The Unequal Costs of Carbon Pricing:

Economic and Political Effects Across European Regions

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Abstract

This paper examines the economic and political effects of carbon pricing across European regions. Our main finding is that a well-identified increase in carbon prices reduces emissions but entails economic and political costs: higher carbon prices significantly lower output and employment while increasing vote shares for extremist and populist parties, contributing to political fragmentation. Consistent with an economic voting channel, opinion surveys reveal a more pessimistic economic outlook and declining environmental concerns among respondents. Importantly, the economic and political costs are not borne equally: carbon-intensive regions experience a larger decline in output and see a stronger shift to extremist political parties. Our findings highlight the need for complementary policies to mitigate the unequal economic impact of carbon pricing and its associated political backlash.

Keywords: Carbon pricing, macroeconomic effects, regional inequality, economic voting, political extremism, household expectations
JEL classification: E62, H23, Q54, R11

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1 Introduction

Carbon pricing is increasingly used to mitigate climate change in Europe, with many countries adopting national carbon taxes alongside the common EU Emissions Trading System (EU ETS). However, carbon pricing remains politically contentious, as demonstrated by the Yellow Vest protests in France and the rejection of the proposed amendment to the Swiss CO2 Act in 2021. As a result, many populist and extremist parties in Europe have positioned themselves as opponents of market-based climate policies, often adopting a climate-skeptic stance (Kulin et al., 2021; see also recent press coverage, The Guardian, 2024 and Le Monde, 2024). Once in power, populist leaders have shown a willingness to dismantle climate policies, as illustrated by Donald Trump's repeated withdrawal from the Paris Agreement.

Despite its effectiveness in reducing emissions, carbon pricing can impose economic costs that are not evenly distributed (see e.g. Känzig, 2023). In this paper, we empirically assess the political costs of carbon pricing policies and their associated economic and distributional effects across European regions. To the best of our knowledge, the political consequences of carbon pricing have not been subject of systematic study in the previous literature.

We find that a well-identified carbon policy shock in the EU ETS—representing a tightening of the carbon pricing regime—results in a sizable economic contraction in the average European region and raises inequality across regions. Higher carbon prices also have political consequences: we estimate a significant increase in the vote share of extremist, populist and Eurosceptic parties, as well as increased fragmentation over the medium term. Our results are consistent with voters responding to a weakening economy, as they become more pessimistic about the economic outlook. In line with that explanation, we find regions more exposed to carbon pricing—for example, those with a higher emission intensity—bear larger economic costs and experience more political polarization.

We assemble a regional dataset that spans 224 major regions from 20 European countries between 2000-2019, combining economic, emissions and voting data. We rely on dis-aggregated election data collected by Schraff et al. (2023) and classify political parties based on the well-established coding by The PopuList (Rooduijn et al., 2023, 2024). The final dataset includes vote shares for extremist, populist and Eurosceptic parties from 104 national and European elections. To measure exogenous changes in carbon prices in the EU ETS, we use the carbon policy shock series developed by Känzig (2023). The shocks are constructed from high-frequency movements in carbon price futures around regulatory events and effectively orthogonal to confounding economic conditions.

Our findings confirm that regulatory-driven increases in carbon prices lead to sizable and persistent reductions in greenhouse gas (GHG) emissions across European regions, demonstrating the policy's effectiveness. However, we estimate substantial associated economic costs: Real GDP, employment, and real household income decline in the average region. Quantitatively, our findings suggest that a carbon price increase, normalized to raise energy prices by 1% on impact, leads to a contraction in GDP by 0.7% that persists for four years. Reassuringly, these regional responses are of similar magnitude to aggregate, country-level estimates in Känzig and Konradt (2024).

In line with the recessionary impacts, we find a deterioration in survey-based household expectations: respondents express more pessimistic views of their country's economic and employment prospects, as well as their own financial situation. At the same time, environmental issues decline in priority among respondents' self-reported concerns.

The adverse economic effects associated with carbon pricing have political consequences. We estimate that higher carbon prices contribute to larger vote shares of extremist, populist and Eurosceptic parties. For instance, the vote share for extremist (either far-left, or far-right) parties is 0.4 percentage points higher two years after the carbon policy shock, and remains elevated in the following years. As a result of the higher vote shares for extremist parties, we also document a persistent increase in political fragmentation. Our findings are therefore consistent with extremist parties benefitting from recessionary periods (e.g. Funke et al., 2016; Guriev, 2018).

We formally assess regional heterogeneity and find that the economic costs of carbon pricing are not borne equally across regions (see also Mangiante, 2024). Specifically, our analysis suggests that regions more exposed to carbon pricing—due to a higher emission intensity, or fewer free allowances—experience a larger contraction in output and employment. Put differently, carbon pricing contributes to regional inequality within a country, as measured by the 90-10 ratio of households' disposable income. Regions bearing higher economic costs also exhibit a stronger political response: our estimates suggest that the rise in the extremist vote share is between 20% and 50% larger and persistent in these regions.

Although effective at reducing emissions, our results emphasize that the economic costs of carbon pricing must be addressed to limit political backlash and sustain political support. Importantly, the EU ETS currently lacks direct measures to cushion the economic impacts on households, making complementary policies essential to address the uneven economic effects we document. For instance, rebating tax revenues to households—ideally in a progressive manner—could alleviate the burden on vulnerable households and regions (see e.g. Fried et al., 2024).

Lastly, we compare the responses to carbon policy shocks and oil supply news shocks and find that, despite their comparable economic impacts, the political backlash to carbon pricing is more pronounced. This finding suggests that fostering public engagement and raising awareness about the long-term benefits of climate policies could help to further mitigate short-term political backlash (see e.g. Schwarz et al., 2024).

Related literature. This paper contributes to several related strands of literature. The first examines the impacts of carbon pricing, with a particular focus on policies enacted in Europe. There is a large body of work showing that carbon pricing is successful in achieving reductions in aggregate emissions (see Martin et al., 2014; Andersson, 2019;

Martinsson et al., 2024, among others). At the same time, there is debate around the economic impacts of carbon pricing. Previous studies suggest limited effects of carbon taxes on economic activity and inflation (Metcalf and Stock, 2023; Konradt and Weder di Mauro, 2023; Kapfhammer, 2023). The EU ETS is associated with adverse economic effects in the form of inflation, higher unemployment and a contraction in output (Känzig, 2023; Berthold et al., 2023; Hensel et al., 2024). Focusing on variation in carbon prices in the EU ETS, our findings confirm the effects at the regional level. Moreover, our analysis shows that carbon pricing can incur political costs, in the form of increased vote shares for extremist and populist parties.

Beyond the aggregate impacts, understanding the distributional effects of carbon pricing policies is crucial for policymakers. For instance, Känzig (2023) illustrates heterogeneous impacts for households with varying income level, while Känzig and Konradt (2024) find the economic impacts differ across countries. In this paper, we illustrate that the economic effects also differ across European regions, resulting in a statistically significant increase in measures of regional inequality. Most closely related, Mangiante (2024) documents that regions in poorer Euro Area countries are more affected by carbon policy shocks. We complement these results by showing that regions more exposed to the EU ETS—either through a higher emission intensity or a lower distribution of free allowances—bear larger economic cost and political costs when carbon prices increase.

Our paper also relates to the literature studying the interaction between the economy and voting for extremist and populist parties (see e.g. Guiso et al., 2019; Guriev, 2018). Common drivers for the rise of populism observed over the past decades include increased inequality related to globalization (see e.g. Colantone and Stanig, 2018; Pástor and Veronesi, 2021; Rodrik, 2021) and the global financial crisis (Funke et al., 2016), which has resulted in an erosion of trust in political institutions across Europe (Algan et al., 2017). Moreover, episodes of austerity have also been linked to the rise of populism in Europe (Gabriel et al., 2023) and the successful Brexit campaign (Fetzer, 2019). For a survey of populist voting and the economy, see Guriev and Papaioannou (2022).

We add to this literature by empirically studying the effects of carbon pricing on voting for extremist and populist parties. Conceptually, our paper is closely related to Gabriel et al. (2023), who assess the impacts of austerity episodes on voting in European regions. Adopting a similar econometric approach and studying a comparable sample, we illustrate that carbon pricing also contributes to higher vote shares for extremist and populist parties. Our findings point to the recessionary effects of cabon pricing as the main driver for the political response.

Lastly, we contribute to a literature studying beliefs about climate and political support for climate policies (see e.g. Howe et al., 2015; Klenert et al., 2018), shaped, for instance, by experiencing severe climate events (see e.g. Deryugina, 2013; Howe et al., 2019; Hoffmann et al., 2022). Survey evidence on the acceptance of carbon pricing policies suggests a strong influence of self-interest, with respondents opposing policies they perceive as financially detrimental (e.g. Douenne and Fabre, 2022; Dechezleprêtre et al., 2022). Based on European survey data, we find that respondents' environmental concern declines in response to higher carbon prices, as they become more pessimistic about the economic outlook.

Road map. The remainder of this paper is organized as follows. Section 2 describes the data sources and steps to assemble the regional panel dataset. In Section 3 we discuss the identification challenge and introduce the empirical specification. Section 4 presents and discusses the different set of results of the analysis. We also perform a set of robustness checks to strenghten the validity of our results. Finally, Section 5 concludes.

2 Data

For our empirical analysis, we assemble a regional panel dataset that combines economic, emissions and voting data for 224 major European regions over the period 2000–2019. We include data from 20 countries, including all major EU economies (covering 97% of EU GDP), as well as Norway, which has been part of the EU ETS since its introduction. Table B.1 in the Appendix lists the relevant NUTS2 regions and Table B.3 describes the main variables in more detail. Table B.4 presents descriptive statistics for the economic and voting variables in our dataset.

2.1 Economic and emissions data

Our main source of regional economic data is the Annual Regional Database (ARDECO) of the European Commission's Directorate General for Regional and Urban Policy.[1] The ERD integrates data from Eurostat's REGIO database and national statistics from the European Commission's AMECO database, using interpolation methods to address data gaps. The data are structured according to Eurostat's Nomenclature of Territorial Units for Statistics (NUTS), a hierarchical classification system dividing the EU's economic territory into four levels. We focus on NUTS2, which corresponds to basic regions, because it is the most granular level for which we can get consistent and high-quality economic and voting data.

We use ARDECO to source data on gross domestic product (GDP), gross value added (GVA), compensation of employees, gross fixed capital formation (GFCF) and households net disposable income, all inflation-adjusted using 2005 prices. To capture labor market developments, we use information on total employment and hours worked. The data also provide a breakdown of regional GVA and employment into six economic sectors based on the NACE Rev. 2 classification.

Conveniently, ARDECO also contains figures on greenhouse gas (GHG) emissions from the Emissions Database for Global Atmospheric Research (EDGAR) for each region. To more directly capture emissions regulated by the EU ETS, we also construct a measure of verified ETS emissions at the regional level. This step is necessary because the

[1] More details are available at https://knowledge4policy.ec.europa.eu/territorial/ardeco-database_en.

EU ETS Transaction Log maintained by the European Commission only publishes data at the national level. Therefore, we aggregate the reported data from regulated industrial installations, digitized by Abrell (2022), using zip codes in their addresses to map them to NUTS2 regions. To ensure the accuracy of our approach, we verify that the aggregated regional measures are comparable to country-level figures.[2] Moreover, as expected, the correlation with aggregate regional GHG emissions is high ($\rho = 0.84$).

When the ETS was first introduced, the European Commission granted free emission allowances to protect energy- and trade-intensive sectors from rapid increases in carbon prices (see e.g. Martin et al., 2014). Although this practice was scaled back in 2013, many regulated firms in the EU ETS still receive some free emission permits, lowering the effective carbon price they face. Following the same steps as before, we aggregate the number of free permits allocated for each NUTS2 region. We primarily use the ETS data to construct regional exposure measures, relying on emission intensity (emissions scaled by GDP) and the share of free allowances (free allowances scaled by emissions).

We complement the regional data with country-level information. To capture inflation dynamics, we use the harmonized index of consumer prices (HICP) sourced from Eurostat. In robustness exercises we also control for the unemployment rate (from the World Bank), a stock market index (from the OECD) and the monetary policy rate (from the Bank for International Settlements), as well as the Brent oil price (from FRED).

2.2 Voting data

To measure political developments at the regional level we rely on the "EU-NED: The European NUTS-Level Election Dataset", assembled by Schraff et al. (2023). This dataset provides detailed and harmonized election data in NUTS2 regions since 1990. Importantly, the data contains information on the number of valid votes, eligible voters and

[2] The regional data covers 92% of country-level emissions in an average year. We still winsorize the ETS data at the 99th percentile in each year, to limit the effects of potential outliers.

votes received by each party in national and European elections.

For the regions in our sample with complete economic data, the data spans 114 elections, of which 110 national elections (1,852 region-election observations) since 2000. We provide a list of the relevant parlamentary elections in Table B.2, and also exploit outcomes of the four European Parliament elections in 2004, 2009, 2014 and 2019. When national and European elections take place in the same year, we retain the national election outcomes.[3]

For the classification of political parties we closely follow the literature (see e.g. Marx et al., forthcoming; Draca and Schwarz, 2024; Federle et al., 2024) to use the well-established coding by The PopuList (Rooduijn et al., 2023, 2024). In particular, this dataset allows us to classify parties on the left and right end of the political spectrum (far-left and far-right), populist parties, and Eurosceptic parties.[4] To combine the two datasets, we leverage the mapping of Partyfacts (Döring and Regel, 2019), which assigns a unique identifier to each political party (or party family).

We proceed to compute vote shares for extremist (either far-left or far-right), populist and Eurosceptic parties, respectively. For each election in our sample, we aggregate their number of votes relative to the total number of valid votes in a region.[5] Panel A of Figure 1 displays the average vote share for extremist, populist and Eurosceptic parties, computed across the regions in our sample in each year. We see a sizable increase in vote shares over time, with values between 25% and 30% in 2019.

Despite the general increase in voting for extremist parties, there remains substantial variation across regions, as Panel B of Figure 1 illustrates. The average regional extremist vote share, computed between 2000 and 2019, ranges between 0 and 49%, with a median value of 15%. Moreover, the extremist vote share also varies substantially across regions

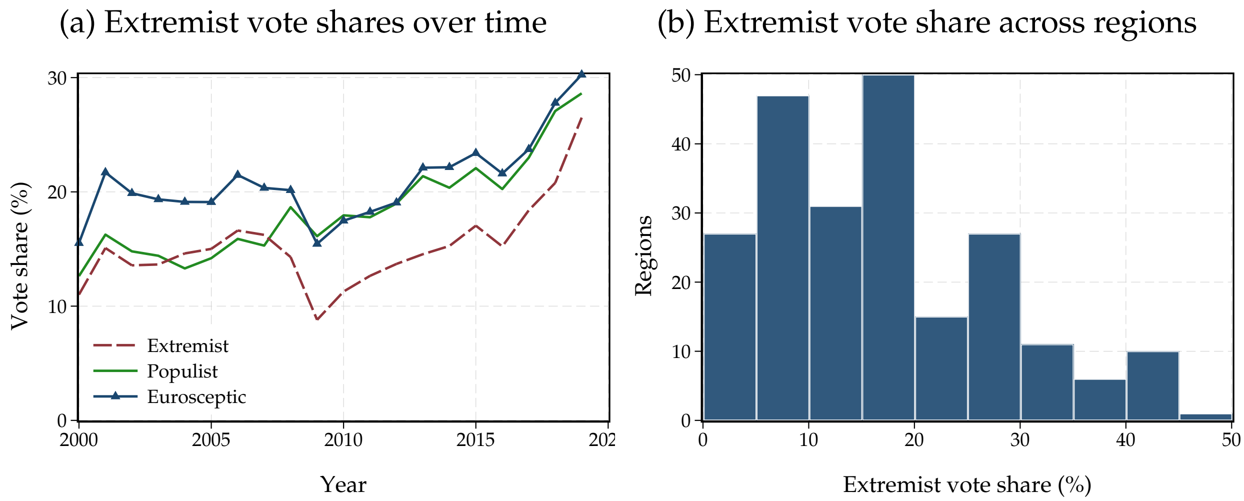
[3]In robustness exercises, we verify that our results hold when instead computing the average vote shares in those years, or excluding European elections entirely.

[4]For details on the precise definitions and consulted experts, see https://popu-list.org/about/.

[5]The coding also identifies parties that are borderline cases, and we ensure that our results are robust to excluding those parties.

within the same country. For instance, the average extremist vote share in the Italian region of South Tyrol is 9.74%, about three times smaller than in Veneto (29.34%) over the same period.

Figure 1: Vote shares for extremist parties in European regions, 2000–2019



Notes: Panel (a) plots the average vote share for extremist, populist and Eurosceptic parties over time. Panel (b) shows a histogram of the average extremist vote share between 2000–2019 across regions.

2.3 Households' expectations data

To measure households' economic expectations and environmental concerns, we rely on the Eurobarometer survey (see e.g. Bursian and Faia, 2018; Guiso et al., 2016). The Eurobarometer is a repeated, harmonized cross-sectional series of public opinion surveys on a broad range of topics, carried out on behalf of the European Commission in EU member countries.[6]

Respondents are surveyed about their expectations for the economic and employment situation in their country, as well as their households' financial situation, over the next 12 months. We follow the approach by Andrade et al. (2022) and Hensel et al. (2024) to code

[6]For more information on the survey, see https://europa.eu/eurobarometer/screen/home.

responses as -1, 0, or 1, corresponding to expectations that conditions will worsen, remain unchanged, or improve, respectively.

Moreover, respondents report a ranking of issues they perceive as important problems in their own countries. Following Hoffmann et al. (2022), we construct an indicator for environmental concern as the share of respondents in each region who consider environmental issues to be among the two most important issues facing their country.[7]

Respondents provide information on their region of residence, which allows us to construct the relevant survey-based measures at the NUTS2 level. To maximize coverage and consistency, we use data from 34 waves between 2004 and 2019 in 15 countries. Since Eurobarometer surveys are carried out up to three times per year, we compute the average annual value in those instances.

2.4 Carbon policy shocks

Identifying the causal impacts of the EU ETS is challenging because carbon prices are market-based and inherently influenced by economic conditions. To isolate exogenous variation in carbon prices, we therefore follow the methodology developed in Känzig (2023) to construct a series of carbon policy surprises from movements in carbon price futures around regulatory events in the EU ETS.[8] The idea is that confounding economic factors are already priced in ex-ante, and are unlikely to change in the narrow window around the event.

To address potential measurement error at lower frequency, the aggregated daily surprises are then used as an external instrument in a monthly vector autoregressive (VAR) model for the European economy between 1999–2019, which includes energy prices, emis-

[7]The answer categories to this question changed slightly over time: Until 2006 the questionnaires only listed one environmental category, "protecting the environment", before adding "energy related issues". From 2011, the two categories were merged into a new category called "the environment, climate and energy issues". To maximize coverage, we count all responses referring to the environment as relevant irrespective of differences in the set of answer categories.

[8]Känzig (2023) identifies 126 relevant events between 2005 and 2019, including adjustments to the overall cap, free allocation and auctioning of allowances, and the use of international credits.

sions, economic and financial variables. Under the assumption of invertibility (Stock and Watson, 2018), it is possible to extract a structural carbon policy shock from the monthly VAR model. Finally, we aggregate the monthly shocks, normalized to induce a 1% increase in the energy component of HICP on impact, to an annual series (displayed in Figure B.1 in the Appendix). For more details on this procedure and background information on the EU ETS, see Känzig (2023).

3 Empirical specification

Our goal is to analyze the economic and political impacts of carbon pricing across European regions over time, while controlling for relevant regional economic conditions. To that end, we use the local projections approach following Jordà (2005), applied to panel data. Specifically, the average regional response to an identified climate policy shock is estimated as follows:

$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \beta_h \text{cpshock}_t + \sum_{l=1}^{L} \theta_{i,h}^{l} \Delta y_{i,t-l} + \sum_{l=1}^{L} \gamma_{i,h}^{l} \Delta x_{i,t-l} + \varepsilon_{i,t+h}, \tag{1}$$

where $y_{i,t+h} - y_{i,t-1}$ is the h-year change in the dependent variable for region i, relative to $t-1$. cpshock_t corresponds to the carbon policy shocks. We include lags of the dependent variable, $\sum_{l=1}^{L} \theta_{i,h}^{l} \Delta y_{i,t-l}$, to capture its persistence. To control for the broader macro-financial environment, $\sum_{l=1}^{L} \gamma_{i,h}^{l} \Delta x_{t-l}$ collects a set of (lagged) regional and country-level variables. In the baseline specification, we include regional (real) GDP growth and country-level inflation, but verify in Figure 10 that the analysis is robust to adopting more or less restrictive sets of controls.

We also include a set of region fixed effects, $\alpha_{i,h}$, to absorb any time-invariant regional characteristics. We set $L = 2$ for the lagged dependent variable and control variables. Inference is based on Driscoll and Kraay (1998) standard errors to allow for general forms of cross-sectional and serial dependence in the panel data.[9] In this setup, β_h captures the dynamic, causal effect of carbon policy shocks on the dependent variable h periods ahead. We compute responses over a four-year horizon, i.e. $h = 0, ..., 4$.

Equation (1) successfully estimates the average effect of carbon policy shocks in European regions, but hides potential heterogeneity in the responses. In particular, regions could be differentially exposed to carbon pricing due to their industrial structure and the allocation of free allowances in the EU ETS. To formally account for differences across regions, we estimate an extension of the model that includes an interaction term,

$$
\begin{aligned}
y_{i,t+h} - y_{i,t-1} =& \alpha_{i,h} + \beta_h \text{cpshock}_t + \delta_h z_{i,t_0-1} \times \text{cpshock}_t + \sum_{l=1}^{L} \theta_{i,h}^{l} \Delta y_{i,t-l} \\
&+ \sum_{l=1}^{L} \gamma_{i,h}^{l} \Delta x_{i,t-l} + \varepsilon_{i,t+h},
\end{aligned} \tag{2}
$$

where z_{i,t_0-1} corresponds to the respective exposure variable of interest. We standardize the exposure variable such that δ_h can be interpreted as the effect of having a standard deviation higher exposure relative to the average region. Since we are interested in identifying δ_h, we also estimate a version of the model that includes time fixed effects, which allows us to control for other potential confounders, but also absorbs the carbon policy shocks. Reassuringly, we find that the inclusion of time fixed effects does not meaningfully affect our estimated responses. To rule out reverse causality of the exposure variable to carbon pricing, we use the latest annual observation prior to our sample period.[10]

We consider a set of different exposure variables in Equation (2). First, we use the carbon intensity, measured as a region's ETS emissions, scaled by GDP. Regions with a higher share of energy companies and large industrial emitters, covered by the EU ETS, are plausibly more affected by higher carbon prices. Nonetheless, we check that the results are

[9]We verify that clustering the standard errors at the region and year level delivers almost identical results.

[10]For the EU ETS-based variables we use the value in 2008, the end of the pilot phase and start of Phase 2 of the ETS.

comparable when using the aggregate GHG intensity, which includes emissions in non-ETS sectors, in Figure A.3 in the Appendix. Second, we also rely on the share of free allowances, a measure of regions' freely allocated allowances to ETS emissions. Following Känzig and Konradt (2024), the idea is that regions receiving more free allowances, relative to the emissions they produce, face lower effective carbon prices.

In addition to estimating heterogeneous regional responses, we can also directly quantify the impacts of carbon pricing on inequality at the country-level. To that end, we construct different measures of regional inequality, based on the 90th and 10th percentiles of the within-country (log) real disposable household income and (log) real compensation distributions (see e.g. Guvenen et al., 2022; Meyer and Sullivan, 2023). Subtracting the latter from the former, an increase in the $\text{p90} - \text{p10}$ ratio implies more dispersion in economic conditions across regions within a country.[11]

Formally, we estimate the response of inequality in a similar local projections framework,

$$\begin{aligned}\Delta(\text{p90} - \text{p10})_{i,t+h} =& \alpha_{i,h} + \beta_h \text{cpshock}_t + \sum_{l=1}^{L} \theta_{i,h}^{l} \Delta(\text{p90} - \text{p10})_{i,t-l} \\ &+ \sum_{l=1}^{L} \gamma_{i,h}^{l} \Delta x_{i,t-l} + \varepsilon_{i,t+h},\end{aligned} \tag{3}$$

where subscript i now refers to a country. We keep including a set of fixed effects, $\alpha_{i,h}$, and two lags of the change in the $\text{p90} - \text{p10}$ ratio (i.e., setting $L = 2$). $\sum_{l=1}^{L} \gamma_{i,h}^{l} \Delta x_{i,t-l}$ collects a set of country-level controls, including real GDP growth, a stock market index, the unemployment rate and monetary policy rate. We compute standard errors based on the lag-augmentation approach (Montiel Olea and Plagborg-Møller, 2021).

[11] We exclude Estonia and Latvia for this exercise, because our sample only includes a single NUTS2 region in these countries.

4 Results

In this section we present the results, beginning with the average regional responses for emissions, economic and political variables. We then show that the estimated responses vary substantially across regions. Finally, we perform a series of robustness checks to further validate the main findings.

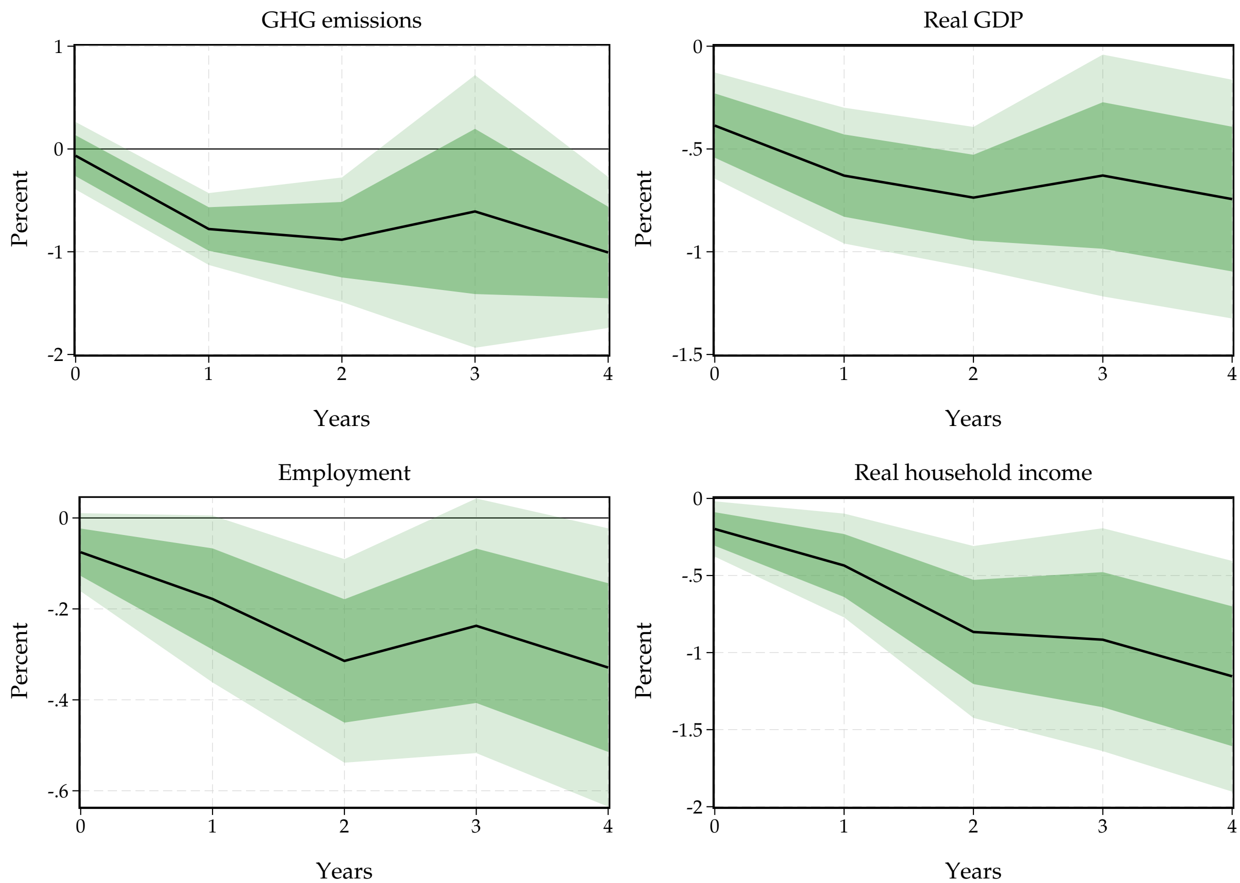
4.1 Carbon policy shocks, the economy and voting outcomes

We start by assessing the effects of carbon pricing on emissions and the economy in the average European region. Figure 2 displays the estimated impulse responses to a carbon policy shock, normalized to increase energy prices by 1% on impact. We find a statistically significant and persistent reduction in GHG emissions for the average European region, of about 1% one year after the shock. These estimates are in line with the previous literature studying the aggregate effects of the EU ETS, and underscore the policy's effectiveness in reducing emissions (see e.g. Känzig, 2023; Känzig and Konradt, 2024).

However, the reduction in emissions comes at economic costs. We see a precisely estimated contraction in real GDP and total employment at the regional level, that persist even four years after the shock. Households are also directly affected by higher carbon prices, as demonstrated by the sizable reduction in real net disposable income. The results highlight the contractionary effects of carbon policy shocks for the average European region (Mangiante, 2024). To further corroborate these findings, we present similar impulse responses for real investment, real compensation of employees, real gross value added (GVA) and total hours worked in Figure A.1 in the Appendix.

How do higher carbon prices in the EU ETS and the associated economic contraction impact voting behavior at the regional level? Figure 3 shows the dynamic responses using the identical empirical approach for a range of political outcomes. We find carbon policy shocks lead to an increase in the vote share of extremist parties in the average region (the

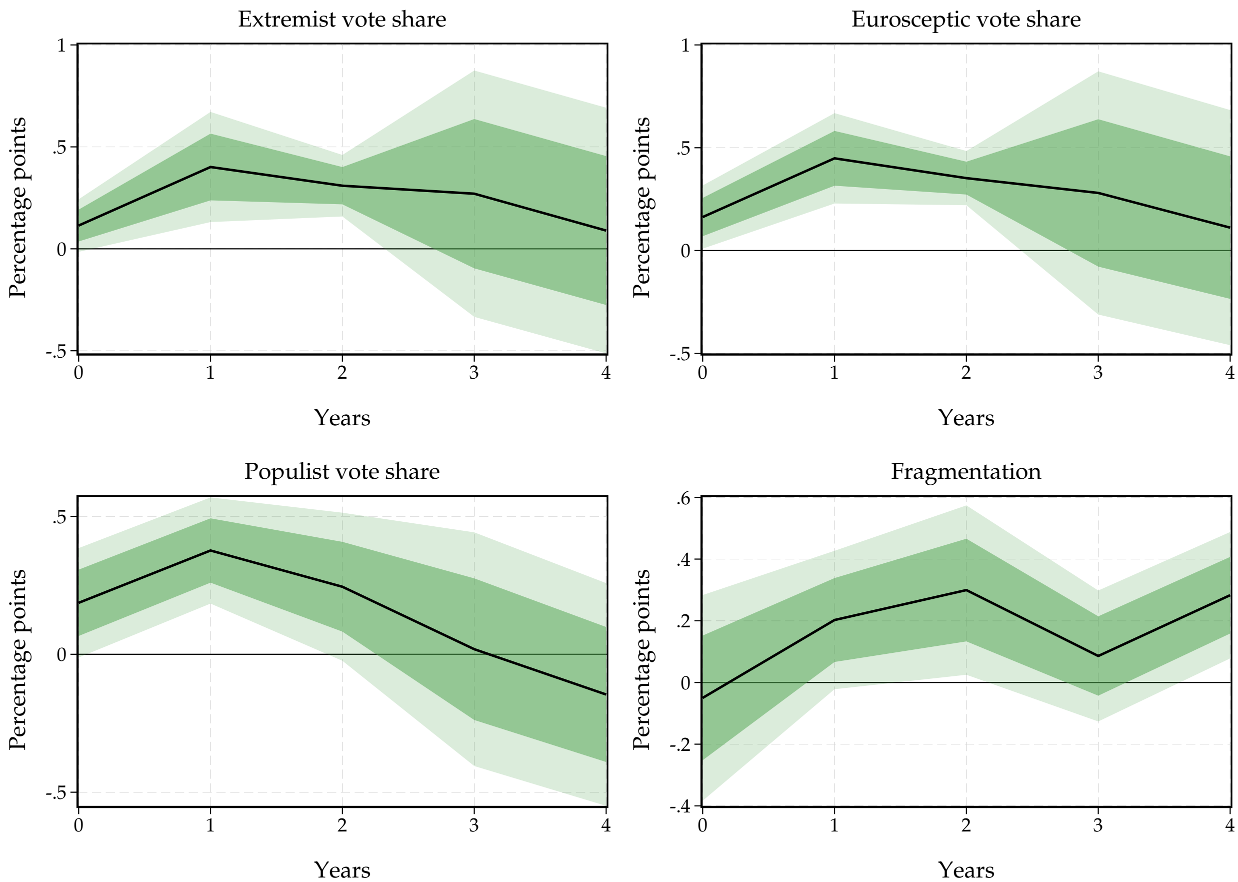
Figure 2: Responses of emissions and economic variables



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for different economic regional variables. Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

combined vote share of far-left and far-right parties). Quantitatively, the vote share of extremist parties rises by between 0.3 and 0.4 percentage points in the two years after the shock, and remains elevated thereafter. Although modest in size, we show in Section 4.3 that carbon policy shocks elicit a larger political response compared to other energy price shocks. Similarly, the vote share for Eurosceptic and populist parties displays a statistically significant increase in the medium term. As a result, political fragmentation, measured as the complement of the Herfindahl-Hirschman-Index (Gabriel et al., 2023), rises.[12]

Figure 3: Responses of vote shares and fragmentation



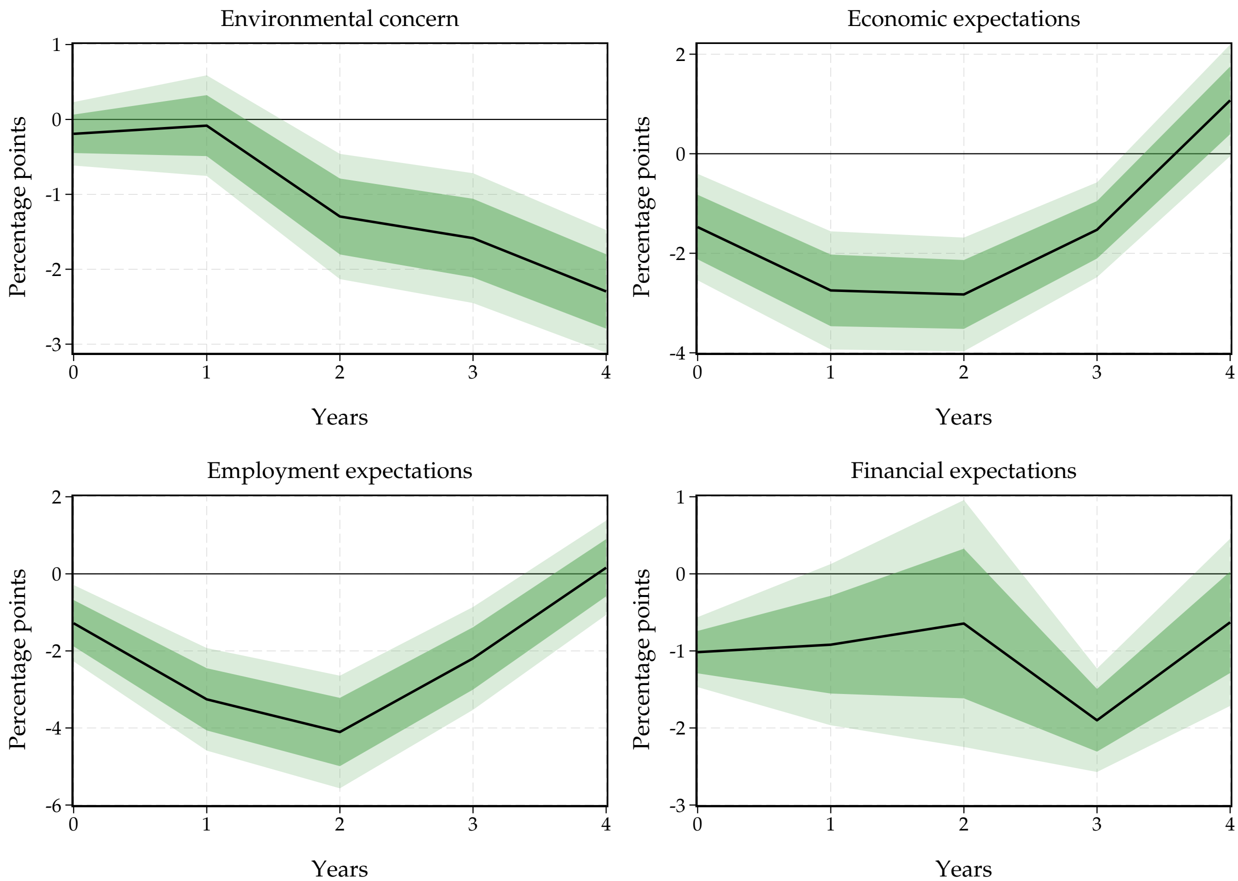
Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for different voting outcomes. Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

These results indicate that higher carbon prices impose substantial and long-lasting political costs, as voters shift to extremist and populist political parties. Figure A.2 in the Appendix further decomposes the responses for far-left and far-right parties, into separate responses for each group. The responses suggest that carbon policy shocks primarily induce a shift towards far-right parties, which tend to benefit more from adverse economic conditions (e.g. Funke et al., 2016). Moreover, Figure A.2 provides evidence of a

[12]Specifically, we compute fragmentation as $1 - \sum_j^J \text{voteshare}_j^2$, where J corresponds to the set of political parties with valid votes in a given election.

small decline in voter turnout, potentially amplifying the increased vote share of extremist parties.

Figure 4: Responses of households' expectations and environmental concerns



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for survey-based measures. Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

The increase in vote shares for extremist, often anti-climate, parties and associated rise in political fragmentation potentially undermines public support for the climate policy agenda. To further investigate this channel, we leverage regional opinion data from the Eurobarometer survey. Specifically, we estimate the local projections with the environmental concern and expectation measures as dependent variables.

Figure 4 shows the corresponding impulse responses. Following a carbon policy shock, we see a statistically significant drop in environmental concern that persists for four years. In quantitative terms, our estimates imply a two percentage point reduction in the share of respondents that view climate and environmental issues as a main concern.

One interpretation is that the adverse economic effects of carbon pricing effectively crowd out environmental concerns due to self-interest motives (see e.g. Douenne and Fabre, 2022; Dechezleprêtre et al., 2022). Consistent with that view, we estimate households become more pessimistic about the immediate economic and labor market conditions in their country. We also see a decline in households' expectations regarding their self-reported financial situation.

Our results therefore suggest a tighter carbon pricing regime leads to a decline in environmental concerns among potential voters. In the same vein, Känzig (2023) documents that higher carbon prices are associated with a decline in attitudes towards climate policies based on British survey data. Put differently, the economic and political impacts of higher carbon prices may hinder future progress on climate policies. Complementary policy measures designed to cushion the economic effects, especially for the most affected regions and households, may therefore help to restore public support for climate policies. Additionally, fostering greater public engagement and awareness about the long-term benefits of climate policies may help counterbalance their short-term economic costs.

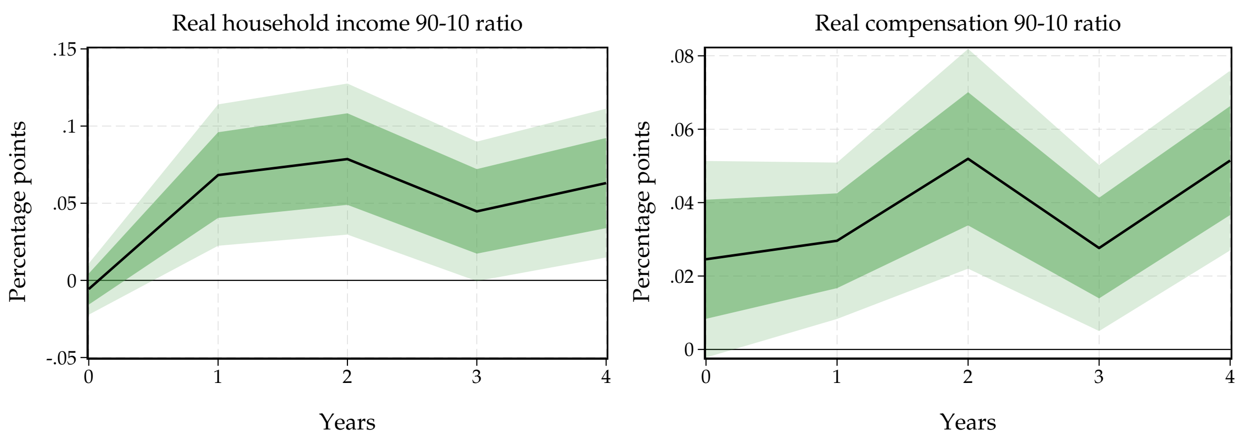
4.2 Heterogeneous effects across regions

As our estimates show, carbon pricing is associated with a significant economic contraction and an increase in the share of votes for extremist parties in European regions. However, these average effects may hide heterogeneity across regions that are differentially exposed to carbon pricing, which could contribute to regional inequality. Inequality, in turn, has separately been linked to rising populism over the recent decades (e.g. Pástor and Veronesi, 2021).

To investigate this dynamic, we begin by assessing the impact of carbon policy shocks on regional inequality within a country. Figure 5 illustrates the responses for the 90-10 ratios for (log) disposable household income and (log) employee compension, respectively. The results reveal a significant and persistent increase in inequality following an increase in carbon prices. Quantitatively, the carbon policy shock raises the 90-10 ratio of household income by about 0.05 percentage points.

Following Guvenen et al. (2022), we also decompose the responses of the 90-10 ratio into 90-50 and 50-10 ratios to study top- and bottom-end inequality. As Figure A.4 in the Appendix shows, carbon pricing raises regional inequality primarily by widening the gap between median and 10th percentile regions. Put differently, poorer regions are more affected by the negative effects of climate policy (see also Mangiante, 2024), thus falling behind even further.

Figure 5: Responses of regional inequality



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for economic inequality. Inequality is measured as the difference between the 90th and 10th percentiles of the cross-sectional distributions of household income (left panel) and employee compensation (right panel) within a given country. Shaded areas denote 68 and 90 percent confidence bands, based on standard errors clustered at the country level.

To dig deeper into the drivers of regional inequality, we proceed to estimate heterogeneous responses to carbon pricing, depending on regions' exposure to the ETS. Indeed, we find differences depending on emission intensity and the share of free allowances.

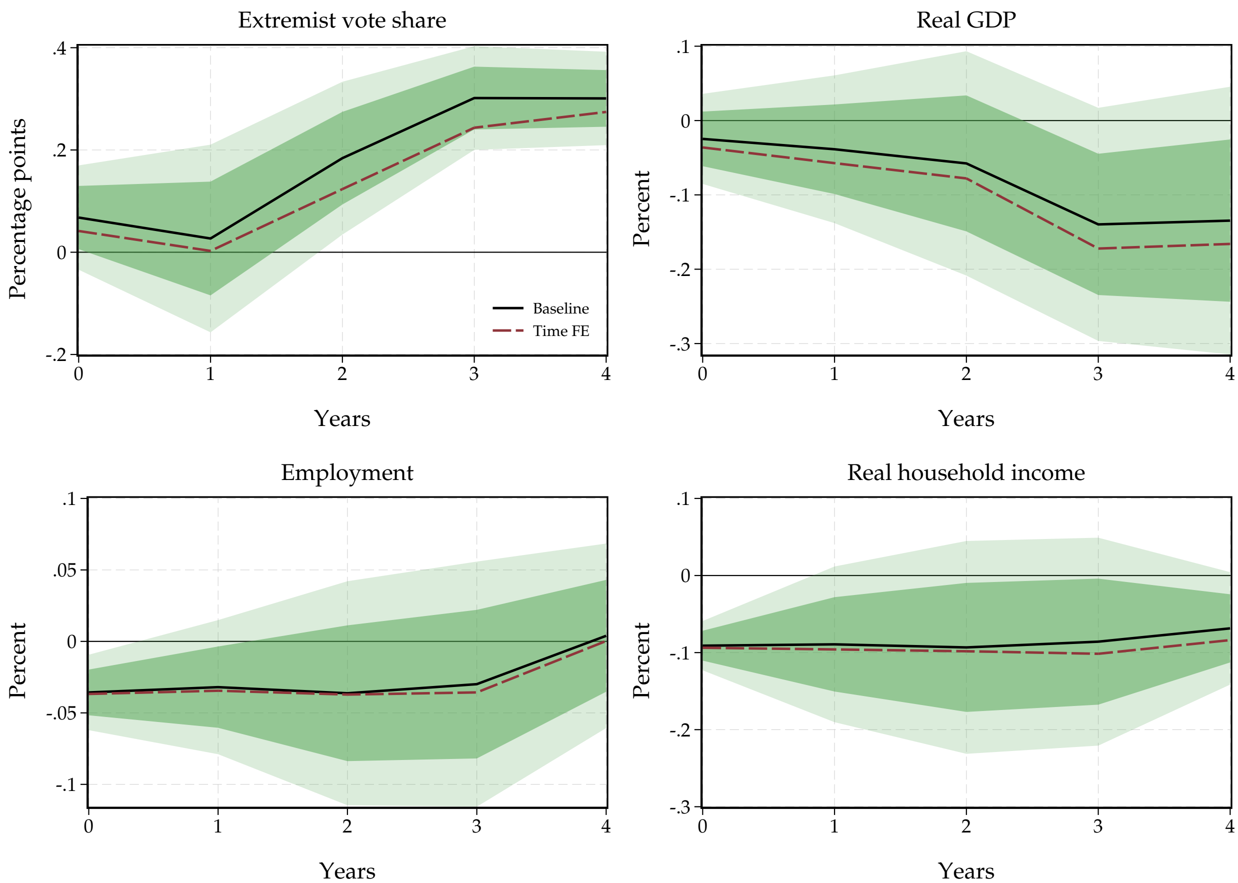
Figure 6 displays a more pronounced economic contraction in regions with a standard deviation higher emission intensity. Moreover, these regions experience a significantly larger and more persistent shift towards extremist parties. The interaction effects are quantitatively meaningful, between 20% to 50% of the average effect we estimate for real GDP and the extremist vote share. Reassuringly, the results hold irrespective of controlling for time fixed effects, as a comparison of the solid black and dashed red lines in Figure 6 shows.

The ETS intensity captures the direct exposure based on the regional agglomeration of industrial installations covered by the carbon market. However, as the ETS only includes certain sectors, regions with a lower ETS intensity could still be relatively more exposed to carbon prices if they have a high emission intensity, for example, due to a limited substitutability to cleaner technologies. To account for that possibility, we carry out a similar analysis based on regions' aggregate GHG emission intensities. The findings, presented in Figure A.3 in the Appendix, confirm that regions with a higher emission intensity experience more pronounced economic effects and see a larger shift toward extremist parties. Our results are in line with cross-country macroeconomic evidence established by Berthold et al. (2023).

The allocation of free emission permits to industrial installations in the EU ETS can be an additional source of heterogeneity (Känzig and Konradt, 2024). In Figure 7, we therefore estimate similar interaction effects based on regions' share of free allowances relative to verified ETS emissions. Regions with a lower share of freely allocated allowances bear substantially larger economic costs, suggesting that free allowances act as a buffer against carbon price increases. Consistent with the economic impact, regions receiving fewer free allowances experience a significantly larger and more persistent increase in voting for extremist parties.

Since the allocation of free allowances was originally based on the carbon- and trade-intensity of participating countries (see Martin et al., 2014, for details), one concern is

Figure 6: Responses for a higher ETS intensity

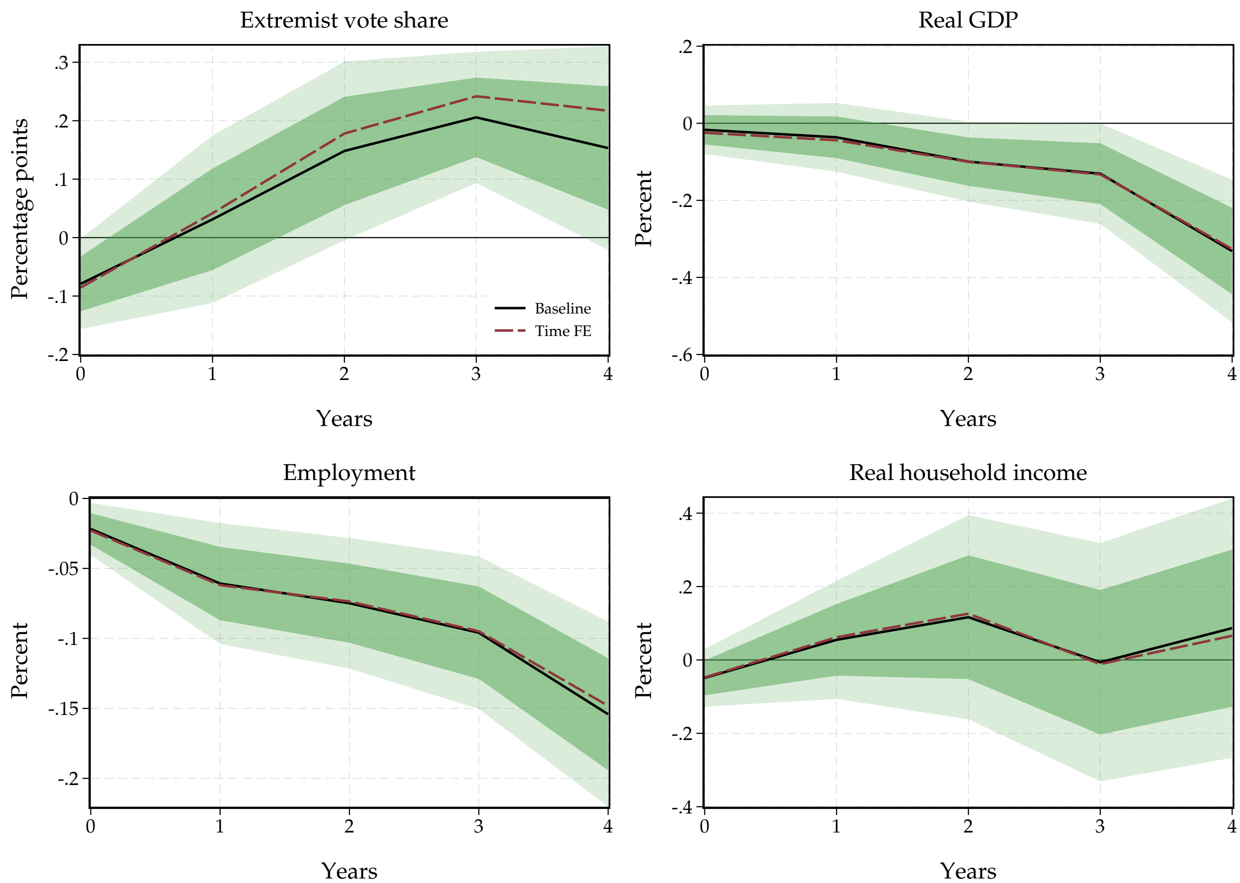


Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for regions with a standard deviation higher ETS intensity (verified emissions relative to GDP). Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

that our results are driven by differences in sectoral composition. We verify in Figure A.5 in the Appendix that the allocation of free allowances still accounts for meaningful heterogeneity even after formally controlling for regions' industrial structure.

In summary, our analysis suggests substantial heterogeneity in the economic impacts of carbon policy shocks, which contribute to regional inequality. These unequal economic effects further exacerbate the political consequences we document, as more affected regions experience a larger shift to extremist political parties. Complementary measures to cushion the economic impacts in carbon-intensive regions could help to alleviate the

Figure 7: Responses for a lower share of free allowances



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for regions with a standard deviation lower share of free allowances to total ETS emissions. Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

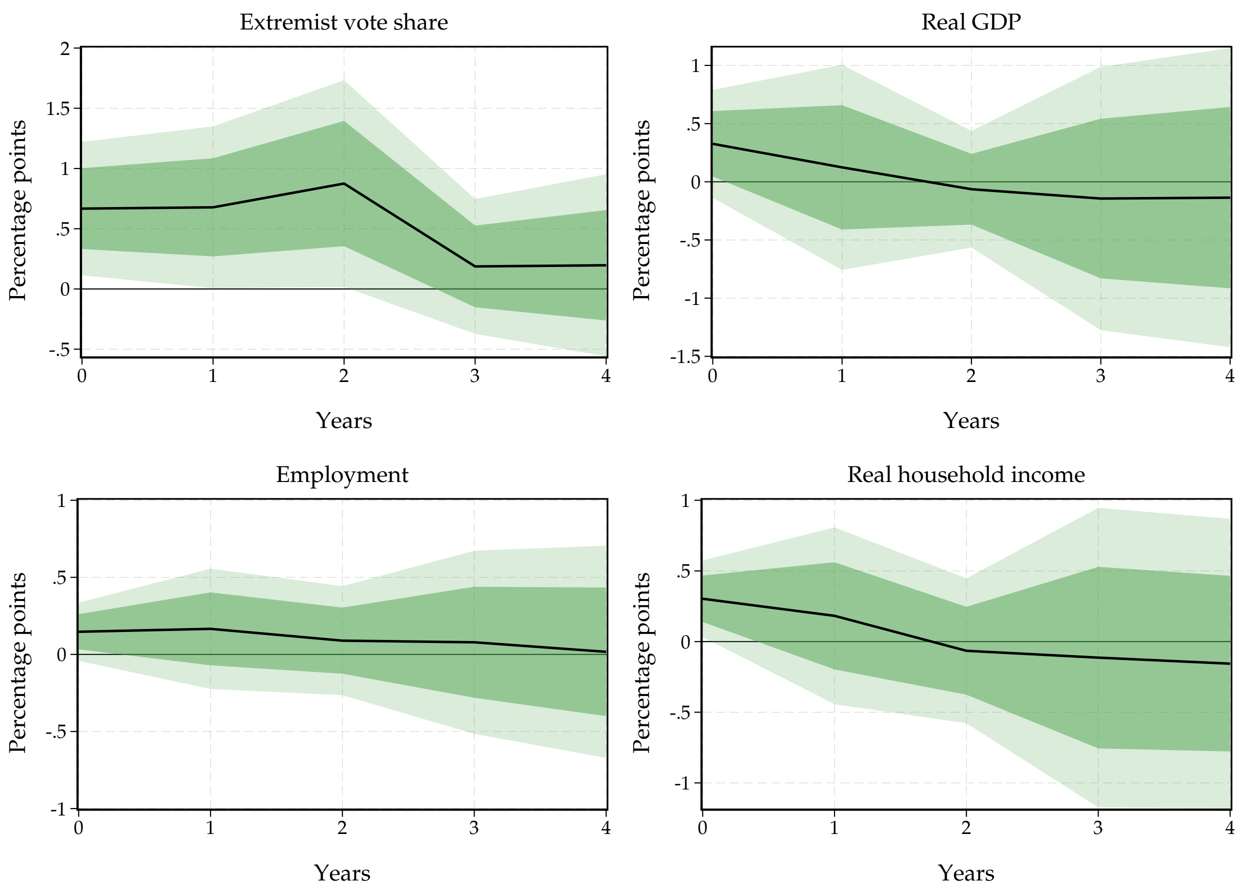
economic disparities and political fragmentation.

4.3 Comparison with oil shocks

In order to shed more light on the underlying channel and benchmark the effect size, we compare our estimated carbon policy shock responses to another type of conventional energy price shock. Specifically, we rely on the oil supply news shocks by Känzig (2021). Importantly, these shocks are comparable because they are constructed using a similar high-frequency approach around relevant events and are orthogonal to economic conditions. Therefore, we can directly estimate impulse responses using oil supply shocks in place of the carbon policy shocks within our existing empirical framework.

For ease of interpretation, we report the difference in estimated responses (computed by subtracting the response to the oil supply shock from the carbon policy shock response) and conduct inference based on boostrapped standard errors clustered at the year level (Almuzara and Sancibrián, 2024). Since the oil shock is normalized to increase the real oil price by 10%, it is quantitatively comparable to the carbon policy shock.

Figure 8: Differences in responses for carbon policy and oil supply shocks



Notes: The figure plots the difference in responses to a carbon policy shock relative to an oil supply shock. The black lines indicate the point estimates, with shaded areas denoting 68 and 90 percent confidence bands, based on bootstrapped standard errors clustered at the year level.

Figure 8 displays the results. We see that carbon policy shocks have economic effects comparable to those of oil supply shocks, leading to similar declines in GDP, employment, and household income.[13] However, our estimates suggest that carbon policy shocks lead to a significantly stronger increase in the extremist vote share over the first two years after the shock.

Put differently, the political backlash to carbon pricing appears more pronounced than that to oil price shocks and goes beyond the associated economic effects. One interpretation is that voters attribute the economic impacts associated with carbon pricing to policymakers, while oil prices are perceived as exogenous to the domestic economy. In the same vein, Gabriel et al. (2023) find that austerity-driven recessions elicit stronger political responses than general economic downturns due to a decline in trust in government.

4.4 Robustness

To validate our main findings we also perform a series of robustness checks. For brevity, this section presents a selected set of results, with additional estimates contained Appendix A.

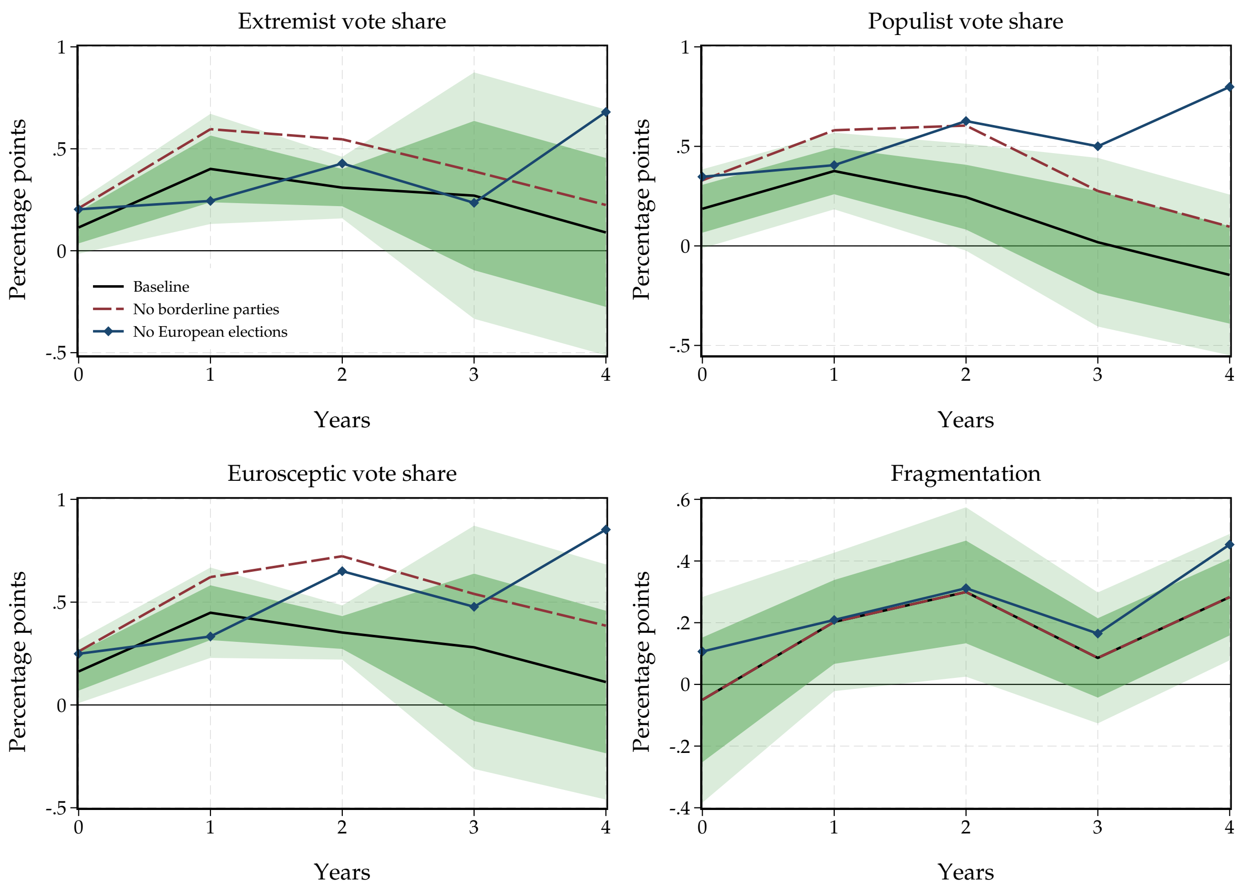
First, we ensure that the European elections in our sample and the classification of political parties do not drive our vote share results. As Figure 9 illustrates, we estimate very similar responses when excluding extremist, populist or Eurosceptic parties classified as "borderline" by The PopuList (Rooduijn et al., 2023, 2024), or focusing only on national election outcomes.

Second, we verify that the baseline specification, Equation (1), is robust to the selection of controls. Figure 10 shows consistent responses based on a model with no additional controls beyond the lagged dependent variable and region fixed effects. In the same figure, we illustrate that the results are also comparable when controlling for the broader

[13] Although not reported here, we find comparable impacts of the two shocks on the environmental concern and economic expectations measures.

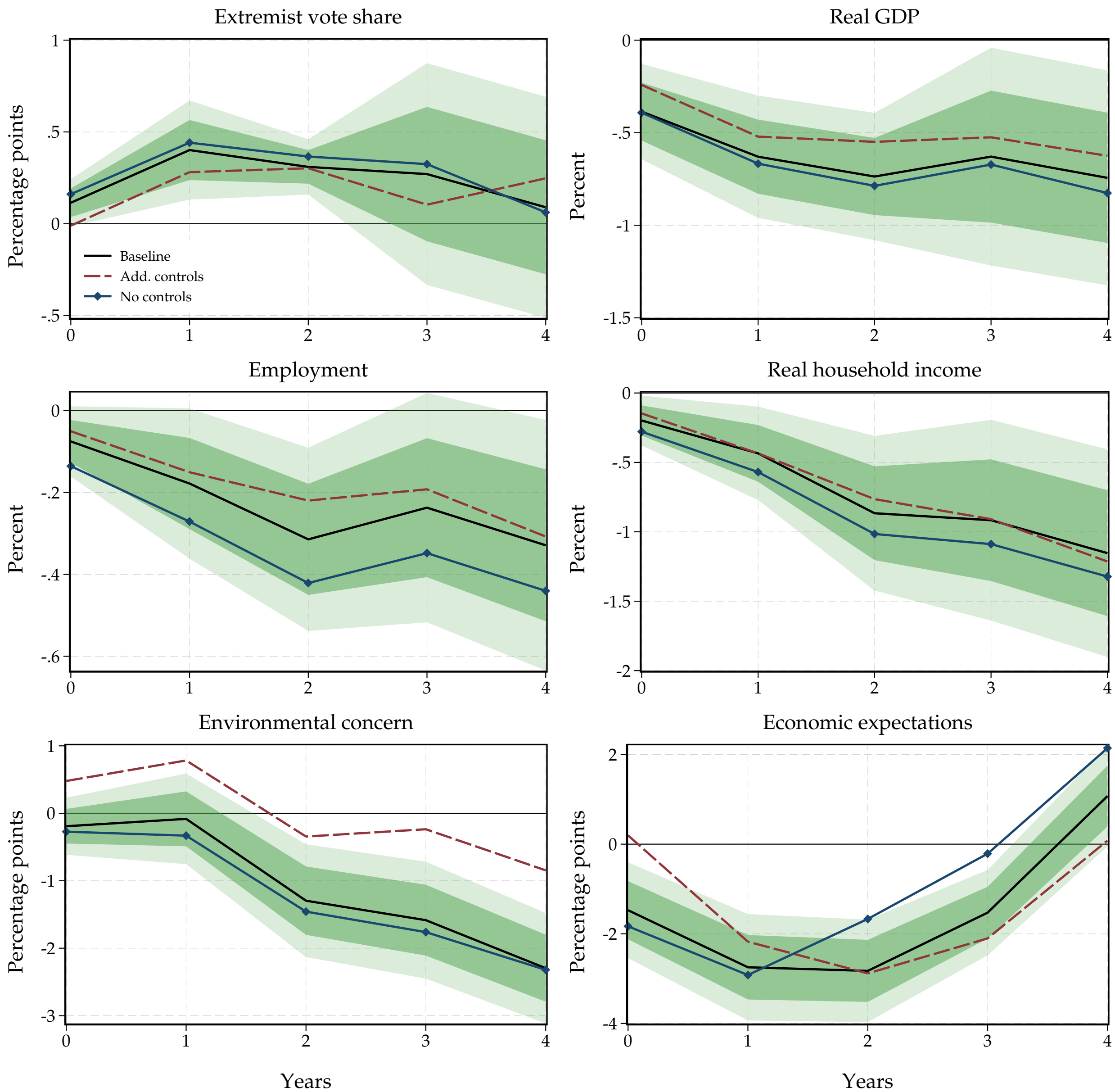
macro-financial environment using the country-level unemployment rate, stock market index, monetary policy rate, as well as the Brent oil price and a dummy variable for the financial crisis.

Figure 9: Responses for different elections and party classification



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact. The black lines indicate the point estimates using the baseline sample and classification, with shaded areas denoting 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors. The blue lines and red dashed lines show point estimates when (i) excluding parties classified as "borderline", and (ii) excluding European elections from the analysis, respectively.

Figure 10: Responses for a different selection of controls



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact. The black lines indicate the point estimates under the baseline specification, with shaded areas denoting 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors. The blue and red dashed lines show point estimates when using (i) no additional controls, and (ii) the country-level unemployment rate, a stock market index, the monetary policy rate, the oil price, as well as a dummy variable for the global financial crisis (2007–2009), respectively.

5 Conclusion

This paper examines the economic and political costs of carbon pricing across 224 major European regions from 20 countries. Exploring regulatory-driven changes in the EU Emissions Trading System, we find that carbon pricing is effective at reducing emissions, but incurs significant economic costs. Our main contribution is to establish that carbon pricing also has political consequences: we estimates that higher carbon prices lead to a significant increase in vote shares of extremist and populist parties in subsequent elections, as well as more political fragmentation. These results are consistent with voters responding politically to adverse economic developments related with carbon pricing. Survey evidence corroborates this hypothesis: we find respondents become more pessimistic about the immediate economic outlook and environmental concerns decline.

Importantly, the economic costs are not borne equally across regions, such that carbon pricing contributes to regional inequality. We find carbon-intensive regions that receive fewer ETS allowances for free suffer a larger contraction in GDP, employment and household income. As a consequence, the shift towards extremist parties is most pronounced in these regions.

Our findings carry important policy implications, especially in light of the scheduled ETS expansion to buildings and transportation sectors in 2027.Political support for climate policy is effectively threatened by the economic costs carbon pricing imposes on European regions. To address the uneven economic impacts of carbon pricing and limit political backlash, complementary measures such as direct rebates of tax revenues to households—ideally in a progressive manner—are necessary (see e.g. Fried et al., 2024). Further, public communication about the long-term benefits of carbon pricing can help restore broader acceptance of climate initiatives (see e.g. Schwarz et al., 2024).

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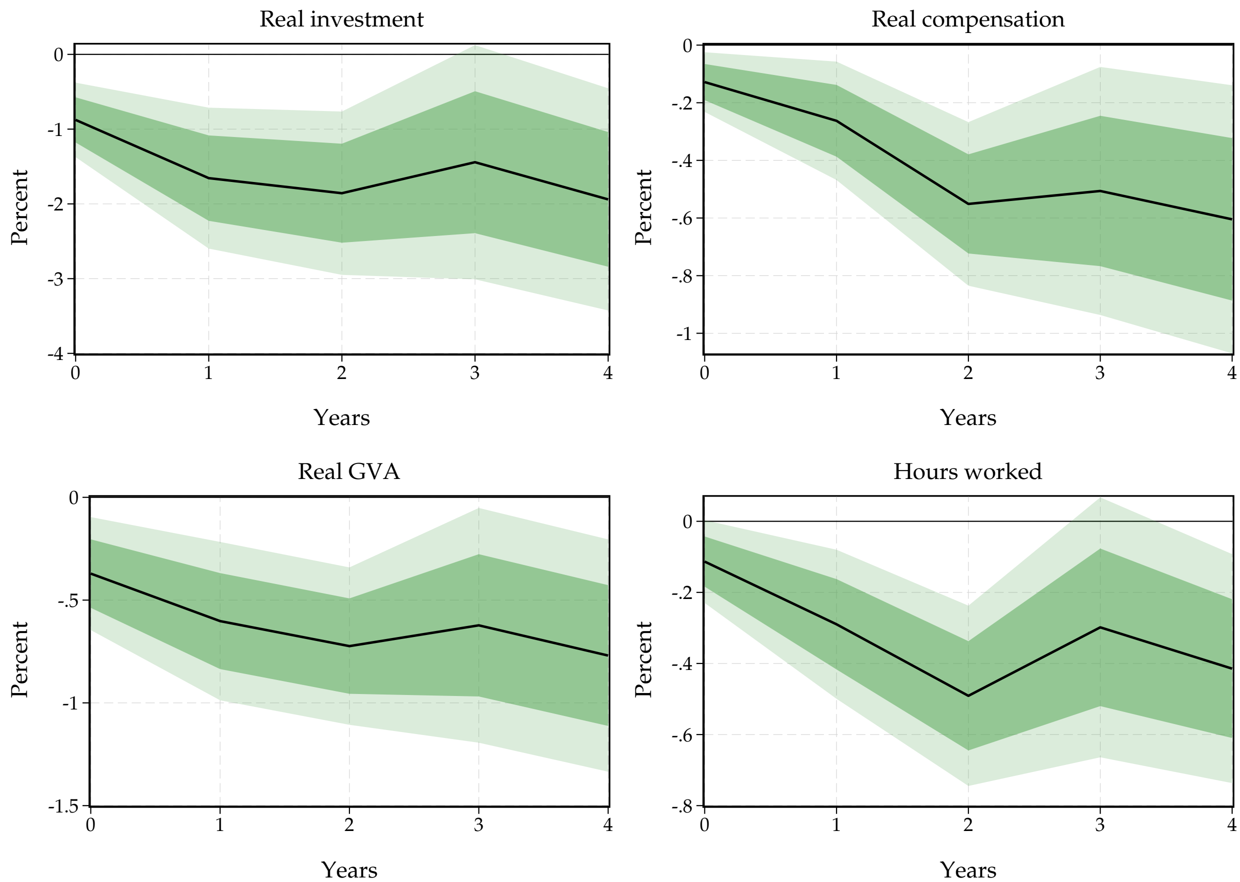
Appendix

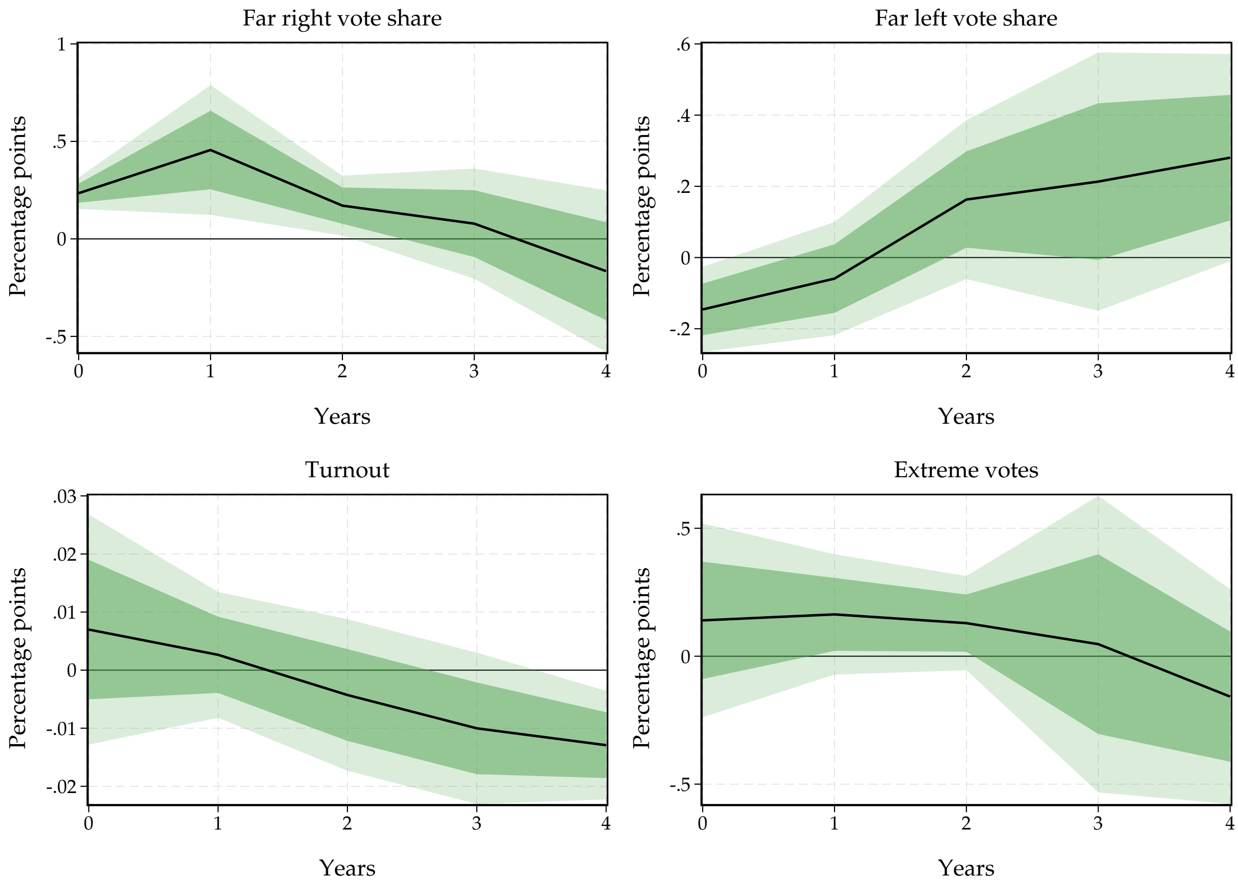
A Additional results, figures and tables

Figure A.1: Responses of additional economic variables



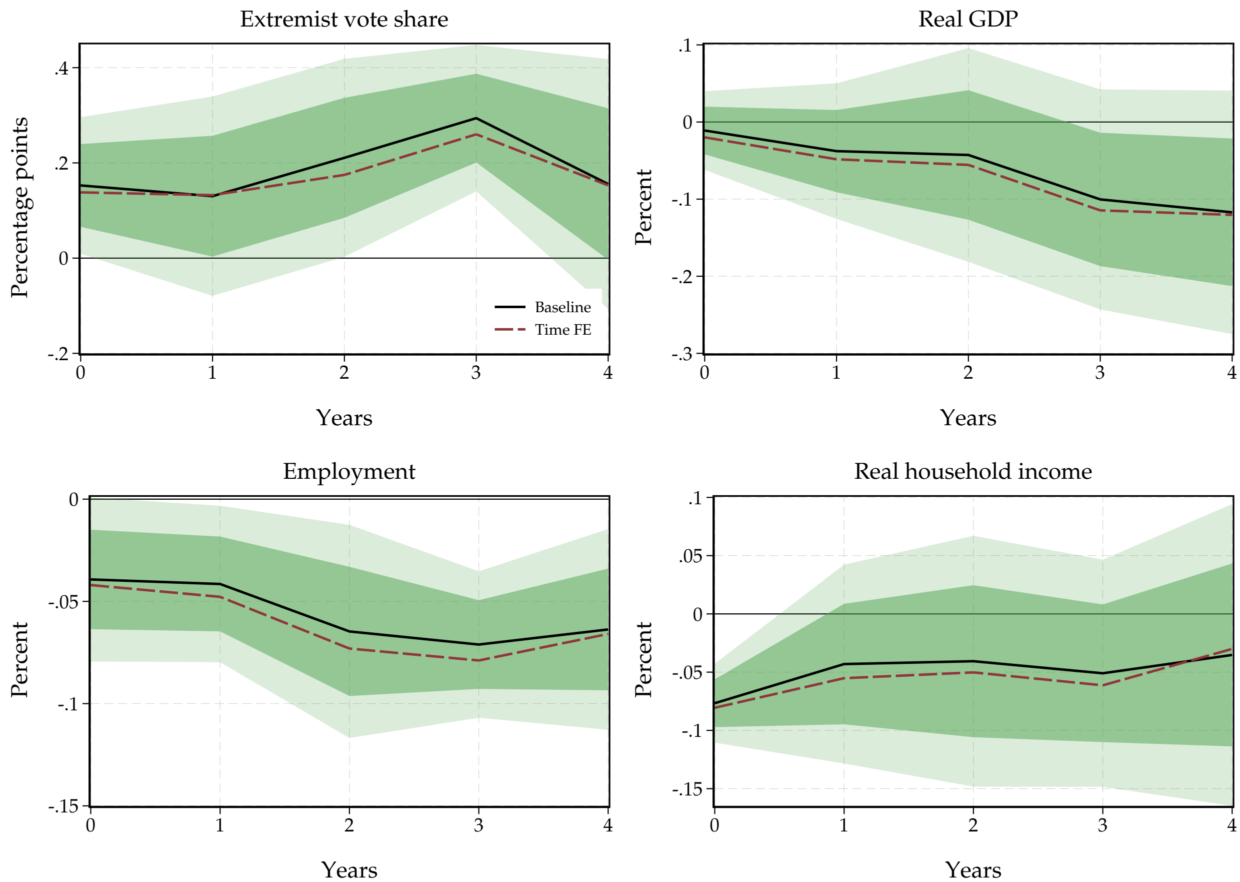
Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for different economic regional variables. The black lines are the point estimates and the shaded areas are the 90 and 68 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

Figure A.2: Responses of additional election outcome variables



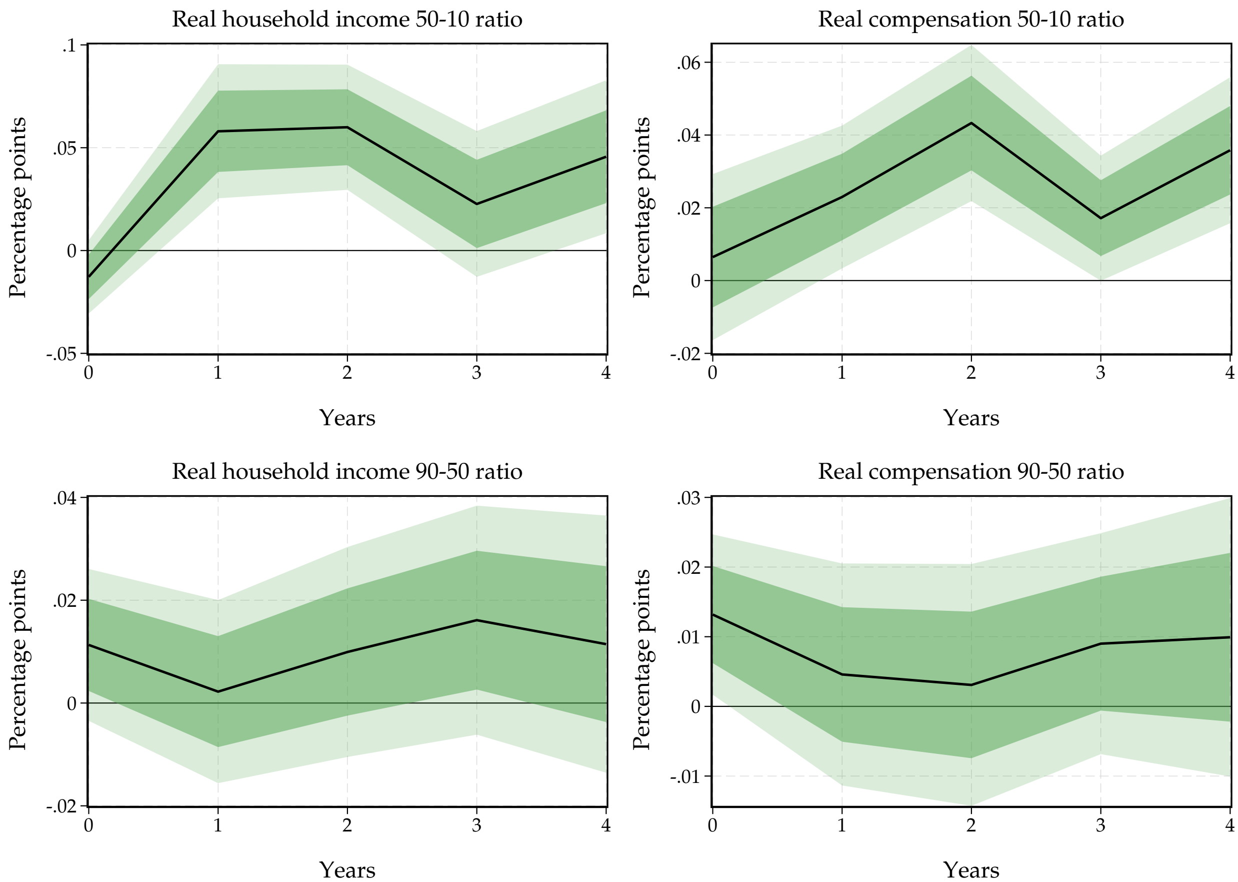
Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for different voting outcomes. The black lines are the point estimates and the shaded areas are the 90 and 68 percent confidence bands, based on Driscoll and Kraay (1998) standard errors. .

Figure A.3: Responses for a higher GHG intensity



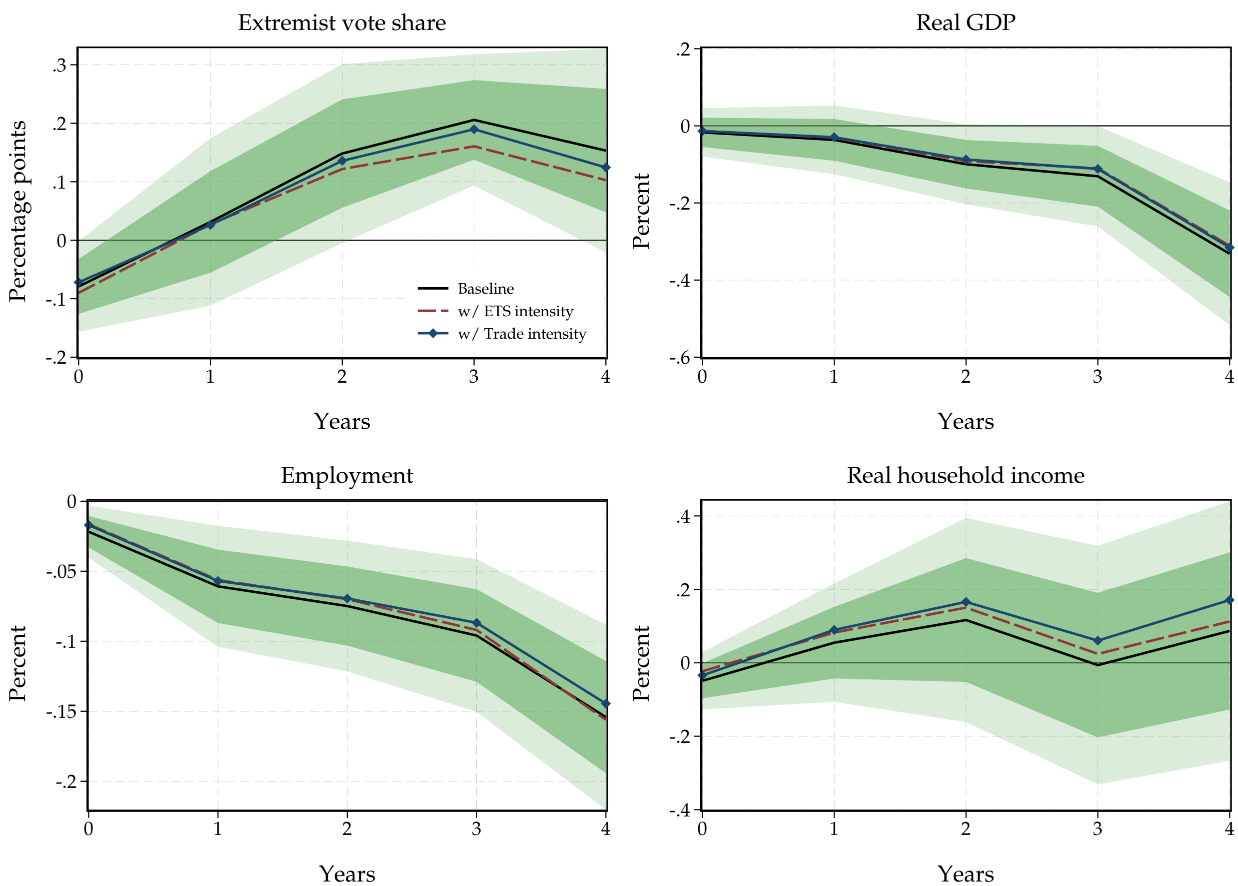
Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for the interaction coeffients of different economic and voting outcomes with region-level characteristics. The black lines are the point estimates and the shaded areas are the 90 and 68 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

Figure A.4: Responses of top- and bottom-end regional inequality



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for economic inequality. Inequality is measured as the cross-sectional difference across regions between the 90th and 50th (50th and 10th) percentiles of household income (left panel) and compensation of employees (right panel). Shaded areas denote 68 and 90 percent confidence bands, based on standard errors clustered at the region-level.

Figure A.5: Responses for a lower share of free allowances, conditional on the sectoral composition



Notes: The figure plots the response to a carbon policy shock, normalized to increase the Euro Area HICP energy by one percent on impact, for regions with a standard deviation lower share of free allowances to total ETS emissions. Shaded areas denote 68 and 90 percent confidence bands, based on Driscoll and Kraay (1998) standard errors.

B Sample and data

Figure B.1: Carbon policy shock series

Notes: This figure shows the series of carbon policy shocks, normalized to increase the Euro Area HICP energy by one percent on impact. For details, see Känzig (2023).

Table B.1: NUTS2 regions

Country	NUTS2 regions
Austria	AT11, AT12, AT13, AT21, AT22, AT31, AT32, AT33, AT34
Belgium	BE10, BE21, BE22, BE23, BE24, BE25, BE31, BE32, BE33, BE34, BE35
Czech Republic	CZ01, CZ02, CZ03, CZ04, CZ05, CZ06, CZ07, CZ08
Denmark	DK01, DK02, DK03, DK04, DK05
Estonia	EE00
Finland	FI19, FI1B, FI1C, FI1D, FI20
France	FR10, FRB0, FRC1, FRC2, FRD1, FRD2, FRE1, FRE2, FRF1, FRF2, FRF3, FRG0, FRH0, FRI1, FRI2, FRI3, FRJ1, FRJ2, FRK1, FRK2, FRL0, FRM0, FRY1, FRY2, FRY3, FRY4, FRY5, FRZZ
Germany	DE11, DE12, DE13, DE14, DE21, DE22, DE23, DE24, DE25, DE26, DE27, DE30, DE40, DE50, DE60, DE71, DE72, DE73, DE80, DE91, DE92, DE93, DE94, DEA1, DEA2, DEA3, DEA4, DEA5, DEB1, DEB2, DEB3, DEC0, DED2, DED4, DED5, DEE0, DEF0, DEG0
Greece	EL30, EL41, EL42, EL43, EL51, EL52, EL53, EL54, EL61, EL62, EL63, EL64, EL65
Hungary	HU11, HU12, HU21, HU22, HU23, HU31, HU32, HU33
Ireland	IE04, IE05, IE06
Italy	ITC1, ITC2, ITC3, ITC4, ITF1, ITF2, ITF3, ITF4, ITF5, ITF6, ITG1, ITG2, ITH1, ITH2, ITH3, ITH4, ITH5, ITI1, ITI2, ITI3, ITI4
Lithuania	LT01, LT02
Latvia	LV00
Netherlands	NL11, NL12, NL13, NL21, NL22, NL23, NL31, NL32, NL33, NL34, NL41, NL42
Norway	NO02, NO03, NO06, NO07, NO08, NO09, NO0A
Poland	PL21, PL22, PL41, PL42, PL43, PL51, PL52, PL61, PL62, PL63, PL71, PL72, PL81, PL82, PL84, PL91, PL92
Portugal	PT11, PT15, PT16, PT17, PT18, PT20, PT30
Spain	ES11, ES12, ES13, ES21, ES22, ES23, ES24, ES30, ES41, ES42, ES43, ES51, ES52, ES53, ES61, ES62, ES63, ES64, ES70
Sweden	SE11, SE12, SE21, SE22, SE23, SE31, SE32, SE33

Notes: The table reports the NUTS2 regions included in the analysis.

Table B.2: Parliamentary elections across countries, 2000–2019

Country	Parliamentary elections
Austria	2002, 2006, 2008, 2013, 2017, 2019
Belgium	2003, 2007, 2010, 2014, 2019
Czech Republic	2002, 2006, 2010, 2013, 2017
Denmark	2001, 2005, 2007, 2011, 2015, 2019
Estonia	2003, 2007, 2011, 2015, 2019
Finland	2003, 2007, 2011, 2015, 2019
France	2002, 2007, 2012, 2017
Germany	2002, 2005, 2008, 2013, 2017
Greece	2000, 2004, 2007, 2009, 2012, 2015, 2019
Hungary	2002, 2006, 2010, 2014, 2018
Ireland	2002, 2007, 2011, 2016
Italy	2001, 2006, 2008, 2013, 2018
Lithuania	2000, 2004, 2008, 2012, 2016
Latvia	2002, 2006, 2010, 2011, 2014, 2018
Netherlands	2002, 2003, 2006, 2010, 2012, 2017
Norway	2001, 2005, 2009, 2013, 2017
Poland	2001, 2005, 2007, 2011, 2015, 2019
Portugal	2002, 2005, 2009, 2011, 2015, 2019
Spain	2000, 2004, 2008, 2011, 2015, 2016, 2019
Sweden	2002, 2006, 2010, 2014, 2018

Notes: The table reports the parliamentary elections included in the analysis. In addition, we also use voting data from the European elections in 2004, 2009, 2014 and 2019.

Table B.3: Data description

Variable	Description	Source	Coverage
Panel A: Regional variables			
ETS emissions	Verified emissions	EU Transaction Log	2005–2019
ETS allowances	Freely allocated allowances	EU Transaction Log	2005–2019
GHG emissions	Total GHG emissions	ARDECO	2000–2019
Real GDP	Real gross domestic product at constant prices	ARDECO	2000–2019
Employment	Total Employment (workplace based, employed persons)	ARDECO	2000–2019
Real household income	Households net disposable income	ARDECO	2000–2019
Investment	Gross Fixed Capital Formation at constant prices	ARDECO	2000–2019
Compensation	Compensation of employees at constant prices	ARDECO	2000–2019
GVA	Real gross value added at constant prices	ARDECO	2000–2019
Hours worked	Hours Worked (employed persons)	ARDECO	2000–2019
Extremist vote share	Extremist party votes to valid votes	EU-NED	2000–2019
Eurosceptic vote share	Eurosceptic party votes to valid votes	EU-NED	2000–2019
Populist vote share	Populist party votes to valid votes	EU-NED	2000–2019
Fragmentation	$1-$ Herfindahl-Hirschman-Index	EU-NED	2000–2019
Far right vote share	Far-right party votes to valid votes	EU-NED	2000–2019
Far left vote share	Far-left party votes to valid votes	EU-NED	2000–2019
Turnout	Valid votes to total electorate	EU-NED	2000–2019
Extreme votes	Extremist party votes to total electorate	EU-NED	2000–2019
Environmental concern	Share of respondents considering environment a top issue	Eurobarometer	2004–2019
Economic expectations	Respondents' expectations over the next 12 months	Eurobarometer	2004–2019
Employment expectations	Respondents' expectations over the next 12 months	Eurobarometer	2004–2019
Financial expectations	Respondents' expectations over the next 12 months	Eurobarometer	2004–2019
Panel B: European and country-level variables			
Carbon policy shock		Känzig (2023)	2000–2019
HICP	HICP all items	Eurostat	2000–2019
Policy rate	Monetary policy interest rate	BIS	2000–2019
Stock market index	Market capitalization of nationally traded companies	OECD	2000–2019
Unemployment rate	ILO estimate	World Bank Group	2000–2019
Oil price	Brent crude spot price	FRED	2000–2019
Oil supply shock		Känzig (2021)	2000–2019

Table B.4: Descriptive statistics

Variable	Observations	Mean	Median	St. Dev.
Far right vote share	4546	9.47	6.59	9.75
Far left vote share	4546	4.87	1.68	7.66
Extremist vote share	4546	14.34	11.93	12.06
Populist vote share	4546	15.28	10.64	15.90
Eurosceptic vote share	4546	17.54	13.86	15.78
Turnout	4546	61.38	65.15	16.98
Fragmentation	4546	75.48	77.65	9.18
Extreme votes	4546	8.68	6.74	7.96
GHG emissions	3580	828.61	857.94	180.26
GVA	4508	1040.37	1054.21	105.78
GDP	4508	1051.87	1066.17	105.86
Investment	4508	890.08	903.27	105.68
Employment	4501	1321.06	1336.50	103.79
Hours worked	4488	1371.71	1381.97	91.78
Compensation	4488	978.98	995.30	106.67
Household income	3600	982.45	996.52	104.59
Environmental concern	2332	9.21	5.93	9.80
Economic expectations	2332	-12.59	-11.85	24.13
Financial expectations	2332	0.21	2.56	17.59
Employment expectations	2332	-14.54	-13.37	27.04
ETS intensity	3247	0.20	0.09	0.44
GHG intensity	4262	0.28	0.14	0.48
Share of free allowances	3198	0.94	0.94	0.90

Notes: The table reports the number of observations, the mean, median and standard deviation of the main variables used in the analysis.