Englisch

Social partners in the green transition of the EU

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Summary: The paper explores the role of social partnership for facilitating processes to reduce greenhouse gas emissions in Europe. Social partnership can help to facilitate the transition to lower emissions by negotiating the costs and benefits of climate reducing policies with the workers affected. At the same time, social partnership is stronger in sectors, which have high emissions and might be tempted to reduce the speed of phasing out high emission production processes. The paper uses data from the Structure of Earnings Survey to examine the relationship between bargaining coverage, unionization, wages and industry emissions in EU member states. It analyses these relationships in the context of different growth trajectories towards the knowledge economy. It finds that high-emitting industries tend to have higher profits, wages and lower wage inequality than others. Brown jobs, however, are not better jobs, but benefit from collective bargaining. At the same time, there are significant differences between the member states of the European Union. The paper concludes by discussing how social partnership deals with the dilemma of being rooted in fossil fuel industries while negotiating change.

Zusammenfassung: Der Beitrag untersucht die Rolle der Sozialpartnerschaft zur Reduzierung von Treibhausgasemissionen in Mitgliedsstaaten der Europäischen Union. Einerseits können die Sozialpartner dazu beitragen den Übergang zu niedrigeren Emissionen zu erleichtern, indem sie mit den betroffenen Arbeitnehmern über die Kosten und den Nutzen von Maßnahmen zur Verringerung des Klimawandels verhandeln. Andererseits ist die Sozialpartnerschaft in Sektoren mit hohen Emissionen stärker ausgeprägt. Das könnte dazu führen, dass Sozialpartner versuchen, die Geschwindigkeit zur Reduzierung emissionsintensiver Produktionsprozesse zu verringern. Wir verwenden Daten aus der europäischen Verdienststrukturerhebung, Structure of Earnings Survey, um die Beziehung zwischen Tarifbindung, gewerkschaftlicher Organisation, Löhnen und Industrieemissionen in den EU-Mitgliedstaaten zu untersuchen. Wir finden, dass Sektoren mit hohen Emissionen höhere Gewinne, Löhne und geringere Lohnungleichheit aufweisen. Berufe mit hohen Emissionen sind hingegen nicht besser bezahlt. Gleichzeitig gibt es deutliche Unterschiede zwischen den Mitgliedsstaaten der Europäischen Union. Abschließend erörtern wir, wie die Sozialpartnerschaft mit dem Dilemma umgeht, in den stark fossilen Industrien verwurzelt zu sein und gleichzeitig den Wandel zu verhandeln.

→ JEL classification: J21, J31, J52
→ Keywords: Green transition, collective bargaining, social partnership

1 Introduction: Transition and decarbonization of European economies

Decarbonization has a substantial impact on labour markets in high-income countries. The ILO estimates that 40 % of world employment depends on functioning ecosystems, which corresponds to 1.2 billion workers at risk of climate change (ILO 2018). Some industries over-proportionally contribute to world GHG emissions by relying on carbon-intensive and material-intensive inputs. If governments aim to lower their reliance on fossil fuels, these sectors will need to drastically change their business models and therefore employment of workers in sectors such as coal mining, oil and gas, as well as transportation (Popp et al. 2020). On the other hand, other sectors are likely to increase employment in renewable energies and insulation of buildings.

In OECD countries, the greening of the economy is expected to create net employment (Montt et al. 2018; Chateau/Mavroeidi 2020). For 2030, the ILO predicts that new jobs will outweigh job losses by 18 million (ILO 2018). The European Commission earmarks net employment growth in the same period to be over 1 million, with European green-tech expected to become a trailblazer for growing export markets (EC 2021). Aggregate trends, however, do not inform about the extent of adjustment needed for individual workers and firms and mask substantial heterogeneity.

How workers adapt to transformation processes often depend on existing inequalities relating to skills (Autor et al. 2003), age (Acemoglu/Restrepo 2022), social networks (Chetty et al. 2022) or place of residence (Autor 2019). To ensure a just transition for workers from high-emitting (brown) industries and jobs that are overrepresented in these industries (brown jobs) to green sectors and jobs, policymakers need to ensure that policies are in place that are aimed to guarantee social inclusion and decent work (EC 2021; ILO 2018). This is likely to cause frictions relating to skills mismatches to perform the tasks required to green their economies and labour shortages. Moreover, brown sectors and jobs are often highly paid, and transition might entail wage losses and worsening of working conditions.

In this paper, we discuss the role of social partnership for the green transition. We assume that the role of social partnership is ambivalent. On the one hand, social partners can help to facilitate the transition to lower emissions by negotiating the costs and benefits of climate reducing policies with the workers affected. On the other hand, strong representation of brown industries and brown jobs through social partners might prevent the green transition as they try to protect employment in these sectors. The task of negotiating the transition depends to a considerable extent on the difference of quality of jobs in brown and green industries.

We use data from the European Structure of Earnings Survey to examine the relationship between bargaining coverage, unionization, wages, and industry emissions in EU member states to establish the differences in wages in brown industries and jobs compared to the rest of the economy. We find that brown industries provide on average well paid jobs and have higher unionization rates. However, brown jobs are not necessarily well paid and are dependent on collective bargaining to become good jobs. These findings characterize the challenge of social partners to negotiate the green transition. We discuss some examples of how social partners address these issues.

2 Social partners and the green transition

While there is a growing literature on the labour market effects of the green transition and the potential effects of skills-mismatches (Vona et al. 2018; Popp et al. 2020; Chateau/Mavroeidi 2020), there is only a small literature on the role of social partners in the process.

A rich literature has shown how *industrial relations* institutions mediate economic downturn and corporate restructuring in general. Empirical work usually stresses specific institutions of employee representation (collective bargaining agreements, unions, or works councils), each of which has developed different toolkits to safeguard employment and respond to labour market shocks flexibly (for a recent overview Hassel et al. 2019). Workplace institutions and social partners develop strategies to ensure the smooth transition using social plans, early retirement agreements and other policies. Collective agreements also set pay and working conditions, training and upskilling often supported by government schemes. Also, in the economics literature Addison (2016) and Blanchard, Jaumotte, and Loungani (2014), argue that more coordinated and collective labour market arrangements can potentially enhance an economy's ability to adjust to common shocks, particularly when there is trust among social partners (IMF 2022).

The World Economic Outlook by the IMF (2022) has tested the effect of labour market institutions on the efficacy of implementation of green policies and found that environmental policies are more effective in reducing the pollution intensity of employment in countries with more coordinated labour market and collective bargaining arrangements (IMF 2022, 77). They assume that such "arrangements could help social partners – businesses, workers, and the government – coordinate on shared actions to support a green transformation as a common objective and ease any associated labour market adjustment".

In contrast, there is little evidence-based literature on how labour institutions mediate the impact of the green transition and climate policy on labour markets. Qualitative accounts review bargaining strategies, coalition building, and power dynamics of unions, and have dubbed some constellations jobs versus environment dilemma (Clarke/Lipsig Mummé 2020; Keil/Kreinin 2022; Thomas/Doerflinger 2020) however, there is currently no empirical evidence to support this claim. With the green structural change imminent, it is unknown whether labour market institutions are either opponents or supporters of greening economies (Kalt 2022).

The *management literature* has explored important avenues of how corporate decision-making bodies and especially chief sustainability officers (CSO) address sustainability concerns at board level and what factors determine GHG emissions. Lerner and Osgood (2022) study interlocked board memberships in US corporations and show that shared board members make firms to significantly adapt new and more climate commitments. Lu et al. (2021) take a familiar approach to explore interlocked board memberships and find empirical evidence for lower GHG emissions. Peters et al. (2019) study the climate performance of firms with chief sustainability officers and found that those with prior experience in climate policy had better sustainability performance post-appointment. Transferred to organized employee representation, there is a lack of understanding about how social partners respond to the recent trend of appointing sustainable executives and how this affects the employment rationales and strategies of these firms.

In the *political economy literature*, producer groups are expected to influence decision-making regarding the industrial sectors they represent. These are either sectors who produce or are de-

pendent on fossil fuels. There is a broader literature on the lobbying by fossil fuel industries to shape the production of knowledge, use the media and access politicians (Blyth/Driscoll 2024; Brulle 2018; Stokes 2020; Brulle 2014; Carmichael/Brulle 2017; Farrell 2016). Often fossil fuel lobbying is stronger in regions that are dependent on fossil fuel or are declining (Knight 2018; Lübke 2021; Scruggs/Benegal 2012). Here, workers and firms form a political coalition protecting the workings of fossil fuel industries (Mildenberger 2020; Oatley/Blyth 2021).

The most recent contributions in comparative political economy focus on national growth regimes and their variations (Baccaro et al. 2022, Hassel/Palier 2021; 2023). They identify drivers of growth of individual countries such as export-led versus demand-led growth, which in turn are linked to the specialization in particular sectors. The added value of specific and their relative size become important for policy outcomes as they often represent large segments of employment providing well-paid jobs. These sectors have various levels of dependence on fossil fuels. Social partners are directly linked to growth regimes and the leading sectors of an economy. In the past, the mining communities had strong levels of union representation and therefore political influence over energy decisions. Similarly, ship building and shipping are both high on emissions and on union representations. In Germany today, energy intensive chemical firms are also highly unionized.

In settings where collective bargaining takes place at the sectoral level, industry associations and sectoral trade unions have a direct stake in particular industries and will aim to protect these industries from economic hardship. We could therefore expect that there are large variations between countries as national growth regimes have distinct dependencies on fossil fuels. Moreover, a growth regime can either block, complement or facilitate decarbonization as national discourse is shaped by the interest of the most important economic sectors. Social partners are expected to feed into protectionism of those sectors, which are seen as the backbone of the economy.

In sum, the research literature is ambivalent about the role of social partners for decarbonization. On the one hand, coordinated industrial relations can help to implement policies, at least in contexts, where decarbonization is not painful to begin with (the Nordic countries) as the IMF research suggests. On the other hand, in contexts of high dependency on fossil fuel industries, social partners can act as protectors of those industries and might slow down decarbonization.

In the following we will empirically investigate the link between high emitting industries/jobs and the role of social partners. We aim to disentangle the ambivalent role of social partnership by focusing on job quality (wages) and the effects of collective bargaining on job quality in polluting industries.

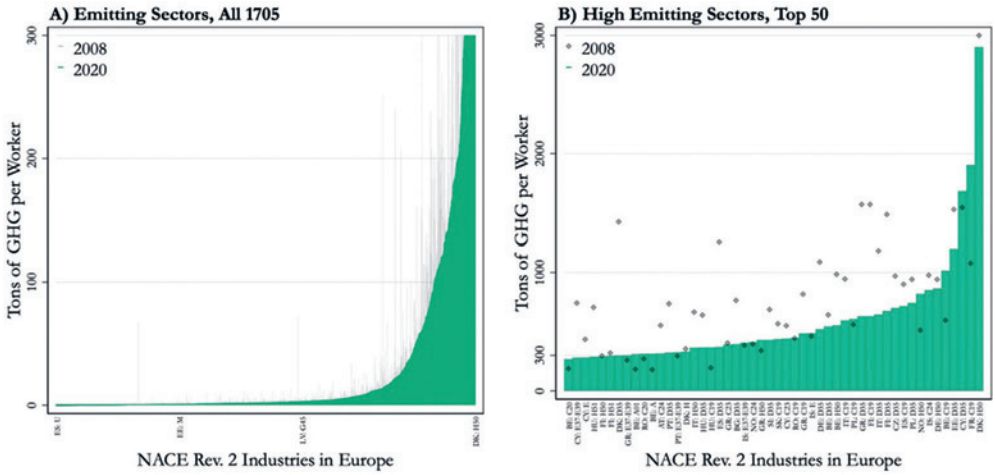
3 Identifying high emitting sectors and jobs

To understand labor market implications of the green transition, we focus on the direct greenhouse gas emissions (GHG) from industries in European member states, thereby omitting contributions from households, heating, consumption, private transport, or indirect emissions generated by the derived demand on input from other industries. Those GHG emissions come overwhelmingly from energy, transport and agriculture industries, but there is substantial regional variation in Europe stemming from whether growth regimes are rooted in fossil fuel-based industries (EEA 2022). Factors such as regional industrial focus, availability of natural resources, or regulation (Shapiro/Walker 2018), such as carbon tax rates, contribute to these disparities.

DOI https://doi.org/10.3790/vjh.2023.334383

In the absence of internationally comparable per-firm or workers emission data (see Wagner et al. 2020 for a recent effort of data harmonization), we generate a dataset of emissions per worker based on two-digit NACE industries from Eurostat. Figure 1 illustrates the heavily left skewed distribution of emissions, where the top 50 are dominated by carbon intensive industries, such as electricity, gas, steam and air supply (D35), water transport (H50), or the manufacturing of coke and refined petroleum products (C19). The time comparison spanning from 2008 to 2020 reveals a general downward trend in emissions per worker for the majority of these top 50 industries. However, there are important exceptions where certain industries have experienced an increase in per-worker emissions (see for instance Rottner/von Graevenitz 2022).[1] Additionally, there is considerable heterogeneity in these trends across different countries.[2]

Figure 1: Tons of GHG emissions per worker in European industries



To identify pollution intensive occupations based on industry emissions, we build on work by Broome et al. (2022), IMF (2022), and Vona et al. (2018), and adopt a percentile-based system to spotlight high-emission industries to identify pollution-intensive occupations within them. Vona et al. (2018) leverage data from four-digit North American Industry Classification System (NAICS) industries, focusing on emissions of six criteria air pollutants along with CO2. They define top-polluting industries by setting the bar at the 95th percentile for at least three out of six air pollutants and find 62 industries to meet that criterion. They define occupations as brown if occupations in in 95th percentile sectors are 7 times more prevalent than in other sectors. The IMF World Economic Outlook from 2022 follows the methodology by Vona et al. (2018) and identifies high-polluting sub-sectors, where emissions per worker of at least three substances (including CO, VOC, NOx, SO2, PM10, PM2.5, lead, and CO2) are in the top 5 percent. In the second step, within these industries,

1 Emissions per worker does not rule out that rising carbon emissions are due to an increase in production scale.

2 Variability in energy use and CO2 emissions within specific industries is markedly greater than the differences observed across industries or even between countries. This observation highlights the limitations of broad, industry-wide environmental policies (Lyubich et al. 2018; Wagner et al. 2020).

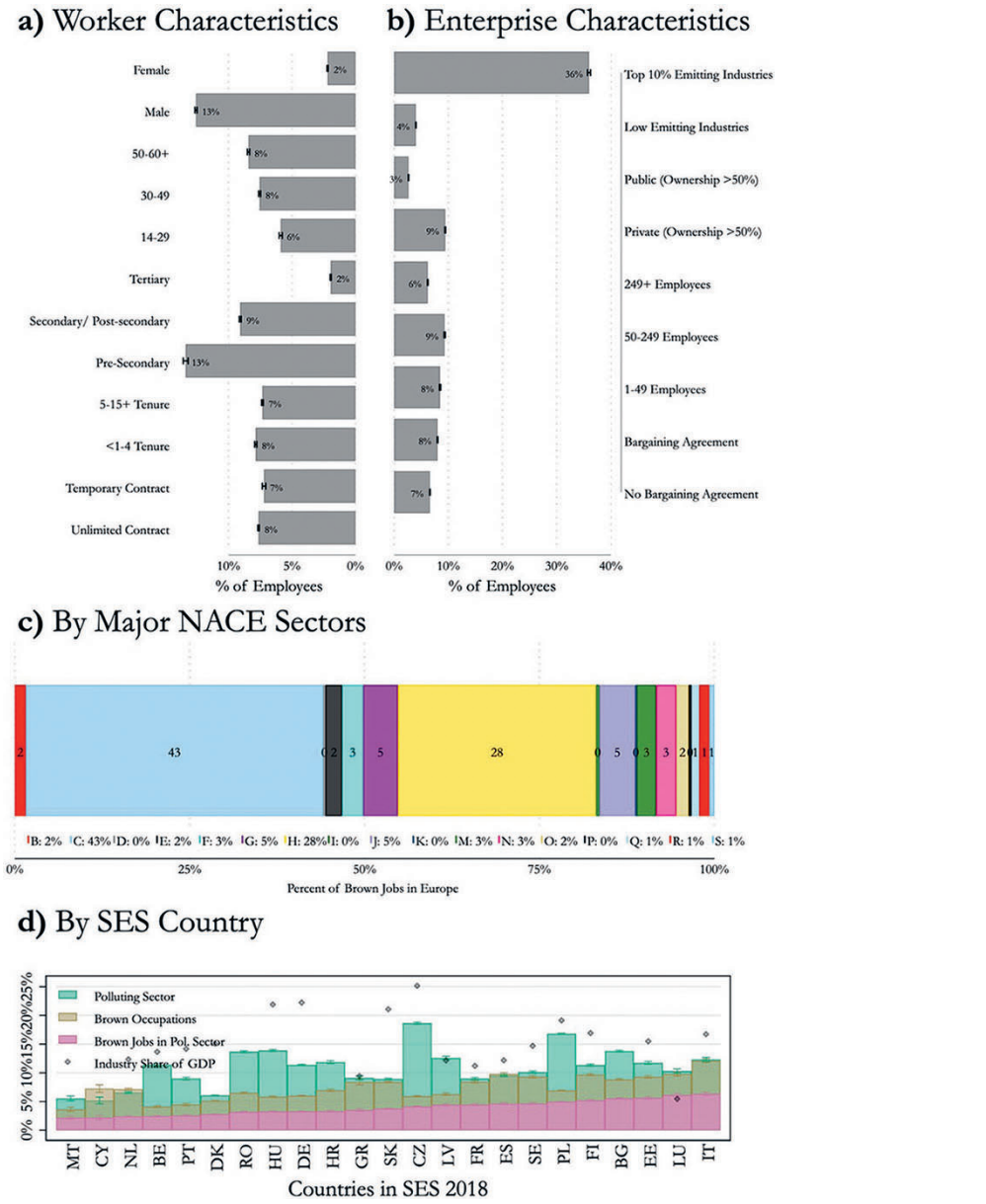
DOI https://doi.org/10.3790/vjh.2023.334383

occupations are tagged as “brown” if the share of employees is at least seven times larger than the average share across all occupations. They crosswalk brown occupations with US employment weights to the International Standard Classification of Occupations (ISCO-08) and tag 4 % of their sample as brown. Broome et al. (2022) draw their data from the UK’s Office for National Statistics (ONS) and set the threshold at the 90th percentile of greenhouse gas emissions per worker, identifying eight sectors as the top polluters based on the most recent values from 2018/19. They define brown occupations, when their prevalence in high emitting sectors is five times as high than average.

Utilizing Eurostat’s air emissions data for sectors defined by NACE Rev. 2 classifications, we identify subsectors with high emissions based on a specific set of criteria. A subsector is flagged as a *polluting subsector* if its emissions per worker exceed the 90th percentile in at least three of the following air pollutants: CO, CO2, NMVOC, NOX, SOX/SO2E, PM10, and PM2.5. Figure 2’s green bars represent the employment level in these top-emitting industries as a percentage of the overall labour force. Notably, countries in Continental and Eastern Europe, such as Poland and Czechia, have over 15 % of their total workforce employed in these sectors.

To calculate the proportion of *brown jobs*, we merge industry-specific emissions data with information from the 2018 Structure of Earnings Survey. The survey provides sufficiently large sample sizes to represent 3-digit ISCO occupations across different regions. Brown jobs are defined as occupations with a representation in high-emitting sectors that is five times greater than their representation across all sectors. These jobs are especially at risk of undergoing changes or being phased out as industries transition to net-zero emissions. Our analysis indicates that brown jobs are most common in the manufacturing, energy production, and transport sectors across Europe. The demographic profile of workers in these jobs skews toward older, male individuals with lower-secondary education. Figure 2 (panel c) shows that brown jobs also exist in other industries; but their presence is relatively insignificant. Panel d of Figure 2 highlights the prevalence of brown jobs in different countries. For instance, Cyprus and Malta have less than 2.5 % of their labour force in brown jobs, while Estonia, Italy, and Luxembourg lead with percentages exceeding 5 %.

Figure 2: Brown Jobs Descriptives



Source: Brown jobs via Structure of Earnings Survey 2018 and Emissions from Eurostat (env_ac_ainah_r2); Employment by activity from Eurostat (sbs_na_sca_r2); Manufacturing share from OECD (NAAG).

DOI https://doi.org/10.3790/vjh.2023.334383

4 Fossil fuel-based sectors are more profitable, better paid and more equitable

A cross country perspective confirms assumptions from political economy research that emissions vary with growth regimes. Countries that rely on the export of manufacturing products such as Austria, Bulgaria, Czechia, Germany, Hungary, Italy, Poland, Romania or Slovakia have a relatively higher high manufacturing share of GDP with a significant part of their work force involved. These are often rooted in carbon-intensive industries. Services-based economies including Belgium, Denmark, Finland, France, Greece, Ireland, the Netherlands, Portugal, Spain, Switzerland, the United Kingdom have a lower overall exposure to net-zero transition adjustments (McKinsey 2022).

Moreover, fossil fuel-based industries are the backbone of social partnership but also social cohesion in the EU. High-emitting industries in the EU show higher levels of profitability, higher wages and lower levels of wage inequality, all under the strong influence of labour unions. Visualizing this industry variation, Figure 3 shows binned scatters of log GHG emissions per worker against six characteristics common in the literature. Average wages are measured as average personnel costs from Eurostat's Structural Business Statistics including social security contributions and taxes from employers. We observe a positive relationship between average wages and GHG emissions per capita across European industries. High-emitting sectors tend to offer higher wages, which may be a consequence of profitability. Figure 3 panel b shows profitability measured by the share of gross operating surplus in value added. We find a positive relationship between profitability and GHG emissions per worker. In essence, high emitting industries also show stronger economic performance which may translate into higher wages. In EU member states, resource-intensive activities continue to be more profitable than other sectors.

Next, income inequality is measured using SES Industry D9/D1 decile ratios. We find a negative correlation between income inequality and GHG emissions per worker. High-emitting sectors often show more equitable income distribution. This raises questions about the role of unionization and collective bargaining. However, as we show in the next section, we do not find a linear correlation between fossil-fuel based industries and collective bargaining coverage on the industry level. The share of employees covered by any collective bargaining agreement in polluting industries is above average but outweighed by low-emitting public and service sectors.

We also find is that the share of workers being member of a trade union is higher in fossil-fuel based industries. Unionization rates are derived from pooled European Social Survey data, cross-walked via NACE 2-digit classifications. A positive correlation exists between unionization levels and GHG emissions per worker. Industries with higher unionization rates are those with a higher environmental impact. This may be influenced by the types of industries that are more likely to be unionized and their associated environmental footprints.

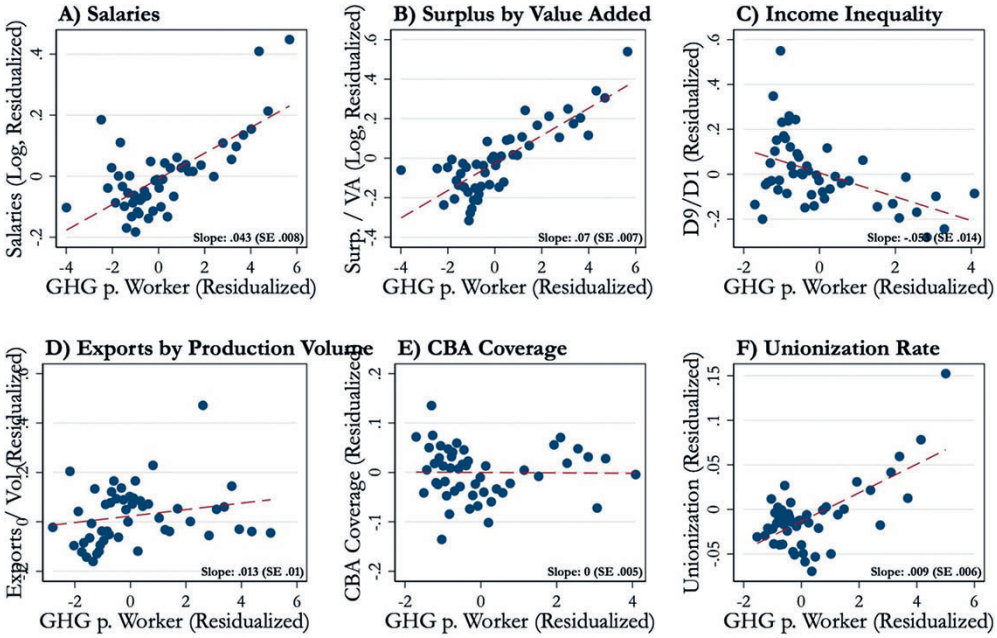
Collective bargaining coverage does not correlate with emissions per worker (Figure 3, panel e). This is not too surprising, given the vast heterogeneity of collective bargaining coverage rates in the EU ranging from 100 % in Austria and France to less than 10 % in many Eastern European states. This finding is also due to the fact that some services industries such as banking and the public sector have very high levels of collective bargaining coverage.

To summarize our findings on high-emitting industries: as the political economy literature assumes, fossil fuel industries are more profitable than others and pay higher wages. There is also

DOI https://doi.org/10.3790/vjh.2023.334383

lower levels of wage inequality and higher unionization rates. Overall, we expect the social partners to be strongly represented in high-emitting industries.

Figure 3: Tons of GHG emissions per worker in European industries



Notes: Binned scatter plots for the effect of GHG emissions per worker on industry outcomes (units are 2-digit NACE industries per country). The top row shows the effect on personnel costs, surplus by value added and decile 9 to decile 1 income inequality. The bottom row shows the relationship between exports as a share of overall production volume, collective bargaining coverage and unionization. All variables are residualized against country fixed effects.
Source: GHG Emissions from Eurostat (env_ac_ainah_r2); Employment, Salaries, Gross Operating Surplus, Export by Activity from Eurostat; Income Inequality and CBA Coverage from SES 2018; Unionization from ESS (2010–2020).

5 Brown jobs are not better jobs than others but benefit from collective bargaining

In this section, we test whether the effects we find for brown industries also apply to brown jobs outside those industries. Brown jobs are those that are overrepresented in brown industries but also occur in other industries. We are also interested in the role of collective bargaining for the quality of brown jobs as an indicator for the strength of social partners for workers in brown jobs.

To study the conditional effects of bargaining systems on wages of brown jobs, we use data from the Structure of Earnings Survey (SES) from 2018 and investigate the relationship between collective bargaining and wages for brown jobs. The SES includes a range of income data, such as hourly pay, bonuses, and different contractual types, along with multiple markers for collective bargaining at the firm and multi-employer levels. This enables precise empirical assessment of how collective bargaining influences components of pay, and whether this effect is larger for workers in brown jobs. Moreover, the data provides large samples to cover income, occupation, industrial sector vis-à-

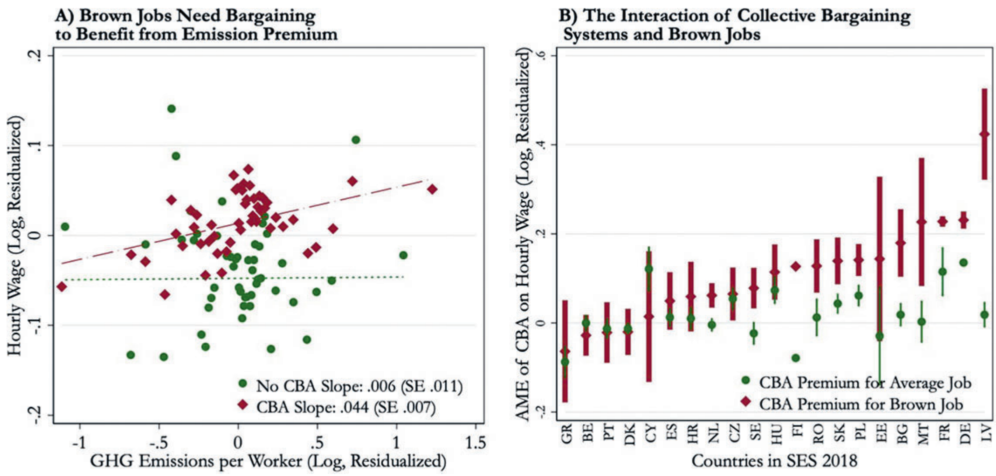
DOI https://doi.org/10.3790/vjh.2023.334383

vis collective bargaining. The empirical focus of our research question lies in quantifying the differential effects of collective bargaining agreements on income across brown and non-brown jobs, thus we estimate the average marginal effects of collective bargaining agreements on wages, with a particular focus on brown jobs associated with carbon-intensive industries.

Overall, we find that in most EU member states brown jobs are not better paid than other jobs. Only in Belgium, brown jobs are better paid than the average of other occupations. In all other countries brown jobs are paid less, in some countries such as Germany, considerably so (figure 4, panel b).

The effect of collective bargaining on wages in the EU is complex. We know from other studies that there is a statistically significant, positive impact of collective bargaining agreements on income in most EU member states (Zwysen/Drahokoupil 2022). We find the same effect in table 1, which shows that but for the Nordic countries, Belgium and Greece, collective bargaining has a positive effect on wages.

Figure 4: Collective bargaining turns brown jobs into good jobs



Notes: Panel a shows a binned scatter for the effect of GHG emissions on residualized log hourly wages for brown jobs differentiated by collective bargaining coverage. Both x and y axis are residualized against three-way interactions between education level, gender, and age, along with full-time work time, temporary contract status, company size, company control type, NUTS regions, and NACE Rev. 2 industries. Standard errors in parentheses are clustered at the establishment level and weights are applied. Panel b shows average marginal effects of how the premium of collective bargaining agreements differs by type of worker (brown job vs average job). See table 1 for regressions results by country. Country regressions carry out the same control variables as above, are weighted and standard errors are clustered at the establishment level.
Source: Structure of Earnings Survey 2018; GHG Emissions from Eurostat (env_ac_ainah_r2).

When we investigate the interplay between collective bargaining and brown jobs, we find a marginal effect of collective bargaining coverage on wages that is more pronounced for brown jobs, which suggests that these agreements serve not merely as wage-setting mechanisms but also as potential equalizers in labor market segments traditionally marked by lower wages or fewer benefits. While collective bargaining agreements are traditionally seen as mechanisms for wage leveling and labor rights, we find finds that their effect is particularly pronounced in brown jobs – roles often linked to carbon-intensive industries. Figure 4 suggests that in some countries, collective bargaining agreements not only serve as wage-setting mechanisms but also act as economic an-

chors that disproportionately sustain income levels in carbon-intensive sectors. This creates a form of economic inertia, essentially stabilizing and even bolstering the old, carbon-intensive system.

We conclude from the analysis that while brown jobs are not good jobs but, overall, less well paid than others, they benefit from collective bargaining more than other jobs. This is not only an effect from being in high emitting industries but applies to other sectors too.

6 Just transition and regional inequality: the example of coal mining closures and transformation councils in Germany and other EU member states

In this section, we address the issue of adjustment to decarbonization by social partners in the context of regional inequalities. As high-emitting industries are concentrated in specific regions, this has become an increasing focus of concern – also because political polarization is seen to be driven by an increasing urban-rural divide. Labor economists have drawn our attention to rural-urban migration given the better job opportunities for low skilled in urban areas but further feeding income inequalities (Autor 2015; Autor et al. 2022). Moreover, innovation and technological change is associated with urban centres due to the proximities of high-quality universities and research focused firms. How to prevent increasing regional countries, where political dynamics are potentially driven by urban-rural divides.

We will discuss the role of social partners using the example of Germany to give a more in-depth analysis on how social partners might be able to facilitate the green transition. Germany has a specific situation regarding regional inequalities for several reasons. First, its historical legacy as a conglomeration of independent kingdoms that united in the German Reich after drawn out conflicts led to a decentralized structure of power-sharing with the central government. Second, and related, the German constitution provides for a fiscal equalizing mechanism between richer and poorer regions that distributed roughly 17bn € in 2021. Thirdly, reunification has widened regional inequalities in Germany as the Eastern Lander were significantly poorer than the Western Lander.

In that context, regional redistribution has a long policy history within Germany that is rooted in enabling fiscal transfers to poorer regions but increasingly goes beyond financial compensation. In recent years, levelling-up policies have started to address issues such as regional innovation clusters and de-carbonization in a more systematic way. We will present a couple of examples to highlight the underlying mechanisms. The examples are the plan for coal mine closures based on an extended stakeholder deliberation, regional networks for transformation and industries.

6.1 Coal mine closures in Germany

The decision to phase out lignite coal in 2038 was taken in January 2020 after a lenghty debate.[3] It is based on the recommendations of the Commission on Growth, Structural Change and Employment (also known as the "Coal Commission"). The Commission had 28 members including politicians from the two ruling parties at the time, scientists, as well as representatives from trade unions, coal companies and regional stakeholders. The recommendations included a road map for closure, compensation to coal companies for foregone profits, adjustment payments for workers in

3 The current government aims to speed up the closures.

DOI https://doi.org/10.3790/vjh.2023.334383

Table 1: Regression of Residualized Log Hourly Wages on Collective Bargaining Premia Differentials

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	LV	MT	NL	PL	PT	RO	SE	SK	HR
Brown Job	0.034	-0.051*	0.127*	-0.074*	-0.126*	-0.020	-0.091*	-0.056	-0.278	-0.138*	0.043	-0.097*	-0.097*	-0.165*	-0.108*	-0.069*	-0.078*	-0.149*	-0.165*	-0.029*	-0.049
	(0.025)	(0.018)	(0.042)	(0.020)	(0.006)	(0.025)	(0.015)	(0.033)	(0.000)	(0.028)	(0.055)	(0.011)	(0.028)	(0.038)	(0.011)	(0.013)	(0.030)	(0.035)	(0.025)	(0.012)	(0.031)
Any Collective Agreement	-0.000	0.019	0.121*	0.054*	0.136*	-0.013	-0.029	0.012	-0.079	0.115*	-0.088*	0.073*	0.018	0.003	-0.004	0.061*	-0.013	0.012	-0.023	0.043*	0.010
	(0.009)	(0.013)	(0.026)	(0.013)	(0.004)	(0.007)	(0.057)	(0.010)	(0.000)	(0.028)	(0.018)	(0.016)	(0.015)	(0.024)	(0.008)	(0.012)	(0.011)	(0.022)	(0.013)	(0.012)	(0.013)
Brown Job Agreement	-0.028	0.161*	-0.107	0.011	0.095*	-0.007	0.173*	0.037	0.206	0.113*	0.024	0.041	0.405*	0.224*	0.066*	0.080*	-0.009	0.115*	0.102*	0.096*	0.049
	(0.025)	(0.037)	(0.073)	(0.031)	(0.010)	(0.027)	(0.075)	(0.034)	(0.000)	(0.029)	(0.060)	(0.031)	(0.053)	(0.076)	(0.014)	(0.021)	(0.035)	(0.036)	(0.026)	(0.027)	(0.041)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	161,920	177,031	29,223	2,424,018	820,850	2,309,183	153,587	216,725	310,993	254,683	38,219	875,480	187,865	39,477	169,853	861,504	95,266	327,888	273,805	957,980	86,965

Notes: * p<0.05; standard errors in parentheses are clustered at the establishment level. Models 1–21 are residualized OLS regressions of annual income on brown jobs and the prevalence of collective bargaining agreements of any kind. Control variables include interactions between education level, gender, and age category, along with full-time work time, temporary contract status, company size, company control type, regions, and NACE Rev. 2 industry. Weights applied.
Source: Structure of Earnings Survey 2018.

the coal industry (amounting to early retirement), access to training schemes, an immediate programme of 240 m € to kickstart the planning of transformation and a special structural funds amounting to 40 billion € over 20 years earmarked to coal regions.

The structural funds dedicated to coal-mining regions were channelled into different funding schemes. 14 billion euros go straight to the lignite regions to compensate for different levels of economic development. The funds are made available directly to the countries for particularly important investments in the coal regions. To this end, the federal states design programs/announcements that relate to defined funding areas.

In addition, the federal government has committed itself to supporting lignite regions through further measures under its own responsibility, so-called federal measures, with up to 26 billion euros by 2038 to strengthen economic growth and create jobs. The federal measures include, for example, research and funding programs, the expansion of transport infrastructure or the settlement of federal institutions. 18 measures of the BMBF with a planned funding volume of approx. €3.9 billion have already started in the coalfields or will start in the next few years (BMBF 2023).

6.2 Regional networks for industry and networks for transformation

While a lot of attention and money is targeted to coal mining regions, other regions have started by themselves to engage with structural change policies, sometimes initiated by the regional governments but often by local stakeholder initiatives.

A recent study on Networks for the Future of Industry (Lichtblau et al. 2022) has mapped 39 networks for the future of industry or on transformation that have been formed over the last 20 years. These networks consist of local actors such as local governments, regional universities, companies and trade unions who have formed stable associations to engage with planning for regional transformation. These regional networks are usually not based in regions that are targeted for regional development either by EU structural funds or the government funds for coal-mining regions but are situated in currently well-off regions which face mounting pressures either from the challenges to the car industry or decarbonization. They aim to anticipate future challenges and prepare pro-actively on how regions can transform their economic models from hosting firms that are suppliers in the car manufacturing industries to new industrial development approaches for instance in renewable energies or public transportation. About half of these networks were set up by companies with broad participation of other stakeholders (Lichtblau et al. 2022). The most important goals of the networks (based on survey data) are to improve cooperation between members, improve communication between businesses, local authorities and civil society and promote access to key technologies.

In some cases, regional governments have set up similar networks, often labelled as councils for transformation. For instance, the Land of Rheinland-Pfalz set up such a council at the initiative of the metal sector union IG Metall. The council agreed on a work programme with three key areas: education and training, research and development and renewables and hydrogens. For each area the partners agreed on direct measures such as better digital tools in vocational training, a venture capital funds for start-ups in the region and subsidies for firms that invest in digital tools (IG Metall 2023).

Government organized councils for transformation and networks for industry sometimes overlap and certainly share many of the problem diagnostics and potential policy responses. One of the key functions is to coordinate between actors for applications for funding from transformation funds from the Federal government or the EU. Bottom-up road maps for climate adaptation, decarbonization and digital transformation are preconditions for regional development funds.

6.3 Other examples for social partner engagement for decarbonization

A report for the European parliament on the role of the social partners for the twin transition lists several collective agreements and position papers by social partners (Bednorz et al. 2022). These include both position papers at the European level as well as national level collective agreements.

The European level joint position papers by the social partners at the sectoral level highlight the need for large investments for the green transition and the need for compensation payments between sectors and regions. Social partners express their expectations that impact assessment and social dialogue must be part of policymaking in the context of the Green Deal (Eurogas, IndustriAll, EPSU 2020; CEI-Bois, EFBWW 2020; EUROFER, IndustriAll 2021). Social partners warn that decarbonisation might disrupt and jeopardise living and working conditions. They particularly request that EU policy making should be more proactive to address emerging social inequalities in the context of the new Emission Trading System and Carbon Border Adjustment Mechanism (EUROFER, IndustriAll 2021). The social partners in the transport sector issued a joint statement for COP26 emphasizing the role of public transport for the green transition and the need for more investments in infrastructure (UITP and ETF 2021).

Moreover, there are industry-wide agreements for just transition in Italy, Spain and Poland (Bednorz et al. 2022). In Italy, the Renewal of the industry-wide agreement for the electricity sector aims to provide a single framework for all workers. It focuses on retraining for workers to improve employability during the green transition. This includes a right to 28 hours of certified training (in addition to health and safety training) which will be monitored by a sectoral joint body. Already in 2017, the sector concluded an agreement which addressed the green transition including a solidarity fund to support workers that were made redundant or redeployed across companies in the sector (Bednorz et al. 2022).

Similar agreements can be found in Spain and in Poland. In Spain, social partners have negotiated a just transition agreement, which establishes a framework for the closure of coal-fired power plants while aiming to maintain or regenerate employment levels in the most affected regions. The mining companies Endesa, Iberdrola and Naturgy made commitments towards retraining and preferred hiring of affected workers, which are well known policy tools from corporate restructuring (Bednorz et al. 2022).

In Poland, a national agreement was concluded for the closure of Polish mines. The agreement guarantees work for currently employed miners until retirement as well as generous social security benefits of 80 % of their salaries, pre-retirement leave, or 120,000 PLN in severance. The mines

will be gradually closed by the end of 2049, and the state budget is to subsidise the reduction in their productive capacity until then (Bednorz et al. 2022).[4]

Social partners in brown industries demand and expect government assistance for the green transition. Their demands refer to assistance for workers but also regions affected. Stronger representation by social partners in brown industries is likely to increase the pressure on policymakers for support.

7 Conclusion

When transitioning to a green economy, sectors that are heavily dependent on fossil fuels face a significant impact on production processes and employment. These sectors, which account for around 30 % of global GDP, are at a crossroads: they must either adapt or risk becoming obsolete. National growth strategies and their alignment with specific industrial sectors further complicate this transition. Social partners often advocate for these industries, particularly in countries where fossil fuel sectors are a cornerstone of the economy. Despite their high profits and employment benefits, these sectors are most susceptible to the disruptions caused by decarbonization policies.

In this paper we investigate the role of social partners in the green transition. We use data from the EU structure of Earnings Survey (SES), the European Social Survey (ESS) and Eurostat emissions data to identify the characteristics of high emission industries and jobs and the effects of social partnership.

We find that high emitting industries have comparatively higher profits, wages, wage equality and unionization. The strong position of these industries for workers will make it more difficult to negotiate transition trajectories. We also find that these sectors are bigger in countries with higher shares of manufacturing.

We also show that brown jobs are not necessarily better jobs than others. On average brown jobs are unskilled or semiskilled and predominantly filled by older males who are paid below average. However, they benefit from collective bargaining more strongly than others.

The strong representation of brown industries and brown jobs is reflected in social partner agreements at the level of the EU and member states on policies to enable a just transition for those who are affected by decarbonization. While many agreements focus on employment guarantees and access to training, there is little attention to the role of the emergence of green jobs and the regional clustering of brown and green jobs.

The example of the roadmap towards coalmine closures in Germany shows how the green transition can be accompanied by heavy social protection of workers and regional investments, if the social partners are strongly involved in policy-decisions.

4 National agreement for the shutdown of the Polish mining industry, available at: https://www.gov.pl/web/aktywa-panstwowe/umowa-spoleczna-dla-gornictwa-podpisana.

DOI https://doi.org/10.3790/vjh.2023.334383

In future research, the regional distribution of brown jobs should be researched in more detail as regional decline has not only political repercussions but is also of increasing relevance for the EU's and member states' industrial policies. The decline of the North of England but also the rustbelt of the United States and the weakness of workers' representation in the process has been held responsible for the rise of populism and polarization (Hill 2021).

Regional networks for transformation, as shown in the German case, can help to bridge the job losses in brown industries with the emergence of green industries in the same region rather than increasing regional inequalities. The social partners can potentially leverage political support and be instrumental for organizing stakeholders and networking for building clusters for innovation and green growth.

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