I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 17596

Heated Debates on Heating: Investigating the Electoral Impact of Climate Policy

Dorothea Kistinger
Noah Kögel
Nicolas Koch
Matthias Kalkuhl

JANUARY 2025

I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 17596

Heated Debates on Heating: Investigating the Electoral Impact of Climate Policy

Dorothea Kistinger*
Potsdam-Institute for Climate Impact Research and Mercator Research Institute on Global Commons and Climate Change

Noah Kögel*
Potsdam-Institute for Climate Impact Research, Mercator Research Institute on Global Commons and Climate Change and University of Potsdam and University of Potsdam

Nicolas Koch
Potsdam-Institute for Climate Impact Research, Mercator Research Institute on Global Commons and Climate Change and IZA

Matthias Kalkuhl
Potsdam-Institute for Climate Impact Research, Mercator Research Institute on Global Commons and University of Potsdam

JANUARY 2025

*These authors contributed equally to this work

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Heated Debates on Heating: Investigating the Electoral Impact of Climate Policy

The transition to a renewable heating system poses extraordinary policy challenges to societies in Europe and beyond. Many buildings are heated decentrally, which makes broad public acceptance essential. As governments may be held responsible for perceived policy impacts on individuals, analyzing their effects on electoral support is of high relevance. This study examines the electoral impact of an amendment to the German Buildings Energy Act which proposed a phase-out of fossil-fueled heating systems. We combine municipal election data with granular socioeconomic and building stock data and apply difference-in-differences regressions to identify treatment effects of the policy amendment on electoral support. We find that material costs of the policy, proxied by the characteristics of the local building stock, led to relative gains for the right-wing populist party, further increasing in low-income areas. These findings highlight the importance of holistic climate policy approaches that account for heterogeneous burdens and counteract a political backlash through compensation policies.

JEL Classification: C21, D72, Q48, Q58

Keywords: climate policy, public acceptance, voting, building sector, difference-in-differences

Corresponding author:
Dorothea Kistinger
Potsdam Institute for Climate Impact Research
PO Box 60 12 03
14412 Potsdam
Germany

E-mail: dorothea.kistinger@pik-potsdam.de

1 Introduction

The European Green Deal aims at achieving climate neutrality across the EU by 2050, leaving the member states 25 years to decarbonize their economies. Space heating of private households contributes significantly to greenhouse gas emissions as only 24.9% of the energy used for heating and cooling across the EU originates from renewable energy sources. In Germany, this share is even lower, with renewable energy accounting for 17.5% (Eurostat 2024). Given the dominance of fossil-based, mostly decentralized heating systems, and Germany's even more ambitious target of climate neutrality by 2045, the country constitutes an exemplifying use case for the transformation challenges that all states of the EU and beyond face.

The energy price crisis emphasised Germany's dependency on fossil fuel imports, particularly from Russia, and has underscored the urgent need to accelerate the decarbonization of the building sector. In response, the German federal government, formed by the social democratic (SPD), the green (Bündnis 90/Die Grünen) and the liberal party (FDP), aimed at advancing the transition to carbon-neutral space heating through the amendment to the German Building Energy Act[1] (in the following referred to as *GEG* for simplicity).

A preliminary proposal of the GEG was leaked to the media in Germany prior to the cabinet's approval. It revealed ambitious regulations for heating systems in residential buildings. According to the draft[2], all heating systems installed from January 2024 must operate using at least 65% renewable energy. This would have banned the new installation of conventional gas heating systems - the dominant technology to date. With a maximum allowed service life of 30 years for heating systems (already established by prior legislation; §72 of GEG) and assuming an average lifespan of 20 years for fossil-based heating systems, many households would have needed to transition to renewable heating systems earlier. Such transitions may come with significant financial implications due to high upfront costs for renewable heating systems such as heat pumps as well as potential additional heterogeneous expenses for retrofit measures (see section 2.3). To mitigate these costs, the government promised subsidies. Yet, the scope of the subsidies and the target groups were initially unclear.

Given the ambition and uncertainty of the GEG proposed by the draft, intense, polarised media coverage followed the leak which fueled an emotional public debate. Reporting on the ban of fossil fuel heating systems in the near future and speculations on potentially high costs for private households dominated the discourse[3]. Throughout the following months, the government adjusted the draft of the GEG multiple times. In September 2023, the Bundestag accepted the final law including a substantially weakened version of the 65% renewable energy rule and subsidy schemes for transition costs as outlined in section 2.2. However, at that point in time, the debate about the preliminary GEG proposal had already shaped the public discourse and political sphere. The ambitious nature of the initial policy draft and the intense public and media discourse it triggered

[1]see https://www.gesetze-im-internet.de/geg/

[2]On February 28, 2023, a draft of the GEG was leaked to media. Since to our knowledge the exact version of the leaked draft has not been officially confirmed, we refer to the version dated March 7, 2023 (see `https://table.media/wp-content/uploads/2023/03/GEG-070323.pdf`).

[3]A review of the political developments and debates can be found in ZEIT Online and Politico.

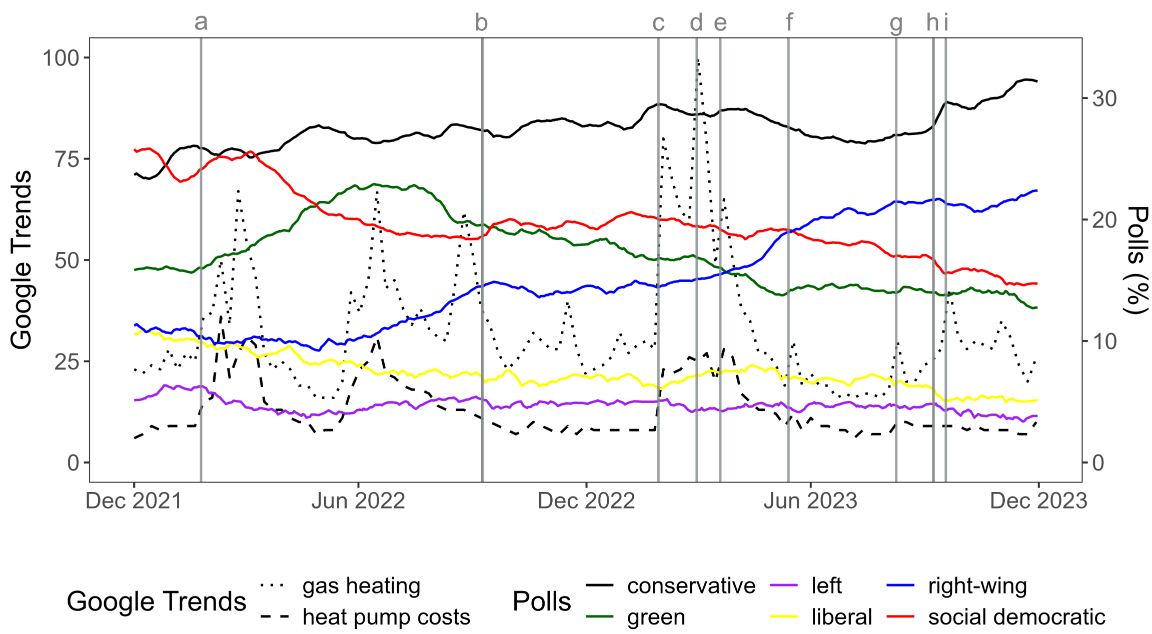


Figure 1: Stated party preferences and GEG relevant Google search requests over time

Notes: The figure shows stated preferences for the most relevant German parties (colors) and normalized Google Trends search requests (line types) between Jan 2022 and Dec 2023. Letters indicate selected events: a) Russia's invasion of Ukraine, b) state election in Lower Saxony, c) public leak of draft to media, d) agreement by government, e) draft by cabinet, f) complementary paper, g) Bundestag passes amendment, h) state elections in Bavaria and Hesse, and i) media reporting on disagreement about subsidies. The original search terms are "Gasheizung" (gas heating) and "Wärmepumpe Kosten" (heat pump costs). (Sources: Google Trends, Poll of Polls).

make the potential impact of the GEG on electoral support a topic of major interest. Given impacts on the electorate, this may also imply long-term disruptions in the public acceptance of ambitious climate policy.

With the formation of the federal government coalition in late 2021, the political landscape in Germany underwent significant changes. The political support started to decline for all three governing parties at some point within the first eight months of 2022, while the right-wing party, and to a lesser extent the conservatives, saw an increase in their support (see Figure 1). Several societal and political factors may have contributed to this development. One possible factor is the energy price crisis in 2022, and another one the GEG and the accompanying political and public discourse as outlined above. In Figure 1, Google search requests indicate that the interest in search items related to space heating provision ("gas heating" and "costs heat pump") correlate with the course of voters' preferences. In particular, during the peak of the energy price crisis (late summer/autumn 2022) or the leak of the first draft, interest in these search items was comparably high and at the same time stated public support for the right-wing party increased. This observation suggests that the context of the GEG presents an interesting case study for analyzing how climate policy influences voting behavior and electoral support.

The academic literature has only yet started to examine impacts on elections following the implementation of climate policies. For instance, studies suggest that voters punish the incumbent government for the expansion of wind energy projects (Stokes 2016; Otteni and Weisskircher 2022), the phase-out of coal power plants (Egli et al. 2020), or the increase of energy taxes (Voeten 2024).

However, the compensation of citizens for adverse burdens due to climate policy may counteract political costs for responsible parties (Colantone et al. 2023).

In this paper, we investigate the impact of material costs implied by the GEG on the results of two state elections in October 2023. Both states (Bavaria and Hesse) and their shifts in voting preferences are relevant to the German society as they make up 23% of the German population and comprise 23% of dwellings. We use election outcome data at the municipal level and granular census data on the settlement structure of German households. The $100m \times 100m$-gridded census data allows us to determine the degree by which citizens in a municipality are affected by the policy change based on the prevailing building structure. With this measure of the treatment intensity, we implement a difference-in-differences approach for municipalities affected the most and the least by the GEG, separately, and compare both results. To isolate the effect of the GEG and minimize confounding factors potentially induced by other crises and policies during the legislative period from 2018 to 2023, we compare election results from Bavaria and Hesse to those from Lower Saxony where the legislative cycle is shifted by one year earlier. This approach allows for an identification of a possibly causal impact of the GEG on voters' decisions at the ballot.

Our results suggest that the right-wing party benefited from the policy change among voters in most affected municipalities compared to the counterfactual. The relative increase is particularly pronounced in municipalities with lower economic status (i.e., high unemployment and low average income), thereby stressing the importance of accompanying compensation policies. Given the urgency of climate policy actions to mitigate climate change, our results stress the need for holistic climate policy approaches to shape instead of obstruct the transition process.

2 Institutional background and related literature

2.1 Related literature

Public acceptance for climate policies has been subject of many studies to date. Typically, survey experiments are conducted to elicit public acceptance rates for certain policies like carbon pricing or subsidy schemes. In meta-analyses, the perceived distributional fairness, the effectiveness of policies in mitigating climate change and individuals' concerns about climate change were found to be strong predictors for public opinion (Bergquist et al. 2022). As text book economic theory finds pricing the externality to be most cost-efficient, researchers have also investigated whether different types of revenue recycling options can spur public acceptance for carbon pricing. Survey-based evidence has identified green spending (e.g. subsidizing wind energy production) as acceptance-enhancing while other schemes like (targeted) cash transfers or tax cuts fail to significantly increase support (Valencia et al. 2023; Barrez 2024).

Despite the growing body of research on public opinion of environmental policy and related determinants, only few studies focus on electoral support. Typically, scholars investigate impacts on voting for and attitudes towards green parties and/or right-wing (populist) parties as main opponent of stringent environmental policies. To date, several determinants have been identified, such as natural disasters (Hazlett and Mildenberger 2020; Hilbig and Riaz 2024; Hoffmann et al.

2022), economic determinants (Kahn and Kotchen 2011; Bez et al. 2023), and technology diffusion (Comin and Rode 2023). Besides, a small strand of literature has assessed the effect of climate policies on electoral support.

Voeten (2024) analyzes the implications of a natural gas tax reform on stated party preferences in the Netherlands. The Dutch government raised gas price taxes incrementally starting in 2016 to fund subsidies for the installation of photovoltaic systems by residential homeowners. The authors exploit differences in Dutch rental contracts determining how elastically rent payments react to energy price fluctuations. Tenants who are exposed to price increases are 5-6 percentage points more likely to state that they would vote for the radical right. In an extended analysis, these estimates are verified for energy poor individuals that also include homeowners.

Similar to the negative income effects imposed by the gas tax, the ban of car use in city centers reduces individuals' wealth by limiting the utility of their vehicles. Colantone et al. (2023) explore these economic implications in their case study of Milan, focusing on individuals' stated voting decision. Their analysis reveals that owners of banned cars were 13.5 percentage points more likely to vote for a populist right-wing party. This vote shifting was primarily driven by the perceived unfairness of adverse economic implications of the policy rather than a change in environmental attitudes. Thus, when voters were compensated for their income loss, their voting behavior also remained unchanged and did not shift towards right-wing parties.

In addition, the phase-out of coal-based power production is associated with political backlash as reported by Egli et al. (2020). They analyze the local electoral responses at presidential elections following the closure of coal mines. If a region's labor market structure relied strongly on the coal mining industry, each decrease of 100 jobs were associated with an increase of 1.2 to 1.5 percentage points in the Republican vote share. The average gain in the Republican vote share was five times larger than the actual number of persons who lost their job. Shifting in voters' preferences was further identified when citizens were exposed to wind energy projects in their neighbourhood (Stokes 2016; Otteni and Weisskircher 2022).

Overall, there is first evidence for considerable political costs of environmental and climate policies if they imply consequences in habits and financial burden. A perceived policy effectiveness and potential compensation measures for citizens have shown to be able to counteract political costs though.

2.2 Legislation of the GEG and its public debate

In light of the energy price crisis 2022 which revealed energy dependency from Russia, the federal government in Germany revised the GEG implementing a renewable energy guideline for residential space heating already by 2024 and accordingly one year earlier than specified in the coalition treaty. Prior to the cabinet's approval, the draft was leaked to the media in Germany in February 2023 as outlined in section 1.

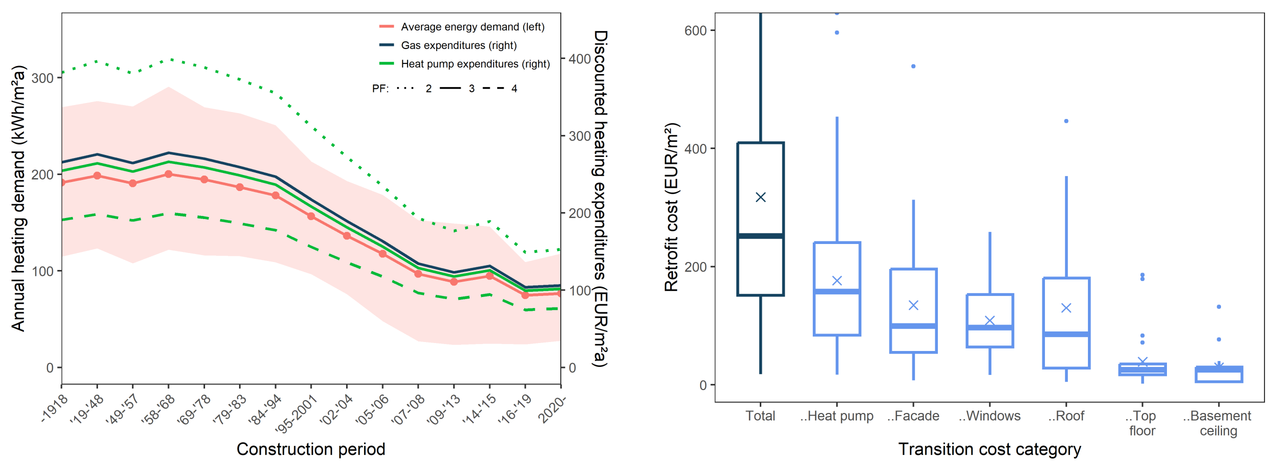
The central element of the GEG was the requirement that newly installed residential heating systems must be operated with at least 65% of renewable energy (GEG). With regard to the vast majority of decentralized fossil-based heating systems in Germany and the short notice until January

1st as well as the uncertainty about which technologies were considered as renewable heating systems, the GEG was perceived and had been discussed in the media as ban of gas and oil heating systems. Accordingly, an emotional and public debate unfolded that centered around the question whether households could afford the transition to a renewable heating system. This was further promoted by the lack of subsidy schemes addressing low-income households in the leaked version of the GEG revision.

The GEG passed the Bundestag on September 8th, 2023 in a version that had been adjusted in three ways compared to the leaked draft[4]: First, the GEG was complemented by an extended subsidy scheme that rewards early adopters and compensates low-income households with higher subsidy rates. Second, the scope of heating systems considered as renewable by the GEG was expanded[5]. Third and most importantly, the guideline is linked to the existence of a local planning for space heating provision at the municipality level. The latter implements transition periods for the 65%-rule such that a household may decide on their heating system under full information about future space heating provision, like district heating or biogas.

To fulfill the 65%-rule in the medium-run, households may need to implement retrofit measures for their residential property cost-efficiently. This potentially causes heterogeneous investment necessities and costs for households which are sketched in the following.

2.3 Stylized implications of the GEG policy change



(a) Heating demand

(b) Transitions costs

Figure 2: Stylized figures on the heterogeneous transition to carbon-neutral space heating

Notes: The left panel shows the average heating demand by construction period and its respective variation (1st-4th quintile, red). Blue and green lines depict the corresponding discounted sum of heating expenditures per m² for gas and heat pump electricity (20 years, $r = 2\%$, 0.08$\frac{EUR}{kWh}$ gas, 0.23$\frac{EUR}{kWh}$ electricity, 2023-prices). Heat pump electricity expenditures are further evaluated for different efficiency levels ($\text{PF} \in \{2, 3, 4\}$). The right panel compares reported costs of different retrofit measures per m² when households switch from a fossil-based heating to a heat pump ($n = 110$, 2023-prices, Source: own depiction based on Frondel et al. (2023)).

Heating demand in the German building sector exhibits a vast heterogeneity and to date mainly

[4]Table 1 in the appendix provides an overview over the legislative process.

[5]According to the accepted GEG, heating systems fulfill the 65%-rule if they are certified by an expert on-site. Consequently, no specific technologies, such as hydrogen, solar thermal, or biomass, are ruled out a priori.

relies on fossil energy sources. In 2022, 75% of dwellings were heated by decentralized fossil fuel-based heating systems (gas, oil, coal) demonstrating the effort necessary to decarbonize the building stock until 2045 (DESTATIS 2024b). Meanwhile, the electrification of space heating by using heat pumps is seen as promising strategy for achieving carbon neutrality cost-efficiently. However, the performance of a heat pump is a priori uncertain and negatively influenced by a low building energy efficiency: A low heat pump efficiency can increase the utility costs compared to a gas heating. For example, the average heating demand of houses built before 1984 is about $190\frac{kWh}{m^2a}$ (see Figure 2a) and at the same time this building age cohort represents a large share (about 70%) of the current building stock (DESTATIS 2024b). Over the lifetime of a heating system which we approximate with 20 years, this implies average discounted heating expenditures of roughly $260\frac{EUR}{m^2}$ for a gas heating.

The electricity expenditures for a heat pump however are to a great extent influenced by its energy efficiency which is quantified by the annual performance factor (PF). This factor mostly varies between 2 and 4 (Bayer and Pruckner 2023; Gibb et al. 2023)[6]. Aside from differences in installation quality, the house-specific flow temperature is decisive for the efficiency of the heat pump. The higher the temperature difference between the flow and the outdoor temperature, the lower the efficiency. In less efficient buildings—where heat loss through the building envelope is higher—a higher flow temperature is necessary to heat the rooms adequately which reduces the heat pump efficiency. Applying a medium heat pump efficiency (PF$=3$) to the average heating demand in buildings built prior to 1984 leads to discounted heating expenditures of approx. $250\frac{EUR}{m^2a}$ which implies only a marginal cost advantage to a gas heating. However, PFs can vary widely, with the potential for both higher and lower values. For instance, using PF$\in[2,4]$ as plausible range for the heat pump efficiency scores results in discounted expenditures between $185-370\frac{EUR}{m^2a}$ (see Figure 2a). In an average German single-family house with a living area of 130m^2 (DESTATIS 2024a), a well-performing heat pump (PF$=4$) may achieve savings of about 9,750 EUR over its lifetime compared to a gas heating. However, heating demand shows a high degree of variation and higher demand may be associated with a lower hypothetical PF score. Individual expenditure burdens may thus be substantial when switching to a heat pump without increasing the energy efficiency.

In order to run heat pumps efficiently, i.e., setting the flow temperature as low as possible, additional retrofit measures (e.g. wall insulation, replacement of radiators) may often be necessary. In total, the individual transition is likely to be associated with high and heterogeneous up-front investment cost ranging between 150 to 410 $\frac{EUR}{m^2}$ (1st to 3rd quartile, see Figure 2b). For the exemplary house above, this entails total household expenditures between 20,000 and 53,000 EUR. However, country-wide and large-scale assessments of retrofit costs and associated utility costs are lacking which fosters household's uncertainty and concern about the optimal technology choice[7].

[6] A performance factor (PF) of 3 implies that the heat pump transforms $1kWh$ of electricity into $3kWh$ of usable heat energy for the household.

[7] For the illustrations in Figure 2, we are using a subset from a novel and unique panel survey on household and building characteristics which comprises about 110 observations for households that switched to heat pumps since 2000 (Frondel et al. 2023). Acknowledging the high degree of heterogeneity in the building sector, the collection of richer data sets is necessary to pin down individual transition necessity and associated costs precisely.

3 Data and Econometric Specification

3.1 Data

We investigate the relationship between the GEG and the results of the Hessian and Bavarian state elections in 2023. Both states and their shifts in voting preferences are relevant to the German society as they make up 23% of the German population and comprise 23% of dwellings (DESTATIS 2024b). For this purpose, we collect three types of raw data: First, election results at the municipal level as dependent variables, second, gridded data on housing and settlement structure for defining treated municipalities, and third, socio-economic covariates at the municipal level to control for confounding effects.

Election Results We consider results of the last two state elections in Bavaria, Hesse and Lower Saxony. The elections in Bavaria and Hesse happened in 2018 and 2023 whereas the ones in Lower Saxony took place in 2017 and 2022. All elections were conducted in October of the respective year. The energy price increases following the Russian invasion of the Ukraine in February 2022 affected similar groups of the population as the GEG did in 2023. In both cases, owners of older energy-inefficient buildings with fossil fuel-based heating systems are affected most. Accordingly, we use the election results of Lower Saxony that voted in autumn 2022—after energy prices peaked but before the GEG legislation—to exclude confounding effects of the energy price crisis (and also the effects of further confounding impacts exclusively relevant to the considered group in the previous years). We thereby isolate the impact of the GEG on voters' preferences. Data on election results for all three states at the municipal level are provided by the respective statistical regional authorities (Bayerisches Landesamt für Statistik 2023; Landesamt für Statistik Niedersachsen 2024; Hessisches Statistisches Landesamt 2023).

Housing and Settlement Structure To define our treatment and control group, we make use of gridded data capturing the number of inhabitants, the ownership structure, binned construction years and the shares of energy sources used for space heating. These data mostly stem from the 2011 German census except for the energy source data, for which we have more recent data from 2022 (DESTATIS 2018; DESTATIS 2024b).

Figure 3 visualizes the spatial granularity of the census data set for the area in and around the city of Augsburg. For defining the local degree of being affected, we make use of the ownership ratio, the ratio of buildings built prior to 1979, and the ratio of heating systems using fossil fuel. Within our raw data set, these indicators are provided at the 100m$\times$100m grid level. The granularity reveals the correlation of local settlement characteristics. For example, ownership ratios are low in the city center of Augsburg but high in the neighbouring, more rural municipalities. In contrast, the share of pre-1979 buildings exhibits more variation but is on average higher in the city center because of the older building stock. Lastly, the ratio of fossil energy sources exemplifies the German dependency on fossil decentralized heating systems as the average magnitude is comparably high. Local clusters in the city center with lower shares of fossil heating stem from district heating provision. Buildings

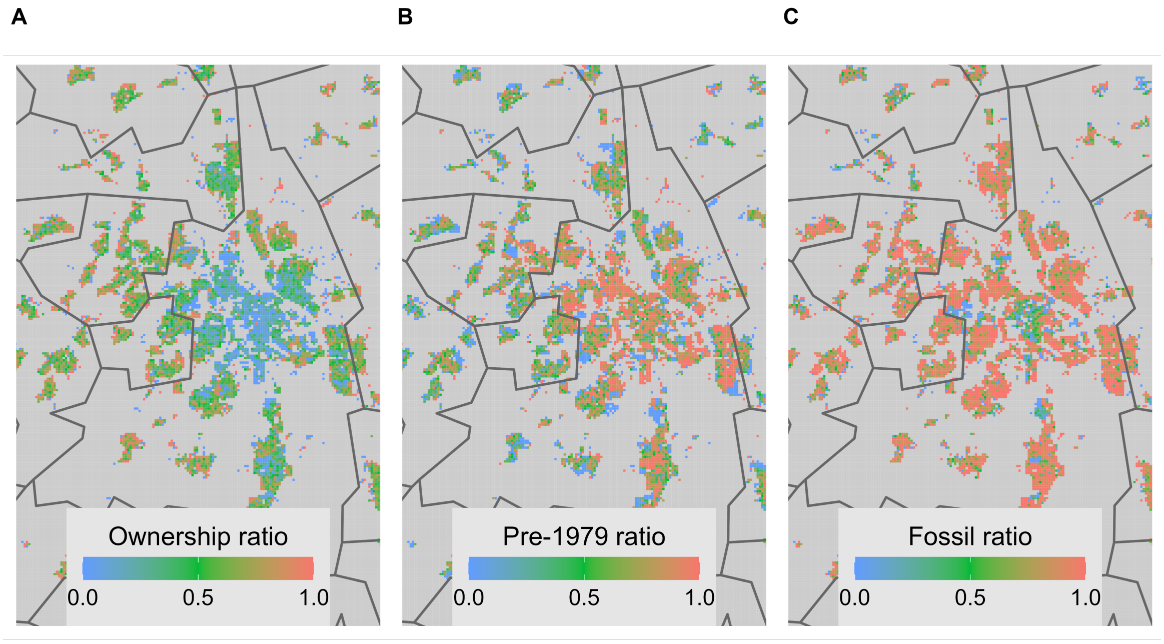


Figure 3: Gridded settlement structure for Augsburg and neighboring municipalities, Bavaria.

Notes: Ratios are computed as share of apartments fulfilling a given criterion from the total number of apartments in a grid cell. We use data on the ownership status (A), the construction year (B), and the energy source for space heating (C). The three panels show the city of Augsburg and its neighboring municipalities.

connected to district heating are not affected by the 65%-rule of the GEG. In the future, district heating could in principle be operated with renewable technologies (larger centralized heat pumps) without much involvement of and potentially lower transition costs (economies of scale) for the households.

Covariates The worsening of economic conditions has been shown to increase support for the far-right (Hernández and Kriesi 2016; Ahlquist et al. 2020). Thus, we use data on the annual municipal tax revenues, unemployment rate and per-capita income[8] to control for adverse local economic developments. In addition, we use data on the average age of citizens and population density to distinguish between urban and rural areas (Franz et al. 2024). Previous panel data studies have shown that immigration significantly influences the vote share of far-right parties. In line with those studies, we included the share of non-Germans (Dustmann et al. 2019; Edo et al. 2019; Kellermann and Winter 2022; Franz et al. 2024)[9]. Data on control variables stem from two statistical agencies that include Bundesinstitut für Bau-, Stadt- und Raumforschung (2024) (income, municipal tax revenues, average age), and Statistische Ämter des Bundes und der Länder (2024) (unemployment, population, non-German citizens)[10].

[8] mesured by the per capita spending capacity

[9] Data on the number of persons without German ID at the municipality level were not available for Bavaria which is why we deduced it from election data. As citizens need a German ID for being eligible to vote, we subtracted the number of eligible voters in a given election year from the number of persons above the legal age to come up with a proxy on the number of non-German citizens in a municipality.

[10] The most recent available data on covariates do not always match the second year of elections (2022, or 2023 respectively). In those cases, we use the latest available year of observation which is 2021 (income, tax revenues),

3.2 Municipal treatment score

We construct a municipal treatment score to assess the degree by which citizens in a municipality are affected by the policy change based on the prevailing building structure. The census data is provided at a $100m \times 100m$-grid which enables us to identify areas where large shares of the population are affected at a granular level. We first identify affected grid cells and secondly scale them up at the municipal level using population weights.

Applying the preceding stylized facts about transitioning the buildings sector to carbon neutrality and the scope of the GEG, we argue that citizens with the following criteria are potentially particularly affected by the policy change:

1. Owner-occupiers (o): Those citizens living in their self-owned dwellings are in charge of their heating system and face the direct costs of installing a new system. At some point, the law forces them to switch to a system that (in parts) uses renewable energies to heat their home (see subsection 2.2).

2. Building age (a): Those citizens living in old buildings (before 1978 when the first energy efficiency regulation became effective) are more likely to be affected by the GEG. As we argued in subsection 2.3, heating demand is higher and associated retrofit measures imposing additional costs are more likely when switching to a heat pump in older buildings.

3. Fossil energy source (e): Those citizens currently living and owning buildings heated decentralized using fossil energy sources (gas, oil, coal) are forced to switch to renewable energy sources at some point by the GEG (see subsection 2.2).

Based on the reasoning above we apply the following routine to our gridded settlement structure data: A grid cell c is affected if a large share of the population living in the cell satisfies each of the conditions listed above. Let k be any of these conditions, i.e., $k \in \{o, a, e\}$, and s_c be the state cell c lies in. For each condition k, we calculate the ratio $r_{k,c}$ as the share of the number of dwellings satisfying the condition from all dwellings in cell c. We then compare these cell-specific ratios to the state-wide threshold values η_{k,s_c}. We set the thresholds η_{k,s_c} to the 75$^{\text{th}}$ percentile value of the state-wide distribution of cell ratios $r_{k,\cdot}$ for all conditions. Mathematically, the following function indicates whether a cell is affected:

$$I(c) = I_o(c) \times I_a(c) \times I_e(c), \text{ where} \tag{1}$$

$$I_k(c) = \begin{cases} 1 & \text{if } r_{k,c} \geq \eta_{k,s_c} \\ 0 & \text{otherwise} \end{cases} \quad \text{for all } k \in \{o, a, e\}. \tag{2}$$

In robustness analyses, we analyze the sensitivity of the results on our choice of η_{k,s_c}. Based on the indicator function at the grid-level, we derive a treatment score T_m at the municipal level. We compute the weighted sum of the indicator functions of the set C_m of all cells which lie inside

and 2022 (unemployment, age, population, non-German citizens).

municipality m. Using the share κ_c of the population of municipality m that lives inside cell c as a weight, we acknowledge that cells with higher population are more influential on the election outcome of a municipality. The treatment score reads as follows:

$$T_m = \sum_{c \in C_m} \kappa_c I(c). \tag{3}$$

The treatment score provides a continuous measure of the extent to which municipalities are affected by the GEG. This allows us to identify the most and least affected municipalities. Figure 4 illustrates the distribution of the treatment score. In all three states, the score is distributed around a median value of 0.013. This value could be interpreted that on average 1.3% of the population in a municipality is strongly affected by the GEG according to our treatment definition (panel B). The score tends to be higher at the countryside whereas bigger cities like Munich, Frankfurt, Hanover, or Augsburg show small values. Lower ownership ratios in cities drive these results (see Figure 3). We further identify differences between the three states (panel A). Finally, higher treatment score values are associated with higher gains for right-wing but higher losses for the federal government parties between the two elections in Hesse and Bavaria (panel C).

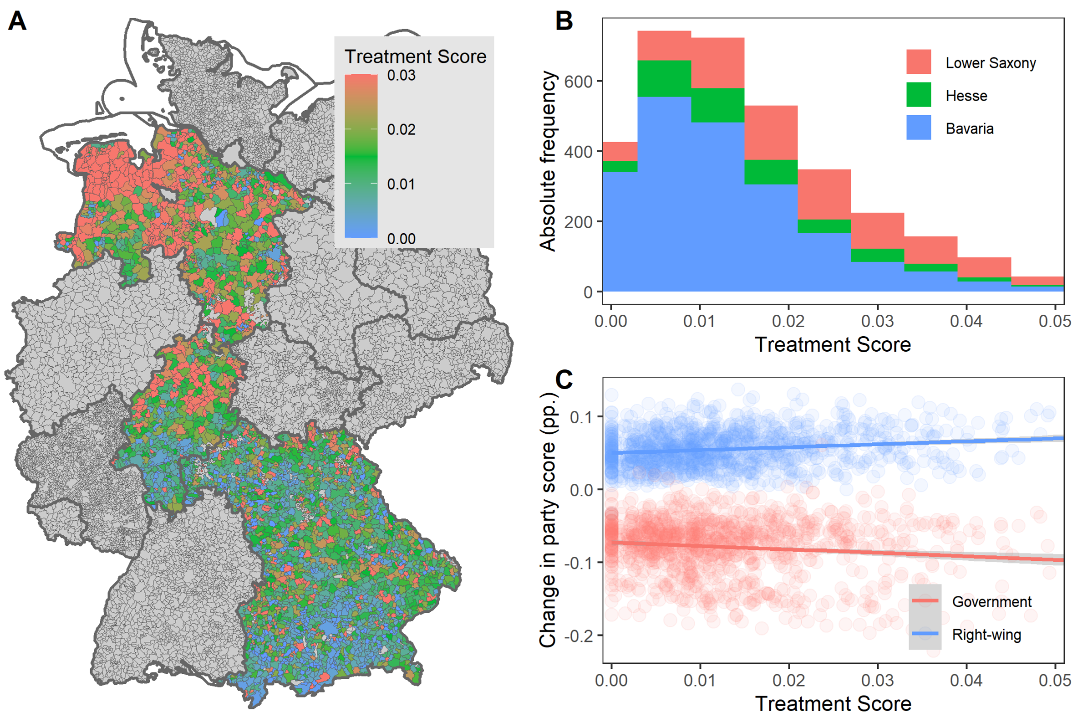


Figure 4: Distribution of treatment score

Notes: Panel A depicts the spatial distribution and panel B the distribution of the treatment score in Lower Saxony, Hesse and Bavaria. Panel C shows the change in the party score between the two elections in Bavaria and Hesse for different treatment scores.

3.3 Econometric Design and Identification

Our goal is to isolate the effect of the GEG—in terms of implied material costs—on the state elections. The treatment score defined above allows us to identify the Bavarian and Hessian municipalities which were affected the most. However, additional crises and policies during the legislative period from 2018 to 2023, such as the energy price crisis in spring and summer 2022 and the land tax reform, may have also influenced this group. To minimize these non-measurable confounding factors and focus on the period relevant to the GEG, we compare election results from Bavaria and Hesse to those from Lower Saxony. The last state election in Lower Saxony took place in October 2022, i.e., the legislative cycle is shifted by one year earlier compared to Bavaria and Hesse. We argue that the GEG and its public debate were the primary events particularly impacting owner-occupiers in old and fossil-based heated houses between the state elections in Lower Saxony and Bavaria and Hesse. Our regression therefore compares election results of most affected municipalities in Bavaria and Hesse to counterfactual municipalities in Lower Saxony. We also conduct a similar placebo analysis for the least affected municipalities according to the treatment score to validate our treatment definition and check for additional confounding effects. The difference between the treatment effect of the most and the least affected municipalities approximates the impact of the GEG on the elections.

We consider a municipality as most affected if its treatment score T_m value exceeds a predefined threshold value t_s and as least affected if the treatment score is smaller than a complementary threshold value $\tilde{t}_s$. The baseline specification uses the 75$^{\text{th}}$ percentile of the state s specific treatment score distribution as the threshold value t_s and the 25$^{\text{th}}$ for the threshold value $\tilde{t}_s$. Accordingly, we create both data sets of least and most affected municipalities by selecting those municipalities whose treatment scores are located at the equally-sized tails of the distribution[11]. To summarize, the thresholds produce two data sets: the first containing election data from Bavaria, Hesse and Lower Saxony for least affected municipalities ($T_m \leq \tilde{t}_s$) and the second for most affected municipalities ($T_m \geq t_s$).

In what follows, we apply a 2×2 difference-in-differences approach in a two-way fixed effects setting to the sets of most and least affected municipalities separately. We employ the following specification for each of the sets of municipalities (i.e. most and least treated) separately:

$$E_{m,y} = \alpha_m + \beta_s y + \gamma D_{m,y} + \delta X_{m,y} + \varepsilon_{m,y} \tag{4}$$

The municipality-specific dummy variable $D_{m,y}$ indicates if a municipality was actually treated by the policy change which means that we consider an election in Bavaria or Hesse in 2023, i.e.,

$$D_{m,y} = \begin{cases} 1 & \text{if } s = \{\text{BY,HE}\} \wedge y = 2023 \\ 0 & \text{otherwise.} \end{cases} \tag{5}$$

Equation 4 regresses the logarithmized party share $E_{m,y}$ for municipality m and year y on our constructed treatment dummy variable[12]. Our treatment effect γ equals the additional increase in a party's share (in percent values) after the legislation changed in most (least) affected municipalities in

[11] In complementary analyses, we vary these threshold values $(t_s, \tilde{t}_s)$ by varying the percentile values. It always holds that $Pr[T_m \geq t_s] = Pr[T_m \leq \tilde{t}_s]$.

[12] We opted for a logarithmized dependent variable to take account of the heterogeneous importance of different parties between states. The social democratic party is more relevant in Lower Saxony than in Bavaria where conservatives traditionally gain higher support. Logarithmizing implies that we estimate gains and losses relative to the counterfactual party share.

comparison to untreated counterfactual municipalities in Lower Saxony. Time-invariant confounders and state-wide voting preference trends are captured by municipality-specific fixed effects α_m and state-specific linear time trends $\beta_s y$, respectively. Further covariates at the municipal level $X_{m,y}$, which include municipality-specific per capita income, unemployment rate, per capita tax revenues, share of non-Germans, average age and population density, control for time-variant confounding effects. Standard errors are clustered at the municipality level.

We follow common practice in the literature and show treatment effects for a selected set of parties that are most relevant in the context of this case study. Those parties include the most relevant right-wing and green party as well as the incumbent federal government parties that are responsible for the policy change[13]. The federal government was formed by a three-party coalition at that time consisting of the social democratic, green and liberal party. For estimating the treatment effect on this coalition, individual party shares are summed beforehand.

4 Results

4.1 Baseline Specification

Figure 5 illustrates the regression results for different model specifications. The colors differentiate between parties, whereas the two line types represent the underlying subsets of most and least affected municipalities. Solid lines indicate the treatment effect, defined as the difference between treated municipalities in Bavaria and Hesse (in 2023) and counterfactual municipalities in Lower Saxony. In contrast, the dotted lines symbolize treatment effects for the complementary group of least affected municipalities as a robustness check.

For our baseline specification, we find an economically and statistically significant positive impact of the GEG on the right-wing party of 35% in most affected municipalities compared to the counterfactual. However, the complementary placebo analysis for the least affected municipalities also reveals an increase of the support for the right-wing party of 14%. This suggests that uncaptured confounding effects like the general recent shift to right-wing parties may spur parts of our treatment effect. Yet, the difference between both estimates (solid and dashed line) can be used to approximate the changes in voters' preferences attributed to the GEG.

Incumbent government parties and the green party lose in response to the treatment in both least and most affected municipalities to a similar extent (23-26%). Thus, while the difference is marginal for the green and the government parties, it is substantial for the right-wing party. This allows for the qualitative conclusion that voters in municipalities whose building structure is more affected by the policy change have changed their voting behavior more compared to voters living in less affected municipalities.

To help build some intuition for the economic relevance of the shift to right-wing parties for affected municipalities and states, we translate the treatment effect to absolute effect magnitudes (see subsection A.3). More specifically, we compute the share of votes which corresponds to the

[13] Party names: *Alternative für Deutschland, AfD* (right-wing); *Bündnis 90/Die Grünen* (green); *Sozialdemokratische Partei Deutschlands, SPD* (social democrats); *Freie Demokratische Partei, FDP* (liberal).

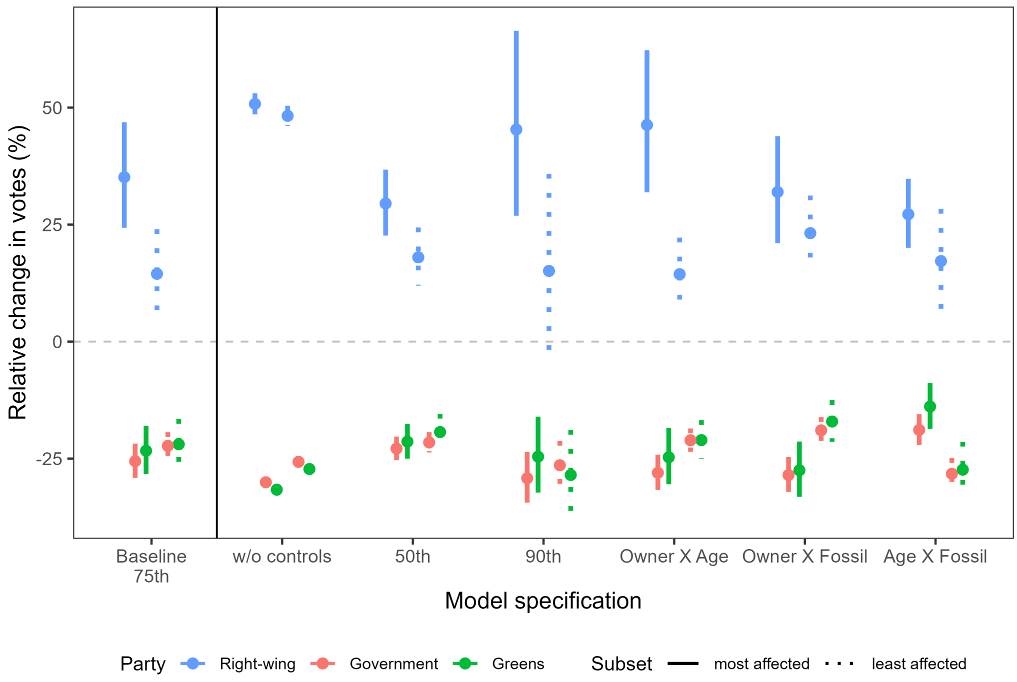


Figure 5: Baseline results and sensitivity to model specifications

Notes: The figure visualizes the treatment effect sizes with the corresponding 95% confidence interval as error bars around the average effect. Colors differentiate between parties whereas the two line types differentiate between underlying data subsets as explained in the main text. Model specifications shown on the x-axis include the baseline specification, a variation of the municipality threshold value, the exclusion of control variables and variations of the treatment definition. Detailed regression results are provided in Table 2 in the appendix.

difference in the estimated treatment effects for most and least affected municipalities on the subset of most affected municipalities. This denotes a conservative estimate which assumes that only the upper 25 percent municipalities of the treatment score distribution has changed their voting behavior in response to the GEG. Focusing on the right-wing party score, we calculate an increase of 3pp. in Hesse and 2.1pp. in Bavaria for the set of most affected municipalities respectively. Most affected municipalities are sparsely populated which is why these local shifts in voting behavior scale to 0.13pp. (Hesse) and 0.12pp. (Bavaria) at the state level. Thus, the absolute magnitude of the policy effect on the election outcomes remains small.

Varying the model specification generally confirms the findings of the baseline specification. The inclusion of control variables significantly reduces the magnitude of the treatment effects and causes a difference between the effects observed for the most and least affected municipalities. If we adjust the municipality threshold t_m to either the median or the 90th percentile value, we find respectively weaker or stronger treatment effects on the right-wing party for the most affected municipalities. Thus, we generalize that the higher we set our threshold t_m, i.e., the more we restrict our analysis to the municipalities with the largest shares of strongly affected owners of real estate, the higher the treatment effect. This supports the validity of the treatment definition and the findings of the baseline specification. In contrast, the complementary placebo analyses for the least affected municipalities show that the treatment effects remain consistent in magnitude across both specifications of $\tilde{t}_m$ while error bars widen in the 90th percentile specification. This suggests that part of the observed treatment effect may still be influenced by a global trend in preference shifting, which we are not able to exclude based on the underlying two-periods election data.

We further explore our results by varying the treatment definition across three additional model specifications. The baseline specification considers interactions between high ownership ratios, older building stocks and fossil-based space heating structures. The three alternative models use pairwise interactions of the three indicators. For the most affected municipalities, we observe a larger treatment effect (up to 46%) on the right-wing party for the treatment definition based on ownership and building age while the effects become slightly smaller for the ownership-fossil and the age-fossil interactions. For the subset of the least affected municipalities, the treatment effects on right-wing voting persist at a smaller level. Thus, while we observe a large difference between the treatment effects for the most and least affected municipalities in the ownership-age specification, the difference decreases for the other two specifications.

In robustness analyses, we further investigate the impact of changes in the grid cell threshold values η_{k,s_c} (see subsection 3.1). Figures 7, 8, 9 in the appendix confirm the overall reasoning of our findings: First, the treatment effect is higher in magnitude for the subset of most affected municipalities. Second, the higher we set the grid cell thresholds individually, the larger are the observed treatment effects—in line with the findings of our baseline specification.

4.2 Heterogeneity Considerations

The transition to renewable heating systems may require individual retrofit measures (see subsection 2.3). Some societal groups, such as high-income or younger households, may afford these measures easier than others. Consequently, treatment effects may vary between different subgroups of the population. In what follows, we use the six control variables introduced in subsection 3.1 to split the data along the respective median values into two subsets. Subsequently, we estimate the two treatment effects for the subsets of the least and most affected municipalities by applying the baseline routine of identifying the 75th and 25th percentile value for t_s and $\tilde{t}_s$. Figure 6 shows the results.

As outlined in subsection 4.1, the most relevant insights stem from the differences in treatment effects observed between the most and least affected municipalities. Therefore, we focus on specifications and cases where the observed pronounced differences. In municipalities with an above-median unemployment rate, we observe a large treatment effect on right-wing voting in most affected municipalities, which is significantly greater than the one in the least affected municipalities. Similarly, while we do not find any difference in treatment effects for municipalities with above-median income, we observe a difference in those with below-median income, although with uncertainty. Municipality tax revenues as third indicator of local economic well-being however produces opposing treatment effects as right-wing voting significantly increases in the above-median subset. Yet, compared to the subset of below-median municipalities, the difference between treatment effects of most affected municipalities is not pronounced. Furthermore, income and the unemployment rate are closer related to individual economic well-being which is plausibly more relevant for the transformation at the individual level.

Regarding green and pro-government voting, our results are less distinct and largely reflect the

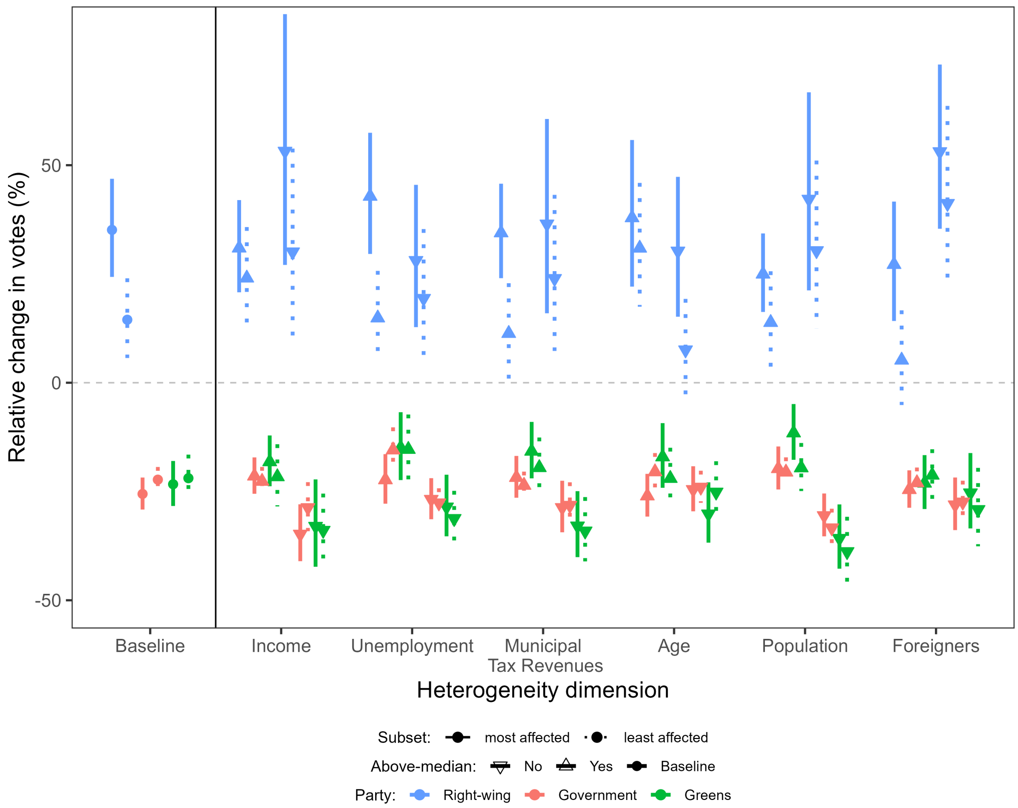


Figure 6: Heterogeneity and treatment effects

Notes: Treatment effect sizes are shown with their corresponding 95% confidence interval as error bars around the average effect. Arrow marker symbolize below- and above-median subgroups. Detailed regression results for selected models are provided in Table 3 in the appendix.

baseline findings. We observe minimal differences between treatment effects of the most and least affected municipalities across all cases. The only notable exception is green voting in younger municipalities where the greens experienced greater losses than on average.

5 Conclusion and Policy Implications

German households potentially face strong transformation necessities with regard to their heating system in the medium-run as a result of the public agreement for carbon neutrality in 2045. Investment costs (for e.g. heating system, retrofitting of building envelope) are expected to be distributed heterogeneously in their magnitude and across societal groups. Uncompensated this may create adverse burden on citizens and thereby lead to societal disruptions for climate policy acceptance. In this paper, we empirically investigated shifts in voters' preferences for Germany following a tightening of the GEG depending on the degree to which voters are affected by it.

We make use of local state election outcome data for Bavaria, Hesse and Lower Saxony and combine them with granular data on the settlement structure of German households. In a difference-in-differences setting, we aim at isolating the effect of the GEG on the Hessian and Bavarian state elections in the most and least affected municipalities.

Our results show gains for the main right-wing party if many households potentially face high material costs imposed by the GEG. Taking account of heterogeneity, we find larger gains for the right-wing party in economically disadvantaged municipalities Our result may constitute a conservative estimate of the effect as the treatment definition focuses on being economically affected by the policy. If citizens also feel affected by the policy even if they are not affected, or object the incomparable policy making process of the government (frequent controversies between the coalition members), we may actually underestimate the impact of this climate policy on the whole electorate.

These results align with the existing literature on the electoral impact of environmental policies. Voters who are directly affected by climate policies such as increased gas taxes (Voeten 2024), combustion car bans (Colantone et al. 2023), wind energy projects (Stokes 2016), or coal phase-outs (Egli et al. 2020) are more likely to vote for right-wing parties. However, compensation schemes may be able to offset citizens' burden and thereby also reduce the likelihood of right-wing voting. These compensation measures may include subsidies for the adoption of new technologies or cash transfers. First evidence by Colantone et al. showed this mechanism for the case study of bans of cars with internal combustion engines in Milan. We demonstrate a similar mechanism with economically disadvantaged municipalities in which citizens may not be able to flexibly adjust and finance their heating technology choice exhibited stronger treatment effects.

Given our findings and those of previous studies, public acceptance for ambitious climate policies would benefit from addressing heterogeneous individual burden. This is of particular relevance for goods with long investment cycles (cars, heating systems, retrofitting) that exhibit bidirectional path dependencies. On the one hand, ambitious climate policy can lead to stranded assets, on the other hand, less efficient policy can prolong investments in fossil fuel-based technologies delaying the transition to renewable alternatives. Thus, policy makers sustain political stability and acceptance rates for ambitious climate policy, if citizens are being compensated for their individual loss in wealth. Accordingly, when it comes to replacing heating systems with renewable alternatives, citizens that face higher difficulties than others (low-income, old, inefficient building envelope) should receive targeted transfers for their heating system's replacement.

The intense and emotional media coverage of the debate (see section 2.2) in combination with a high degree of uncertainty about the costs for homeowners and the size of potential subsidies may have led citizens to overestimate the actual personal financial impact of the GEG. Additionally, government parties had not agreed unanimously on the proposal at the time it was leaked. In combination with the continuous reoccurring controversies between member parties of the government, the policy making process may have strengthened right-wing voting. A more balanced approach in transparently communicating costs of climate policies as well as compensation measures, both in the media and by political actors, could help to prevent public resistance for ambitious climate protection policies.

References

Ahlquist, John, Mark Copelovitch, and Stefanie Walter (2020). "The Political Consequences of External Economic Shocks: Evidence from Poland". en. In: *American Journal of Political Science* 64.4, pp. 904–920. DOI: 10.1111/ajps.12503. URL: https://onlinelibrary.wiley.com/doi/10.1111/ajps.12503.

Barrez, Jeroen (2024). "Public acceptability of carbon pricing: unravelling the impact of revenue recycling". en. In: *Climate Policy*, pp. 1–23. DOI: 10.1080/14693062.2024.2376747. URL: https://www.tandfonline.com/doi/full/10.1080/14693062.2024.2376747.

Bayer, Daniel R. and Marco Pruckner (2023). "Modeling of Annual and Daily Electricity Demand of Retrofitted Heat Pumps based on Gas Smart Meter Data". en. In: *Proceedings of the 10th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation*. Istanbul Turkey: ACM, pp. 248–251. DOI: 10.1145/3600100.3623745. URL: https://dl.acm.org/doi/10.1145/3600100.3623745.

Bayerisches Landesamt für Statistik (2023). *Landtagswahlstatistik 2018 und 2023*. data set. URL: https://www.statistik.bayern.de/wahlen/landtagswahlen/ergebnisse/index.html.

Bergquist, Magnus, Andreas Nilsson, Niklas Harring, and Sverker C. Jagers (2022). "Meta-analyses of fifteen determinants of public opinion about climate change taxes and laws". en. In: *Nature Climate Change* 12.3, pp. 235–240. DOI: 10.1038/s41558-022-01297-6. URL: https://www.nature.com/articles/s41558-022-01297-6.

Bez, Charlotte, Valentina Bosetti, Italo Colantone, and Maurizio Zanardi (2023). "Exposure to international trade lowers green voting and worsens environmental attitudes". en. In: *Nature Climate Change* 13.10, pp. 1131–1135. DOI: 10.1038/s41558-023-01789-z. URL: https://www.nature.com/articles/s41558-023-01789-z.

Bundesinstitut für Bau-, Stadt- und Raumforschung (2024). *INKAR – Indikatoren und Karten zur Raum- und Stadtentwicklung*. URL: https://www.inkar.de/.

Colantone, Italo, Livio Di Lonardo, Yotam Margalit, and Marco Percoco (2023). "The Political Consequences of Green Policies: Evidence from Italy". en. In: *American Political Science Review*, pp. 1–19. DOI: 10.1017/S0003055423000308. URL: https://www.cambridge.org/core/product/identifier/S0003055423000308/type/journal_article.

Comin, Diego and Johannes Rode (2023). *Do Green Users Become Green Voters?* en. Tech. rep. w31324. Cambridge, MA: National Bureau of Economic Research, w31324. DOI: 10.3386/w31324. URL: http://www.nber.org/papers/w31324.pdf.

DESTATIS (2018). *Zensus 2011: Bevölkerungs- und Wohnungszählung 2011*. URL: https://www.zensus2011.de/DE/Home/home_node.html.

— (2024a). *Wohnen in Deutschland – Zusatzprogramm des Mikrozensus 2022*. URL: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Wohnen/Publikationen/Downloads-Wohnen/wohnen-in-deutschland-5122125229005.html.

— (2024b). *Zensus 2022: Eine neue Datenbasis für Deutschland*. URL: https://www.zensus2022.de/DE/Home/_inhalt.html.

Dustmann, Christian, Kristine Vasiljeva, and Anna Piil Damm (2019). "Refugee migration and electoral outcomes". In: *The Review of Economic Studies* 86.5. Publisher: Oxford University Press, pp. 2035–2091. URL: https://academic.oup.com/restud/article-abstract/86/5/2035/5112970.

Edo, Anthony, Yvonne Giesing, Jonathan Öztunc, and Panu Poutvaara (2019). "Immigration and electoral support for the far-left and the far-right". In: *European Economic Review* 115, pp. 99–143. DOI: 10.1016/j.euroecorev.2019.03.001. URL: https://www.sciencedirect.com/science/article/pii/S0014292119300418.

Egli, Florian, Nicolas Schmid, and Tobias Schmidt (2020). "Electoral Response to the Decline of Coal Mining in the United States". en. In: *SSRN Electronic Journal*. DOI: 10.2139/ssrn.3710589. URL: https://www.ssrn.com/abstract=3710589.

Eurostat (2024). *Share of energy from renewable sources*. URL: https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN__custom_9909313/default/table?lang=en.

Franz, Christian, Adelina Garamow, Alexander S. Kritikos, Alexander Kriwoluzky, and Marcel Fratzscher (2024). "Wirtschaft, Demografie und strukturelle Missstände: Die Faktoren hinter dem Erfolg der AfD bei der Europawahl 2024". In: *DIW Wochenbericht*. Publisher: DIW - Deutsches Institut für Wirtschaftsforschung Version Number: 2.0. DOI: 10.18723/DIW_WB:2024-30-1. URL: http://www.diw.de/sixcms/detail.php?id=diw_01.c.909548.de.

Frondel, Manuel, Andreas Gerster, Kathrin Kaestner, Michael Pahle, Antonia Schwarz, Puja Singhal, and Stephan Sommer (2023). *The German Heating and Housing Panel (GHHP) - Wave 1Wärme- und Wohnen-Panel - Welle 1: Building Characteristics*. en. Artwork Size: 6.796 KB Pages: 6.796 KB. DOI: 10.7807/GHHP:BUILDING:V1. URL: https://fdz.rwi-essen.de/en/doi-detail/id-107807ghhpbuildingv1.html.

Gibb, Duncan, Jan Rosenow, Richard Lowes, and Neil J. Hewitt (2023). "Coming in from the cold: Heat pump efficiency at low temperatures". en. In: *Joule* 7.9, pp. 1939–1942. DOI: 10.1016/j.joule.2023.08.005. URL: https://linkinghub.elsevier.com/retrieve/pii/S2542435123003513.

Hazlett, Chad and Matto Mildenberger (2020). "Wildfire Exposure Increases Pro-Environment Voting within Democratic but Not Republican Areas". en. In: *American Political Science Review* 114.4, pp. 1359–1365. DOI: 10.1017/S0003055420000441. URL: https://www.cambridge.org/core/product/identifier/S0003055420000441/type/journal_article.

Hernández, Enrique and Hanspeter Kriesi (2016). "The electoral consequences of the financial and economic crisis in Europe". en. In: *European Journal of Political Research* 55.2, pp. 203–224. DOI: 10.1111/1475-6765.12122. URL: https://ejpr.onlinelibrary.wiley.com/doi/10.1111/1475-6765.12122.

Hessisches Statistisches Landesamt (2023). *Landtagswahlergebnisse 2018 und 2023*. URL: https://statistik.hessen.de/.

Hilbig, Hanno and Sascha Riaz (2024). "Natural Disasters and Green Party Support". en. In: *The Journal of Politics* 86.1, pp. 241–256. DOI: 10.1086/726917. URL: https://www.journals.uchicago.edu/doi/10.1086/726917.

Hoffmann, Roman, Raya Muttarak, Jonas Peisker, and Piero Stanig (2022). "Climate change experiences raise environmental concerns and promote Green voting". en. In: *Nature Climate Change* 12.2, pp. 148–155. DOI: 10.1038/s41558-021-01263-8. URL: https://www.nature.com/articles/s41558-021-01263-8.

Kahn, Matthew E. and Matthew J. Kotchen (2011). "Business Cycle Effects on Concern about Climate Change: The Chilling Effect of Resession". en. In: *Climate Change Economics* 02.03, pp. 257–273. DOI: 10.1142/S2010007811000292. URL: https://www.worldscientific.com/doi/abs/10.1142/S2010007811000292.

Kellermann, Kim Leonie and Simon Winter (2022). "Immigration and anti-immigrant voting in the 2017 German parliamentary election". In: *German Economic Review* 23.3, pp. 341–401. DOI: 10.1515/ger-2021-0026. URL: https://www.degruyter.com/document/doi/10.1515/ger-2021-0026/html.

Landesamt für Statistik Niedersachsen (2024). *Landtagswahlergebnisse 2017 und 2022*. Tabelle M5000312. URL: https://www.statistik.niedersachsen.de/themen/Landtagswahlen-niedersachsen/landtagswahlen-in-niedersachsen-tabellen-und-wahlkreiskarten-227429.html.

Otteni, Cyrill and Manès Weisskircher (2022). "Global warming and polarization. Wind turbines and the electoral success of the greens and the populist radical right". en. In: *European Journal of Political Research* 61.4, pp. 1102–1122. DOI: 10.1111/1475-6765.12487. URL: https://ejpr.onlinelibrary.wiley.com/doi/10.1111/1475-6765.12487.

Statistische Ämter des Bundes und der Länder (2024). *Regionaldatenbank Deutschland*. URL: https://www.regionalstatistik.de/genesis/online/.

Stokes, Leah C. (2016). "Electoral Backlash against Climate Policy: A Natural Experiment on Retrospective Voting and Local Resistance to Public Policy". en. In: *American Journal of Political Science* 60.4, pp. 958–974. DOI: 10.1111/ajps.12220. URL: https://onlinelibrary.wiley.com/doi/10.1111/ajps.12220.

Valencia, Farah Mohammadzadeh, Cornelia Mohren, Anjali Ramakrishnan, Marlene Merchert, Jan Minx, and Jan Steckel (2023). *Public support for carbon pricing policies and different revenue recycling options: a systematic review and meta-analysis of the survey literature*. DOI: 10.21203/rs.3.rs-3528188/v1. URL: https://www.researchsquare.com/article/rs-3528188/v1.

Voeten, Erik (2024). "The Energy Transition and Support for the Radical Right: Evidence from the Netherlands". en. In: *Comparative Political Studies*, p. 00104140241237468. DOI: 10.1177/00104140241237468. URL: http://journals.sagepub.com/doi/10.1177/00104140241237468.

A Appendix

Code and data for replication see [LINK].

A.1 Overview on legislative process

Feb 28, 2023	Leak of draft to media	Newspaper headlines about banning oil and gas heating systems in 2024
Mar 07, 2023	Publication of ministry draft	Inclusion of longer transition periods bound to commitment to district heating
Mar 31, 2023	Political agreement between government parties	Emphasizing the freedom of choice in choosing heating system (like hydrogen-ready gas heating systems), exception rules for homeowners older than 80 years
Apr 19, 2023	Cabinet resolution	Formal agreement on above mentioned points
Jun 13, 2023	Complementary paper	Linkage to municipal heat planning, classification of biomass as carbon neutral energy source, announcement of subsidy program
Jun 15, 2023	Start of parliamentary debate	Government push for final reading and resolution on Jul 07
Jul 05, 2023	Decision by the Federal Constitutional Court	Prohibition of final reading prior to summer break due to short consulting time for MP
Sep 08, 2023	Bundestag passes amendment to the GEG	Inclusion of complementary paper into final law, longer transition periods, allowing temporary installation of fossil boilers for five years instead of exemptions for aged homeowners, exception rules for hydrogen-ready gas heating systems

Table 1: Overview on legislative process

A.2 Detailed baseline regression results

Table 2: Detailed regression results for regression specifications in Figure 5

Dependent Variable:	log_party_share													
	(B,R,75,M)	(B,Gr,75,M)	(B,Go,75,M)	(B,R,75,L)	(B,Gr,75,L)	(B,Go,75,L)	(W,R,75,M)	(W,Gr,75,M)	(W,Go,75,M)	(W,R,75,L)	(W,Gr,75,L)	(W,Go,75,L)	(B,R,50,M)	(B,Gr,50,M)
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Variables														
treatment	0.3011***	-0.2657***	-0.2952***	0.1352***	-0.2477***	-0.2521***	0.4107***	-0.3805***	-0.3576***	0.3937***	-0.3180***	-0.2971***	0.2585***	-0.2406***
	(0.0425)	(0.0344)	(0.0252)	(0.0408)	(0.0342)	(0.0188)	(0.0076)	(0.0091)	(0.0077)	(0.0074)	(0.0082)	(0.0062)	(0.0277)	(0.0241)
standardize(unemployment_rate)	0.0037	0.0053	0.0106	0.0139	-0.0114	0.0051							-0.0070	0.0137
	(0.0144)	(0.0135)	(0.0074)	(0.0212)	(0.0137)	(0.0076)							(0.0102)	(0.0100)
standardize(nongerman_rate)	0.0174	-0.0257	-0.0175	-0.0670	0.0165	0.0216							0.0279	-0.0071
	(0.0220)	(0.0192)	(0.0118)	(0.0413)	(0.0220)	(0.0147)							(0.0181)	(0.0154)
log(population_density)	-0.2767	0.6008*	0.7122***	0.6725***	-0.0746	-0.0488							-0.1270	0.3825*
	(0.3087)	(0.3139)	(0.1911)	(0.1900)	(0.3806)	(0.2038)							(0.2201)	(0.2287)
log(income)	1.406***	-1.451***	-0.8974***	3.247***	-1.065***	-0.7585***							1.930***	-1.635***
	(0.5048)	(0.4081)	(0.2838)	(0.4808)	(0.3825)	(0.2127)							(0.3312)	(0.2826)
average_age	-0.0078	-0.0020	0.0132	-0.0102	0.0103	0.0101							-0.0101	0.0015
	(0.0130)	(0.0151)	(0.0086)	(0.0178)	(0.0182)	(0.0087)							(0.0099)	(0.0111)
log(tax_revenues)	0.0057	-0.0457	-0.0428	0.0605	0.0758	0.0542*							-0.0288	-0.0391
	(0.0383)	(0.0386)	(0.0297)	(0.0407)	(0.0572)	(0.0320)							(0.0282)	(0.0278)
factor(id_state)3 × year	0.1376***	0.1077***	0.0064	0.0954***	0.1007***	0.0041	0.1608***	0.0821***	-0.0082***	0.1474***	0.0882***	-0.0041***	0.1223***	0.1084***
	(0.0081)	(0.0072)	(0.0049)	(0.0085)	(0.0076)	(0.0039)	(0.0040)	(0.0032)	(0.0014)	(0.0047)	(0.0035)	(0.0015)	(0.0056)	(0.0050)
factor(id_state)6 × year	0.0030	-0.0246***	-0.0079***	-0.0009	-0.0132***	-0.0109***	0.0035	-0.0261***	-0.0103***	-0.0140***	-0.0084***	-0.0072***	0.0025	-0.0272***
	(0.0028)	(0.0037)	(0.0026)	(0.0035)	(0.0035)	(0.0023)	(0.0023)	(0.0033)	(0.0023)	(0.0024)	(0.0032)	(0.0022)	(0.0021)	(0.0026)
Fixed-effects														
id	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics														
Observations	1,706	1,706	1,706	1,707	1,707	1,707	1,706	1,706	1,706	1,708	1,708	1,708	3,414	3,414
R^2	0.95915	0.95045	0.98208	0.94969	0.95743	0.98168	0.95847	0.94892	0.98138	0.94433	0.95674	0.98122	0.95910	0.95273
Within R^2	0.87451	0.79353	0.82152	0.84336	0.75901	0.80422	0.87240	0.78715	0.81459	0.82674	0.75500	0.79927	0.87604	0.79405

Clustered (id) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Regression models are labelled according to the following pattern: (*model type*, *party*, *municipality threshold*, *subset*). *Model type* differentiates between baseline (B), without control variables (W), or alternative treatment definitions (oXa—ownership-age, oXe—ownership-fossil, aXe—age-fossil interaction). *Party* describes the dependent variable and includes right-wing (R), greens (Gr) and federal government parties (Go). The *municipality threshold* is either the 50^{th}, 75^{th}, or 90^{th} percentile of the state-wide treatment score distribution. The *subset* may refer either to the least (L) or the most (M) affected municipalities. For details see section 3. Numbers do not match those in Figure 5 as regression coefficients, β, need to be transformed for obtaining marginal effects when using a logarithmized dependent variable, $ME = e^{\beta} - 1$ (Source: own depiction).

Table 1 *continued*: Detailed regression results for regression specifications in Figure 5

Dependent Variable:	log_party_share													
	(B,Go,50,M)	(B,R,50,L)	(B,Gr,50,L)	(B,Go,50,L)	(B,R,90,M)	(B,Gr,90,M)	(B,Go,90,M)	(B,R,90,L)	(B,Gr,90,L)	(B,Go,90,L)	(oXa,R,75,M)	(oXa,Gr,75,M)	(oXa,Go,75,M)	(oXa,R,75,L)
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Variables														
treatment	-0.2595***	0.1655***	-0.2149***	-0.2428***	0.3738***	-0.2821***	-0.3454***	0.1406*	-0.3355***	-0.3067***	0.3805***	-0.2839***	-0.3290***	0.1345***
	(0.0167)	(0.0269)	(0.0241)	(0.0141)	(0.0692)	(0.0548)	(0.0390)	(0.0846)	(0.0644)	(0.0347)	(0.0529)	(0.0407)	(0.0267)	(0.0337)
scale(unemployment_rate)	0.0080*	-0.0086	-0.0041	0.0047	0.0111	0.0261	0.0351**	0.0276	-0.0086	0.0005	-0.0073	-0.0018	0.0065	-0.0221
	(0.0047)	(0.0112)	(0.0096)	(0.0049)	(0.0345)	(0.0342)	(0.0170)	(0.0312)	(0.0221)	(0.0120)	(0.0159)	(0.0135)	(0.0070)	(0.0143)
scale(nongerman_rate)	-0.0108	-0.0338	0.0034	-0.0002	0.0171	-0.0057	-0.0077	-0.1077	0.0122	0.0324	0.0050	-0.0100	-0.0238***	-0.0612
	(0.0102)	(0.0242)	(0.0157)	(0.0112)	(0.0295)	(0.0275)	(0.0157)	(0.0698)	(0.0306)	(0.0222)	(0.0165)	(0.0144)	(0.0091)	(0.0389)
log(population_density)	0.5446***	0.3645**	0.0177	0.1524	-0.2169	0.2370	0.6285**	0.5592**	-0.3199	-0.1675	-0.2810	0.6184*	0.6631***	0.5928***
	(0.1392)	(0.1727)	(0.3127)	(0.2028)	(0.5007)	(0.5276)	(0.3108)	(0.2482)	(0.3536)	(0.1955)	(0.3491)	(0.3533)	(0.2049)	(0.1828)
log(income)	-1.236***	3.035***	-1.494***	-1.028***	0.7553	-1.209*	-0.3276	3.280***	-0.1686	-0.3632	0.9704	-1.352***	-0.5655*	3.299***
	(0.1948)	(0.3107)	(0.2673)	(0.1610)	(0.8238)	(0.6590)	(0.4334)	(0.9516)	(0.6956)	(0.3786)	(0.6039)	(0.4517)	(0.2992)	(0.4364)
average_age	0.0111*	-0.0181	0.0058	0.0155**	0.0026	0.0048	0.0185	-0.0253	-0.0134	0.0078	-0.0219	-0.0059	0.0063	0.0111
	(0.0065)	(0.0119)	(0.0126)	(0.0074)	(0.0225)	(0.0268)	(0.0142)	(0.0260)	(0.0262)	(0.0116)	(0.0158)	(0.0152)	(0.0087)	(0.0154)
log(tax_revenues)	-0.0358*	0.0533*	0.0339	0.0076	-0.0722	-0.0654	-0.0163	-0.0074	0.1269	0.0917	0.0134	-0.0692*	-0.0685**	0.0268
	(0.0200)	(0.0282)	(0.0316)	(0.0211)	(0.0544)	(0.0558)	(0.0376)	(0.0607)	(0.1087)	(0.0575)	(0.0413)	(0.0396)	(0.0291)	(0.0374)
factor(id_state)3 × year	0.0122***	0.0998***	0.1080***	0.0091***	0.1551***	0.1074***	-0.0034	0.1079***	0.0896***	-0.0030	0.1454***	0.1026***	0.0031	0.0905***
	(0.0033)	(0.0056)	(0.0051)	(0.0029)	(0.0121)	(0.0125)	(0.0081)	(0.0157)	(0.0137)	(0.0064)	(0.0093)	(0.0085)	(0.0050)	(0.0080)
factor(id_state)6 × year	-0.0124***	-0.0046**	-0.0164***	-0.0100***	0.0017	-0.0320***	-0.0121***	0.0044	-0.0107	-0.0081*	-0.0041	-0.0282***	-0.0067***	-0.0031
	(0.0018)	(0.0022)	(0.0025)	(0.0018)	(0.0044)	(0.0061)	(0.0041)	(0.0070)	(0.0066)	(0.0041)	(0.0031)	(0.0040)	(0.0026)	(0.0028)
Fixed-effects														
id	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics														
Observations	3,414	3,406	3,406	3,406	684	684	684	687	687	687	1,706	1,706	1,706	1,703
R^2	0.98194	0.95259	0.96033	0.98170	0.95666	0.93979	0.98190	0.94661	0.94252	0.98115	0.95162	0.93665	0.98283	0.95660
Within R^2	0.82573	0.85995	0.78082	0.81189	0.86204	0.75627	0.82110	0.81311	0.71578	0.79878	0.86317	0.77372	0.83111	0.86575

Clustered (id) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Regression models are labelled according to the following pattern: (*model type*, *party*, *municipality threshold*, *subset*). *Model type* differentiates between baseline (B), without control variables (W), or alternative treatment definitions (oXa—ownership-age, oXe—ownership-fossil, aXe—age-fossil interaction). *Party* describes the dependent variable and includes right-wing (R), greens (Gr) and federal government parties (Go). The *municipality threshold* is either the 50th, 75th, or 90th percentile of the state-wide treatment score distribution. The *subset* may refer either to the least (L) or the most (M) affected municipalities. For details see section 3. Numbers do not match those in Figure 5 as regression coefficients, β, need to be transformed for obtaining marginal effects when using a logarithmized dependent variable, $ME = e^{\beta} - 1$ (Source: own depiction).

Table 1 *continued*: Detailed regression results for regression specifications in Figure 5

Dependent Variable:	log_party_share													
	(oXa,Gr,75,L)	(oXa,Go,75,L)	(oXe,R,75,M)	(oXe,Gr,75,M)	(oXe,Go,75,M)	(oXe,R,75,L)	(oXe,Gr,75,L)	(oXe,Go,75,L)	(aXe,R,75,M)	(aXe,Gr,75,M)	(aXe,Go,75,M)	(aXe,R,75,L)	(aXe,Gr,75,L)	(aXe,Go,75,L)
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Variables														
treatment	-0.2364***	-0.2369***	0.2774***	-0.3217***	-0.3356***	0.2084***	-0.1873***	-0.2103***	0.2406***	-0.1494***	-0.2091***	0.1587***	-0.3198***	-0.3320***
	(0.0268)	(0.0161)	(0.0441)	(0.0415)	(0.0266)	(0.0322)	(0.0273)	(0.0174)	(0.0296)	(0.0290)	(0.0206)	(0.0464)	(0.0402)	(0.0232)
scale(unemployment_rate)	-0.0075	5.7×10^{-7}	0.0063	0.0188	0.0351***	-0.0095	0.0127	0.0058	0.0029	-0.0017	0.0023	0.0102	0.0100	0.0232***
	(0.0116)	(0.0064)	(0.0203)	(0.0189)	(0.0097)	(0.0158)	(0.0134)	(0.0058)	(0.0107)	(0.0095)	(0.0049)	(0.0190)	(0.0157)	(0.0070)
scale(nongerman_rate)	0.0181	0.0213	0.0609***	-0.0015	-0.0277**	-0.0952**	-0.0011	0.0011	-0.0635***	-0.0225	-0.0069	0.0227	-0.0202	-0.0145
	(0.0216)	(0.0149)	(0.0208)	(0.0233)	(0.0137)	(0.0478)	(0.0266)	(0.0208)	(0.0232)	(0.0221)	(0.0168)	(0.0197)	(0.0166)	(0.0105)
log(population_density)	-0.3705	-0.0608	-0.2002	0.3966	0.5576***	0.3537	-0.4007	-0.0117	0.5527	0.9240**	0.9987***	0.1805	0.7835***	0.4895***
	(0.2650)	(0.1846)	(0.3137)	(0.3175)	(0.1916)	(0.2189)	(0.2775)	(0.2274)	(0.3559)	(0.4032)	(0.2483)	(0.3758)	(0.2841)	(0.1864)
log(income)	-0.3818	-0.4830**	1.421***	-1.043**	-0.5550*	2.776***	-1.546***	-1.194***	2.555***	-2.478***	-1.626***	3.017***	-0.8871**	-0.5045**
	(0.3332)	(0.1967)	(0.5036)	(0.4703)	(0.2836)	(0.4058)	(0.3480)	(0.2224)	(0.3991)	(0.4014)	(0.2531)	(0.4969)	(0.4294)	(0.2464)
average_age	-0.0152	0.0016	0.0069	0.0347**	0.0210**	-0.0340**	-0.0145	0.0095	-0.0381**	0.0228	0.0454***	-0.0094	0.0077	0.0115
	(0.0156)	(0.0082)	(0.0143)	(0.0165)	(0.0089)	(0.0149)	(0.0152)	(0.0076)	(0.0150)	(0.0180)	(0.0100)	(0.0188)	(0.0138)	(0.0085)
log(tax_revenues)	0.0796*	0.0680**	-0.0063	0.0119	0.0213	0.0280	0.0371	-0.0018	-0.0327	0.0198	-0.0059	-0.0283	0.0237	0.0171
	(0.0464)	(0.0270)	(0.0388)	(0.0492)	(0.0279)	(0.0391)	(0.0358)	(0.0252)	(0.0350)	(0.0333)	(0.0237)	(0.0469)	(0.0547)	(0.0314)
factor(id_state)3 × year	0.0972***	-0.0009	0.1438***	0.1013***	0.0049	0.1015***	0.1085***	0.0097**	0.0986***	0.1259***	0.0105***	0.1207***	0.0930***	0.0057
	(0.0062)	(0.0035)	(0.0095)	(0.0084)	(0.0054)	(0.0074)	(0.0063)	(0.0038)	(0.0066)	(0.0062)	(0.0040)	(0.0102)	(0.0084)	(0.0047)
factor(id_state)6 × year	-0.0149***	-0.0133***	0.0015	-0.0234***	-0.0108***	-0.0080***	-0.0145***	-0.0087***	-0.0020	-0.0224***	-0.0081***	-0.0022	-0.0175***	-0.0112***
	(0.0027)	(0.0020)	(0.0031)	(0.0042)	(0.0027)	(0.0029)	(0.0032)	(0.0022)	(0.0028)	(0.0034)	(0.0021)	(0.0034)	(0.0038)	(0.0029)
Fixed-effects														
id	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics														
Observations	1,703	1,703	1,706	1,706	1,706	1,704	1,704	1,704	1,705	1,705	1,705	1,703	1,703	1,703
R^2	0.96884	0.98258	0.96161	0.94412	0.98175	0.95011	0.95922	0.98326	0.95925	0.96231	0.97936	0.95378	0.95710	0.98104
Within R^2	0.80554	0.82837	0.87598	0.77647	0.82656	0.86220	0.77373	0.82189	0.88826	0.80004	0.81806	0.84937	0.77651	0.82602

Clustered (id) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Regression models are labelled according to the following pattern: (*model type*, *party*, *municipality threshold*, *subset*). *Model type* differentiates between baseline (B), without control variables (W), or alternative treatment definitions (oXa—ownership-age, oXe—ownership-fossil, aXe—age-fossil interaction). *Party* describes the dependent variable and includes right-wing (R), greens (Gr) and federal government parties (Go). The *municipality threshold* is either the 50^{th}, 75^{th}, or 90^{th} percentile of the state-wide treatment score distribution. The *subset* may refer either to the least (L) or the most (M) affected municipalities. For details see section 3. Numbers do not match those in Figure 5 as regression coefficients, β, need to be transformed for obtaining marginal effects when using a logarithmized dependent variable, $ME = e^{\beta} - 1$ (Source: own depiction).

A.3 Derivation of the quantitative estimate

Let $s_{m,y}$ be the share of votes for the right-wing party in municipality m in year y. In line with the potential outcomes notation, we define $s^1_{m,y}$ as the share of votes observed in the presence of the amendment to the GEG, and $s^0_{m,y}$ as the share of votes if the GEG did not occurred. We estimate the ATT $\hat{\gamma}$ for the following regression model as given in Equation 4:

$$E_{m,y} = log(s_{m,y}) = \alpha_m + \beta_s Y + \gamma D_{m,y} + \delta X_{m,y} + \varepsilon_{m,y}.$$

Given the logarithmization of the dependent variable, the measure shown in Figure 5 and Figure 6,

$$\begin{aligned}
\tilde{\gamma} :&= \exp(\hat{\gamma}) - 1 && (6)\\
&= \frac{E[s^1_{m,2023}|m \in \{BY, HE\}]}{E[s^0_{m,2023}|m \in \{BY, HE\}]} - 1 && (7)\\
&= \frac{E[s^1_{m,2023}|m \in \{BY, HE\}] - E[s^0_{m,2023}|m \in \{BY, HE\}]}{E[s^0_{m,2023}|m \in \{BY, HE\}]}, && (8)
\end{aligned}$$

gives the relative increase/decrease of the treated municipalities (i.e., the most/least affected municipalities in Hesse and Bavaria) compared to the counterfactual. This expression is equivalent to

$$E[s^0_{m,2023}|m \in \{BY, HE\}] = \frac{E[s^1_{m,2023}|m \in \{BY, HE\}]}{\tilde{\gamma} + 1}. \tag{9}$$

We implement the analysis and obtain the estimate of $\tilde{\gamma}$ separately for the most and the least affected municipalities yielding $\tilde{\gamma}^{most}$ and $\tilde{\gamma}^{least}$.

To approximate the political cost, we assume that $\tilde{\gamma}^{most}$ yields the counterfactual for all most affected municipalities m in Bavaria and Hesse:

$$s^0_{m,2023} = \frac{s^1_{m,2023}}{\tilde{\gamma}^{most}}. \tag{10}$$

We also compute the counterfactual share of votes for the most affected municipality m which would have been observed if the treatment effect had been equal to the treatment effect of the least affected municipalities $\tilde{\gamma}^{least}$, i.e.,

$$s^0_{m,2023,placebo} = \frac{s^1_{m,2023}}{\tilde{\gamma}^{least}}. \tag{11}$$

We can use those expressions to compute

- $\Delta s_{m,2023} = s^1_{m,2023} - s^0_{m,2023}$: The additional share of votes for the party which we attribute to the GEG according to our analysis, and
- $\Delta s_{m,2023,placebo} = s^1_{m,2023} - s^0_{m,2023,placebo}$: the additional share of votes for the party which we would had observed in case of the treatment effect of the analysis of the least affected municipalities (placebo analysis).

The difference $\Delta s_{m,2023} - \Delta s_{m,2023,placebo}$ approximates the additional share of votes going back to the difference in treatment effects which we wish to approximate for each most affected municipality m:

$$\Delta s_{m,2023} - \Delta s_{m,2023,placebo} = s^1_{m,2023} - s^0_{m,2023} - (s^1_{m,2023} - s^0_{m,2023,placebo}) \tag{12}$$

$$= s^0_{m,2023,placebo} - s^0_{m,2023} \tag{13}$$

$$= \left(\frac{1}{\tilde{\gamma}^{least} + 1} - \frac{1}{\tilde{\gamma}^{most} + 1} \right) s^1_{m,2023} \tag{14}$$

based on Equation 10 and Equation 11.

Using the number of valid votes for each most affected municipality, we can translate the additional shares to additional votes for the party. Normalization by the total number of valid votes in all most affected municipalities or all municipalities of a state approximates the additional percentage points for the party which our analyses attribute to the GEG in affected municipalities or the entire state respectively.

A.4 Varying the grid cell thresholds

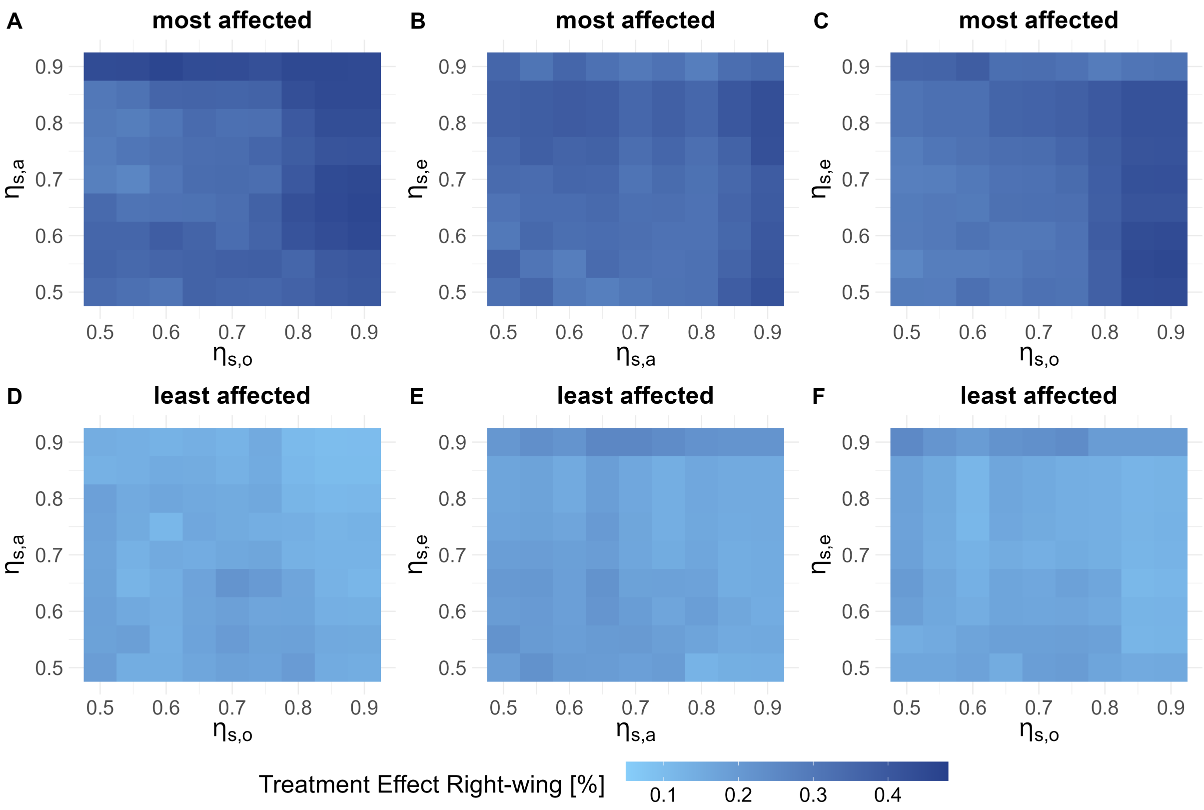


Figure 7: Heatmap of treatment effect on right-wing voting for baseline regression when grid level thresholds are varied ($\eta_{s,k}$ for $k \in \{o, a, e\}$). Respective remaining third threshold dimension is fixed at 0.75.

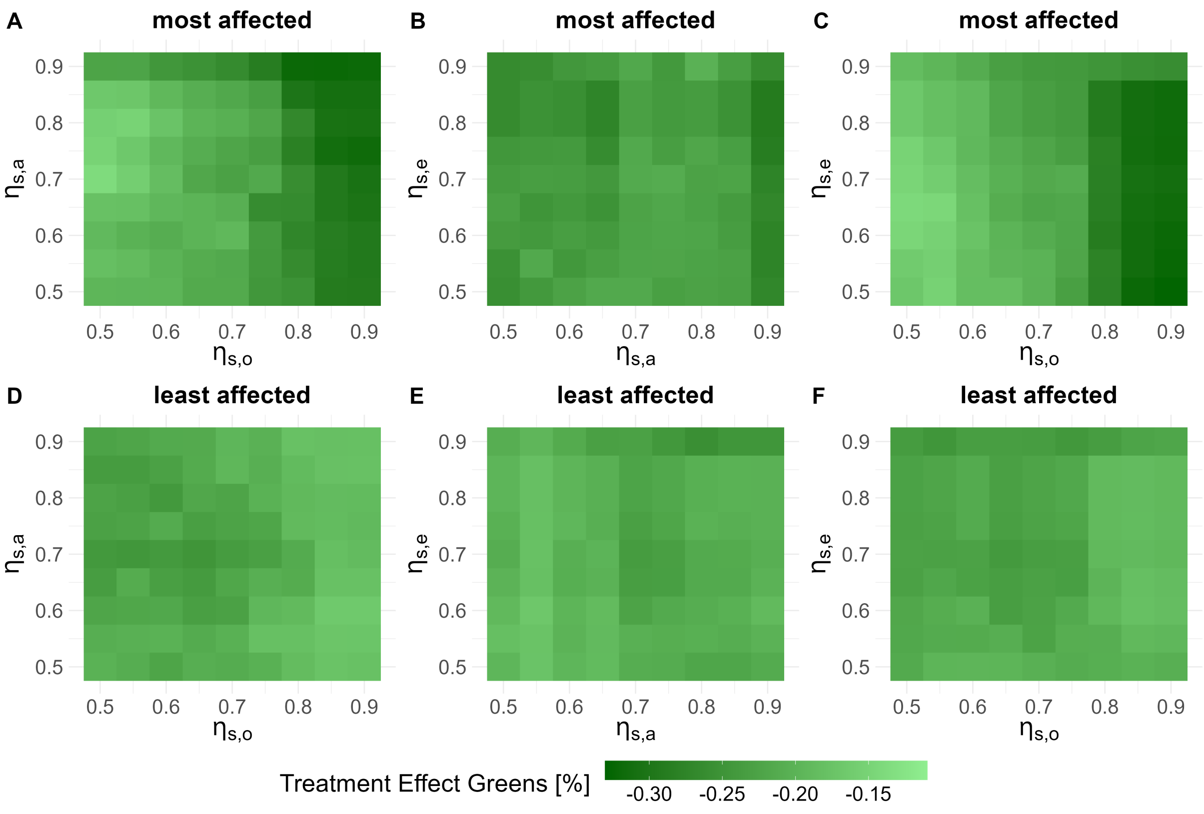


Figure 8: Heatmap of treatment effect on green voting for baseline regression when grid level thresholds are varied ($\eta_{s,k}$ for $k \in \{o, a, e\}$). Respective remaining third threshold dimension is fixed at 0.75.

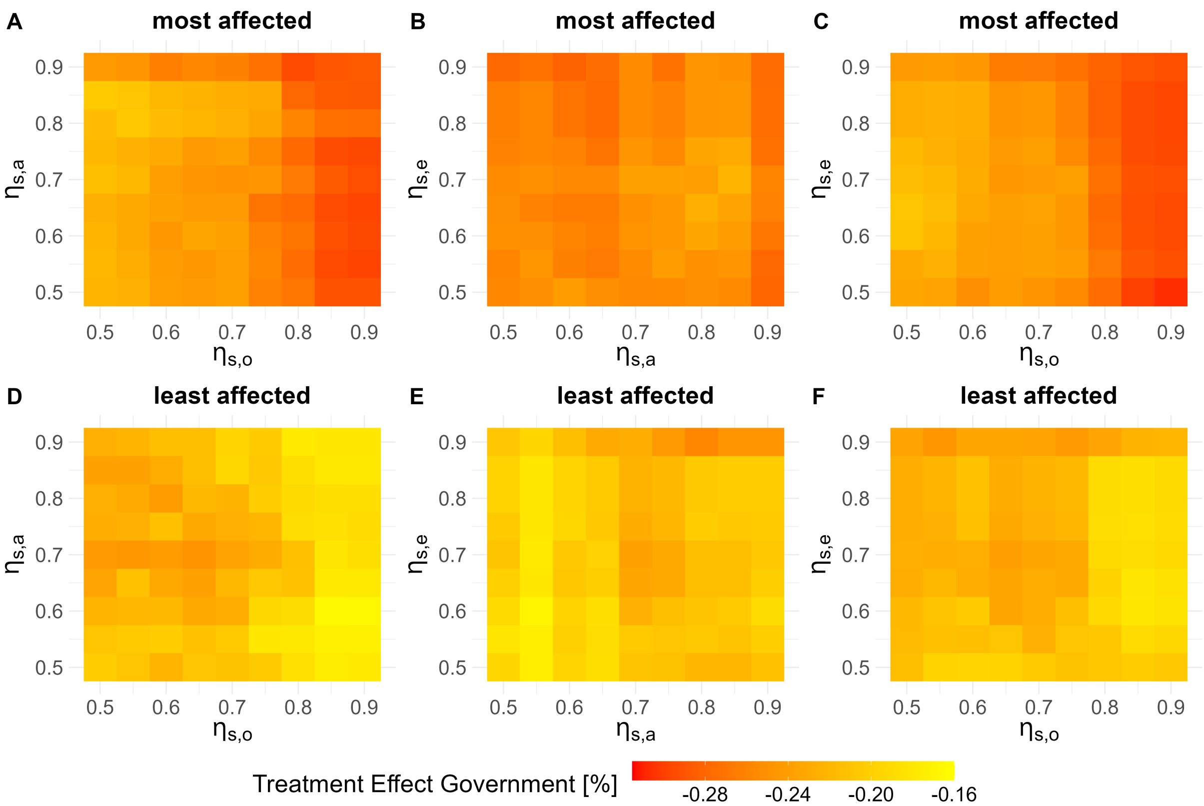


Figure 9: Heatmap of treatment effect on pro-government voting for baseline regression when grid level thresholds are varied ($\eta_{s,k}$ for $k \in \{o, a, e\}$). Respective remaining third threshold dimension is fixed at 0.75.

For high grid cell threshold values of $\eta_{s,k} = 0.9$, observed treatment effects decrease which stands against our reasoning (see e.g. $\eta_{s,e}$ in panel B or E of Figure 7). However, this data anomaly occurs because of two effects: First, with increasing grid cell threshold values, a lower number of grid cells are marked as affected which in turn decreases the magnitude and variance of the treatment score at the municipal level. Second, we observe more zero values of the treatment score. For example, if we select those municipalities with a treatment score value below or equal the 25$^{\text{th}}$ percentile value ($Pr[T_m \leq \tilde{t}_s] = 0.25$) of zero, we may consider more than 25 percent of the municipalities as being least affected which may bias our treatment effect upwards.

A.5 Selected regression results for heterogeneity considerations

Table 3: Selected regression results for heterogeneity considerations

Dependent Variable:	log_party_share											
	Inc_B_M	Inc_B_L	Inc_A_M	Inc_A_L	Unemp_B_M	Unemp_B_L	Unemp_A_M	Unemp_A_L	Tax_B_M	Tax_B_L	Tax_A_M	Tax_A_L
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables												
treatment	0.4266***	0.2629***	0.2697***	0.2156***	0.2476***	0.1772***	0.3566***	0.1388***	0.3110***	0.2147***	0.2960***	0.1073**
	(0.0954)	(0.0856)	(0.0412)	(0.0461)	(0.0650)	(0.0639)	(0.0497)	(0.0459)	(0.0831)	(0.0736)	(0.0411)	(0.0503)
scale(unemployment_rate)	0.0208	0.0191	0.0128	-0.0135	-0.0137	-0.0185	0.0089	0.0302	-0.0025	0.0184	-0.0051	-0.0028
	(0.0276)	(0.0346)	(0.0127)	(0.0226)	(0.0105)	(0.0156)	(0.0256)	(0.0283)	(0.0219)	(0.0281)	(0.0172)	(0.0284)
scale(nongerman_rate)	0.0244	-0.0832	-0.0138	-0.0829**	0.0706**	-0.0412	-0.0219	-0.0703	0.0393*	-0.0114	-0.0097	-0.1222**
	(0.0312)	(0.0613)	(0.0238)	(0.0357)	(0.0284)	(0.0498)	(0.0236)	(0.0500)	(0.0228)	(0.0329)	(0.0313)	(0.0606)
log(population_density)	-0.6395	0.4492*	0.1859	1.085***	-0.7392	0.3312	0.1014	0.7097	-0.6328	0.4322*	0.0158	0.8939**
	(0.4427)	(0.2493)	(0.4786)	(0.3604)	(0.4786)	(0.2649)	(0.4409)	(0.4487)	(0.4336)	(0.2220)	(0.4555)	(0.4066)
log(income)	0.1451	2.115**	1.777***	1.984***	2.101***	3.114***	0.9015	3.095***	1.372	2.350***	1.590***	3.696***
	(1.064)	(0.9468)	(0.5293)	(0.5818)	(0.7705)	(0.7276)	(0.5944)	(0.5631)	(0.9683)	(0.8529)	(0.5145)	(0.5685)
average_age	0.0007	-0.0251	-0.0333	-0.0129	-0.0143	-0.0213	-0.0165	-0.0192	0.0073	-0.0432*	-0.0385**	0.0170
	(0.0185)	(0.0240)	(0.0203)	(0.0213)	(0.0193)	(0.0266)	(0.0179)	(0.0257)	(0.0181)	(0.0231)	(0.0191)	(0.0263)
log(tax_revenues)	-0.0408	0.0374	-0.0841	0.0285	0.0847	0.0697	-0.0729	0.0358	-0.0551	0.0945	-0.0150	0.0331
	(0.0525)	(0.0618)	(0.0521)	(0.0558)	(0.0603)	(0.0565)	(0.0527)	(0.0594)	(0.0710)	(0.0800)	(0.0401)	(0.0528)
factor(id_state)3 × year	0.1709***	0.1443***	0.1156***	0.0936***	0.1260***	0.1103***	0.1441***	0.0892***	0.1461***	0.1211***	0.1267***	0.0819***
	(0.0167)	(0.0174)	(0.0086)	(0.0104)	(0.0123)	(0.0135)	(0.0095)	(0.0102)	(0.0150)	(0.0139)	(0.0089)	(0.0116)
factor(id_state)6 × year	-0.0016	-0.0056	0.0037	-0.0008	-0.0055	-0.0050	0.0066*	-0.0015	0.0028	-0.0064	0.0022	-0.0011
	(0.0040)	(0.0055)	(0.0040)	(0.0041)	(0.0047)	(0.0057)	(0.0034)	(0.0037)	(0.0040)	(0.0045)	(0.0040)	(0.0044)
Fixed-effects												
id	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics												
Observations	854	854	856	855	854	854	854	853	854	850	854	854
R^2	0.95798	0.95543	0.95685	0.95240	0.95967	0.94819	0.95625	0.95524	0.95465	0.94973	0.96393	0.95552
Within R^2	0.87407	0.85921	0.86856	0.85579	0.85912	0.83122	0.88867	0.86853	0.86945	0.84115	0.88399	0.86398

Clustered (id) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

These selected regression models use the logarithmized share of the right-wing party and the baseline specification regarding grid cell and municipality thresholds. The models are labelled according to the following pattern: (*heterogeneity dimension*, *below/above median*, *subset*). *Heterogeneity dimension* states which control variable we use for splitting our data initially. These selected models look at income (Inc), unemployment rate (Unemp), and municipality tax revenues (Tax). *Below/above median* clarifies which data set is being investigated, above (A) or below (B) the median threshold value. The *subset* may refer either to the least (L) or the most (M) affected municipalities. For details see section 3. Numbers do not match those in Figure 6 as regression coefficients, β, need to be transformed for obtaining marginal effects when using a logarithmized dependent variable, $ME = e^{\beta} - 1$ (Source: own depiction).