383628/KWSB-ProtokollegesamtohneTN-Listen200dpi.pdf (accessed on 22 May 2024).
Köster, Jakob, Sophie Bose, Klaus Dörre, and John Lütten. 2022. Nach der Braunkohle. Konflikte um Energie und regionale Entwicklung in der Lausitz. In *Abschied von Kohle und Auto? Sozial-ökologische Transformationskonflikte um Energie und Mobilität*, 2nd ed. Edited by Klaus Dörre, Madeleine Holzschuh, Jakob Köster and Johanna Sittel. Frankfurt: Campus Verlag, pp. 71–128.
Kraemer, Klaus. 2018. Sehnsucht nach dem nationalen Container: Zur symbolischen Ökonomie des neuen Nationalismus in Europa. *Leviathan* 46: 280–302. [CrossRef]
Kraemer, Klaus, and Sebastian Nessel, eds. 2015. *Geld und Krise: Die Sozialen Grundlagen Moderner Geldordnungen*. Frankfurt (Main): Campus.
Krüger, Timmo. 2021. Energiekonflikte und Demokratiekrise. Eine radikaldemokratische Perspektive auf das Ringen um Gemeinwohlziele der Energiewende. *Zeitschrift für Politikwissenschaft* 31: 539–63. [CrossRef]
Land, Kenneth C., and Alex C. Michalos. 2018. Fifty Years after the Social Indicators Movement: Has the Promise been Fulfilled? An Assessment and an Agenda for the Future. *Social Indicators Research* 135: 835–68. [CrossRef]
Löw Beer, David, Konrad Gürtler, Jeremias Herberg, and Tobias Haas. 2021. Wie legitim ist der Kohlekompromiss? Spannungsfelder und Verhandlungsdynamiken im Prozess der Kohlekommission. *Zeitschrift für Politikwissenschaft* 31: 393–416. [CrossRef]
Luderer, Gunnar, Christoph Kost, and Dominika Sörgel, eds. 2021. *Ariadne-Report: Deutschland auf dem Weg zur Klimaneutralität 2045. Szenarien und Pfade im Modellvergleich*. Potsdam: Potsdam Institute for Climate Impact Research. Available online: https://pathfinder.ariadneprojekt.de/ (accessed on 22 May 2024).
Lueders, Hans. 2024. When Democracy Brings Insecurity: The Political Legacies of Regime Change. *World Politics* 76: 125–71. [CrossRef]

Luhmann, Maike, Claudia Crayen, and Michael Eid. 2010. Entwicklung der Sorgen um die wirtschaftliche Situation in Ost- und Westdeutschland seit der Wiedervereinigung. In *Leben in Ost- und Westdeutschland: Eine Sozialwissenschaftliche Bilanz der Deutschen Einheit 1990–2010*. Edited by Peter Krause and Ilona Ostner. Frankfurt (Main): Campus, pp. 751–67.

Luhmann, Maike, Pola Weiss, Georg Hosoya, and Michael Eid. 2014. Honey, I Got Fired! A Longitudinal Dyadic Analysis of the Effect of Unemployment on Life Satisfaction in Couples. *Journal of Personality and Social Psychology* 107: 163–80. [CrossRef]

Luhmann, Maike, Wilhelm Hofmann, Michael Eid, and Richard E. Lucas. 2012. Subjective Well-Being and Adaptation to Life Events. A Meta-Analysis. *Journal of Personality and Social Psychology* 102: 592–615. [CrossRef]

Madero-Cabib, Ignacio, and Anette Eva Fasang. 2016. Gendered work–family life courses and financial well-being in retirement. *Advances in Life Course Research* 27: 43–60. [CrossRef]

Markard, Jochen, Karoliina Isoaho, and Linda Widdel. 2022. Discourses around decline: Comparing the debates on coal phase-out in the UK, Germany and Finland. In *Technologies in Decline*. Edited by Zahar Koretsky, Peter Stegmaier, Bruno Turnheim and Harro van Lente. London: Routledge, pp. 118–44.

Mau, Steffen, Thomas Lux, and Linus Westheuser. 2023. *Triggerpunkte: Konsens und Konflikt in der Gegenwartsgesellschaft*. Berlin: Suhrkamp.

Mäding, Heinrich. 2021. Gleichwertige Lebensverhältnisse und Fachpolitik–explorative Beobachtungen und Überlegungen am Beispiel der aktuellen Kohlepolitik. *Raumforschung und Raumordnung* 79: 73–86. [CrossRef]

MDR. 2022. Kohleausstieg–festhalten oder Verschieben? Available online: https://www.mdr.de/nachrichten/mitmachen/mdrfragt/mdrfragt-ergebnisse-kohle-100-downloadFile.pdf (accessed on 22 May 2024).

MDR. 2023. Habeck-Vorstoß: Kohle-Aus 2030-nach NRW nun auch im Osten? Available online: https://www.mdr.de/nachrichten/mitmachen/mdrfragt/mdrfragt-ergebnisse-kohleausstieg-100-downloadFile.pdf (accessed on 22 May 2024).

Mills, Melinda, Ronald R. Rindfuss, Peter McDonald, and Egbert te Velde. 2011. Why Do People Postpone Parenthood? Reasons and Social Policy Incentives. *Human Reproduction Update* 17: 848–60. [CrossRef] [PubMed]

Müller-Hansen, Finn, Max W. Callaghan, Yuan Ting Lee, Anna Leipprand, Christian Flachsland, and Jan C. Minx. 2021. Who cares about coal? Analyzing 70 years of German parliamentary debates on coal with dynamic topic modeling. *Energy Research & Social Science* 72: 101869.

Obschonka, Martin, Michael Stützer, Peter J. Rentfrow, Leigh Shaw-Taylor, Max Satchell, Rainer K. Silbereisen, Jeff Potter, and Sam Gosling. 2018. In the shadow of coal: How large-scale industries contributed to present-day regional differences in personality and well-being. *Journal of Personality and Social Psychology* 115: 903–27. [CrossRef] [PubMed]

Oei, Pao-Yu, Hauke Hermann, Philipp Herpich, Oliver Holtemöller, Benjamin Lünenbürger, and Christoph Schult. 2020. Coal phase-out in Germany–Implications and policies for affected regions. *Energy (Oxf)* 196: 117004. [CrossRef]

Pike, Andy, Vincent Béal, Nicolas Cauchi-Duval, Rachel Franklin, Nadir Kinossian, Thilo Lang, Tim Leibert, Danny MacKinnon, Max Rousseau, Jeroen Royer, and et al. 2023. 'Left behind places': A geographical etymology. *Regional Studies* 58: 1167–79. [CrossRef]

Ribbeck-Lampel, Juliane, Paul Spohr, and Andreas Otto. 2023. *Revier ist nicht gleich Revier: Die Bedeutung von Raumstrukturen für die Transformation der Braunkohleregionen in Deutschland*. Bonn: BBSR, urn:nbn:de:101: 1-202306281107062737 9870.

Rinscheid, Adrian, and Sebastian Koos. 2023. War and Pandemic Do Not Jeopardize Germans' Willingness to Support Climate Measures. *Communications Earth & Environment* 4: 101. [CrossRef]

Rinscheid, Adrian, Gregory Trencher, and Daniel Rosenbloom. 2022. 10 Phase-out as a policy approach to address sustainability challenges: A systematic review. In *Technologies in Decline*. Edited by Zahar Koretsky, Peter Stegmaier, Bruno Turnheim and Harro van Lente. London: Routledge, pp. 225–48.

Rodríguez-Pose, Andrés. 2018. The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society* 11: 189–209. [CrossRef]

Rohrer, Julia M., Martin Brümmer, Jürgen Schupp, and Gert G. Wagner. 2021. Worries across time and age in the German Socio-Economic Panel study. *Journal of Economic Behavior & Organization* 181: 332–43. [CrossRef]

Roth, Bettina, Elisabeth Hahn, and Frank M. Spinath. 2017. Income inequality, life satisfaction, and economic worries. *Social Psychological and Personality Science* 8: 133–41. [CrossRef]

Schmälzle, Michaela, Martin Wetzel, and Oliver Huxhold. 2019. Pathways to Retirement: Are They Related to Patterns of Short- and Long-Term Subjective Well-Being? *Social Science Research* 77: 214–29. [CrossRef] [PubMed]

Singh Garha, Nachatter. 2022. From Decarbonization to Depopulation: An Emerging Challenge for the Carbon-Intensive Regions under the Energy Transition in Spain. *Sustainability* 14: 14786. [CrossRef]

Statistik der Kohlenwirtschaft e.V. 2023. Beschäftigte im Braunkohlenbergbau. Beschäftigte nach Revieren. Available online: https://kohlenstatistik.de/downloads/braunkohle/ (accessed on 25 January 2024).

Strambo, Claudia, May Thazin Aung, and Aaron Atteridge. 2019. Navigating Coal Mining Closure and Societal Change: Learning from Past Cases of Mining Decline. Available online: https://www.sei.org/wp-content/uploads/2019/07/navigating-coal-mining-closure-and-societal-change.pdf (accessed on 22 May 2024).

Strigel, Werner H. 1977. The "business climate" as leading indicator. In *In Search of Economic Indicators*. Edited by Werner H. Strigel. Berlin: Springer, pp. 67–80.

UN. 2015. Paris Agreement. Available online: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf (accessed on 24 January 2023).

UNFCCC. 1997. Kyoto Protocol to the United Nations Framework Convention on Climate Change. Available online: https://unfccc.int/sites/default/files/resource/docs/cop3/l07a01.pdf (accessed on 22 May 2024).
Walsh, Cormac. 2014. Rethinking the Spatiality of Spatial Planning: Methodological Territorialism and Metageographies. *European Planning Studies* 22: 306–22. [CrossRef]
Young, Rebekah, and David R. Johnson. 2015. Handling Missing Values in Longitudinal Panel Data with Multiple Imputation. *Journal of Marriage and the Family* 77: 277–94. [CrossRef]