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Stephan Sommer, Théo Konc and Stefan Drews[1]

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Abstract

The success of climate policies depends crucially on the dynamics of public support. Using unique longitudinal data from three surveys conducted between 2019 and 2022, we study the variations of public support for carbon pricing in Germany. The period includes two relevant events: the introduction and ramping up of carbon pricing in Germany and the exogenous increase in energy prices following the Russian invasion of Ukraine. Using panel methods, we show that support is very persistent over time and might have increased slightly more recently. However, people who experience high energy costs display a lower support. Regarding revenue use, we detect that social cushioning has become more popular after the introduction of carbon pricing. Our findings suggest that it is crucial to gather enough support before implementing climate policies.

JEL-Codes: D12, H23, Q58

Keywords: Climate change mitigation; political economy; panel methods

April 2023

1 Stephan Sommer, RWI and Bochum University of Applied Sciences; Théo Konc, Technical University Berlin and Potsdam Institute for Climate Impact Research; Stefan Drews, University of Málaga . *– We thank Johanna Arlinghaus, Jens Ewald, Adrien Fabre, Niklas Harring, Linus Mattauch, and Charlotte Plinke, as well as seminar participants in Berlin, Gothenburg, and Maryland for very helpful discussions. We gratefully acknowledge financial support by the German Federal Ministry for Economic Affairs and Climate Action (BMWK, grant 03EI5213), the German Federal Ministry for Education and Research (BMBF) in the framework of the Kopernikus project Ariadne (grant 03SFK5C0), the E.ON foundation, and the Robert Bosch foundation.* *– All correspondence to: Stephan Sommer, Bochum University of Applied Sciences, Am Hochschulcampus 1, 44801 Bochum, Germany, stephan.sommer@hs-bochum.de*

1 Introduction

Carbon pricing is considered a key policy instrument to achieve climate change mitigation. About 70 carbon pricing initiatives are currently implemented around the world (World Bank, 2023). However, compared to other policy instruments, carbon pricing is one of the most unpopular measures to reduce emissions (Bergquist et al., 2022; Furceri et al., 2021; Long et al., 2021; Rhodes et al., 2017). Along with institutional factors and business influence, public opposition is one of the main factors that explain why some countries have failed to adopt effective carbon pricing (Khan and Johansson, 2022).

A growing body of interdisciplinary research is accumulating knowledge about citizens' support for climate policies in general (Drews and Van den Bergh, 2016; Kyselá et al., 2019; Ejelöv and Nilsson, 2020) and related to carbon pricing specifically (Carattini et al., 2018; Dechezleprêtre et al., 2022; Maestre-Andrés et al., 2019; Sommer et al., 2022) as well as revenue use (Baranzini and Carattini, 2017). However, most empirical research has undertaken cross-sectional surveys to examine hypothetical policies, and little is known about how and why public support for real carbon pricing schemes develops over time (Kallbekken, 2023). Yet, this is problematic because decision-makers may hesitate to implement policies if they expect that support expressed through surveys from pre-adoption phases underestimate public discontent when people consider the policy's effects less seriously (Anderson et al., 2023). Furthermore, an initial carbon price is often just a starting point for countries to ramp up their ambition over time (Leipprand et al., 2020). Understanding the dynamics of support for an increasing tax is therefore key to design feasible climate policies (Kallbekken, 2023).

In this paper, we report findings from a unique longitudinal data set that was collected in three panel survey waves (N=4353) conducted between 2019 and 2022 in Germany among the same respondents. We capture variations linked to two relevant events: First, Germany introduced and ramped up a carbon price. Specifically, the carbon price was introduced at a rate of €25 per ton in 2021 and increased to €30 in 2022.

Second, energy prices increased starkly and created tensions on the global energy market following the Russian invasion of Ukraine. With this data set we seek to examine two research questions. First, are attitudes to carbon pricing and the use of revenues affected by its introduction and tensions in the global energy market? Second, how do changes in support for carbon pricing depend on potential effects on individual energy and transport expenditures? Using a longitudinal data set allows us to control for individual characteristics that remain constant over time, such as gender and many personality traits (Cobb-Clark and Schurer, 2012).

The few empirical studies that have used multiple survey waves provide mixed evidence. Survey data from Canada suggests that support for the carbon tax in British Columbia has increased over time (Murray and Rivers, 2015). A study for Australia examines how acceptance of carbon pricing developed over the course of the 2013 general election campaign (Dreyer et al., 2015). Through two surveys before and after the general election, Dreyer et al. (2015) find hardly any changes in attitudes and perceptions, even though carbon pricing was an important campaign topic. The stability of attitudes might be owed to lower increases in travel costs compared to people's expectations before the policy's adoption. Drews et al. (2022) measure acceptance of a carbon tax before and after the first wave of the Covid-19 virus and find that it has increased over time.

We focus on the perceptions of personal economic costs, as they appear to be an important factor for decreasing support of climate policy in general (Fanghella et al., 2023; Groh and Ziegler, 2018) and carbon pricing specifically (Carattini et al., 2017), and people tend to overestimate such costs (Douenne and Fabre, 2022). However, it is possible that actual experiences following the policy's implementation may correct these perceptions, leading to increased support for the policy (Konc et al., 2022). For example, public support for congestion pricing increased notably in Sweden after its implementation (Schuitema et al., 2010). A recent study by Mildenberger et al. (2022) measures the support for real carbon taxation in Canada and Switzerland. Using a survey experiment, they conclude that providing information about the actual financial benefits of carbon taxation, resulting from a strategic use of tax revenues, has no effect on support in Canada and a positive effect in Switzerland.

Our results suggest that roughly 60% of respondents support rather low carbon prices of €10, €25 and €30, whereas higher prices are supported by less than the majority. Overall, Germany's introduction of carbon pricing in 2021 and the increase in energy prices following the war in Ukraine had only a small bearing on support. Support seems to have marginally increased over time despite these events. Moreover, support is persistent, as respondents who support carbon pricing in one survey wave are much more likely to support it later on. Controlling for within-variation of the subjects we show that variables that usually explain support in cross-sectional analyses, e.g. car use, income, and education (Bergquist et al., 2022), are not significant in the longitudinal analysis. Yet, among respondents who are vulnerable to high energy prices public support has decreased. Importantly, Regarding the use of revenues, we detect that earmarking for green investments has become less popular, while compensating low-income households has become more popular. In particular, people experiencing high energy costs are more likely to increase their support for direct transfers.

2 Data and experimental design

The data for our analysis of the longitudinal support for carbon pricing stems from three survey waves, spanning from 2019 to 2022. They were administered in collaboration with the German professional survey institute forsa, which maintains a sample of roughly 100,000 members that is representative of the German population aged 14 and above. The participants of the forsa panel are recruited via telephone as well as cellphone. All randomly selected respondents were invited to the survey via a short email. In addition to the link to the questionnaire, the invitation contained a short introduction to the overall topic of the survey. As it is common with forsa, the participants received a small compensation for completing the survey in the form of bonus points. These can be exchanged either with small prizes, such as vouchers and a lottery ticket or can be donated.

We conducted the first survey between October 9, 2019 and November 6, 2019, i.e. just when the German government announced the new 'climate package', which included the introduction of a carbon price for the heating and transport sectors (see Edenhofer et al., 2020, for more details). After a pretest among 125 respondents who reported no problems with the questionnaire, it was sent out to a total of 9842 households. Overall, we retrieved data from 6549 individuals, whereof 432 discontinued the questionnaire at some point. In this case, respondents are household heads who are defined as the individuals who are usually responsible for financial decisions at the household level. The rationale behind this choice is the following: The questionnaire included several items that were most accessible to household heads, such as hypothetical purchase decisions of energy-intensive appliances and the elicitation of energy costs.

In the first survey, we split the participants into three groups that were confronted with a hypothetical carbon price of €10 (n=2122), €50 (n=2106), and €100 (n=2143), respectively, and asked one binary question about the support of this price (see Sommer et al., 2022, for more details). In addition, the respondents received information about the cost associated with the carbon price. Specifically, we informed them about the additional cost for a car trip from Berlin to Munich and the annual consumption of natural gas as well as heating oil for an average German family.[1]

After the carbon price of €25 was introduced in 2021, we administered a second survey with the same set of questions. In order to get a full picture of the attitudes in the German population, we opted to administer this second survey to a sample of individuals aged 18 and above. However, whenever possible we contacted the household heads from the first survey. This survey was initiated on June 11, 2021 and completed on June 30, 2021 after a positive pretest in the first of week of June. This questionnaire was sent out to 12,652 individuals and 8677 of them decided to participate. 651 (7.5%)

[1]For the wording of the experiment and all other relevant survey questions, see the Online Appendix.

dropped out at some stage of the questionnaire. We were able to recruit 3866 out of the 6371 participants who completed the choice experiment in the first survey wave.

Respondents who were confronted with a carbon price of €50 or €100 in the first wave were assigned the same price level in the second survey. We used this experimental setup to avoid declines in the carbon price level over time. Because the German carbon pricing scheme started out with a price of €25 instead of €10 as foreseen during the design phase of the first survey, we use €25 instead as the third price category. Respondents who were confronted with a price of €10 in the first survey were randomly assigned to a price level of €25, €50 or €100, just as respondents who had not participated in the first survey. This allows us to analyze support for a carbon price increase.

Finally, in the summer of 2022, we conducted a third survey, repeating our experiment and trying to recruit as many respondents as possible who already participated in the first two waves. This survey was initiated on July 18 and finalized on August 6 after a positive result from the pretest. This questionnaire was sent out to 8028 individuals. Overall, 6583 individuals participated, but 579 (8.8%) dropped out at some stage of the questionnaire. We were able to recruit 3296 respondents who participated in all three surveys, and 1451 of those reported answers to all relevant questions used in the empirical analysis.

The last wave captures potential effects of the Russian invasion of Ukraine, and the ensuing energy crisis in Germany. Between January and August 2022, the natural gas price for households almost doubled (Ruhnau et al., 2022), while the electricity price for households increased by 19% during the first semester of 2022 (Eurostat, 2022). The German government implemented a series of policies to reduce the impact on people's budget. Among others, households enrolled in the housing benefit program received a heating allowance of approximately €300. Moreover, the federal tax on oil was lowered, leading to a reduction of gasoline and diesel prices between 17 and 30 cents per litre and a cheap ticket for local and regional transport was introduced.

Regarding the carbon prices in the experiment, we followed the same procedure as in the second survey: Respondents who were confronted with a carbon price of €50 or €100, respectively, were assigned the same price level again. As over time, the German carbon price reached €30 we use this price instead as the third price category. Respondents who were confronted with a price of €25 in the second survey were randomly assigned to a price level of €30, €50 or €100.Figure 1 illustrates how respondents are mapped from one group to another across the three surveys.

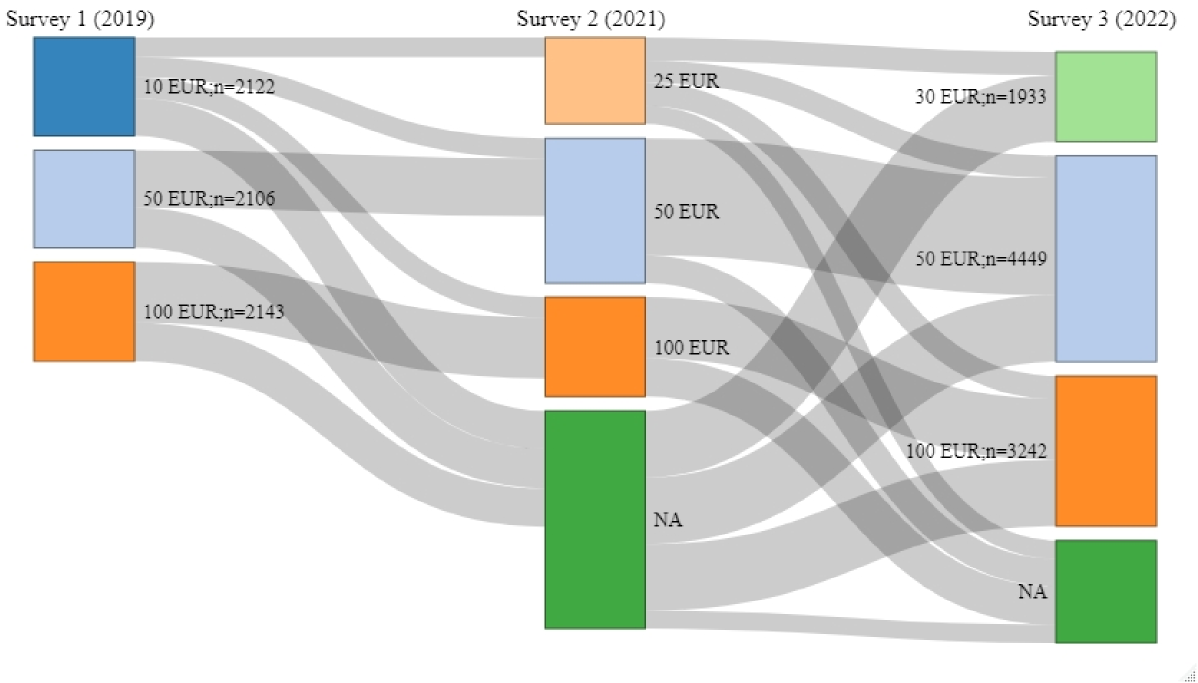


Figure 1: Mapping of respondents over surveys

Beside the choice experiments, the surveys collected socio-economic characteristics and attitudes. For our analysis, we restrict the sample to respondents who participated in all three survey waves and reported answers to all questions we deem necessary for our analysis, resulting a final sample of 1451 individuals (N=4353).[2] Table 1 displays the summary statistics of the respondents across the three waves.[3] The mean age of

[2]Defining a binary variable as one if an individual participated in the first survey but not in the second and third survey and zero if she took part in all surveys, we can analyze the attrition in our sample. Running a simple OLS model with this dependent variable, we detect that participation in the second survey is irrespective of the carbon price level in the first round of the experiment (Table C1 in the Online Appendix). College graduates and more affluent individuals are less likely to drop out. Importantly, attrition does not seem to correlate with pro-environmental or political attitudes. Thus, we assume that our sample is not self-selected based on a propensity for climate-related topics.

[3]Table C2 in the appendix compares the descriptive statistics of our sample to the population means of household heads in Germany in 2022. We detect that our sample is somewhat older, more affluent, and better educated.

the respondents has increased, which is a mechanical effect owed to the timing of the surveys. The other socio-economic characteristics in turn have been stable over time. For instance, roughly 30% of the respondents are college graduates, the mean household size is two and just more than 20% reside in rural areas, which are defined as those with a population density of below 50 inhabitants per km^2. Monthly household net income is measured in intervals of €500 bottom-coded at €700 and top-coded at €5700. Evaluated at the center of each interval, mean income is roughly €3000 in the three years.

Table 1: Summary Statistics

	2019	2021		2022	
	Mean	Mean	t-Stat.	Mean	t-Stat.
(A) Socio-economic characteristics					
Age	57.815	59.281	(2.744)**	60.377	(4.787)**
Female	0.341	0.341	(-0.000)	0.341	(-0.000)
College degree	0.287	0.288	(-0.041)	0.287	(-0.041)
Household size	2.008	1.979	(-0.874)	1.967	(-1.301)
Income	2,967	3,004	(0.816)	3,049	(1.808)
Unemployed	0.023	0.022	(-0.257)	0.019	(-0.898)
Has children	0.642	0.643	(0.116)	0.629	(-0.734)
Homeowner	0.580	0.587	(0.376)	0.584	(0.188)
East Germany	0.256	0.254	(-0.085)	0.255	(-0.043)
Rural	0.229	0.220	(-0.580)	0.219	(-0.625)
(B) Carbon tax related					
Car owner	0.908	0.912	(0.389)	0.908	(0.000)
Gas heating	0.517	0.510	(-0.409)	0.523	(0.297)
Oil heating	0.203	0.184	(-1.289)	0.170	(-2.245)**
Other heating	0.280	0.306	(1.543)	0.307	(1.584)
High energy cost	0.401	0.447	(2.517)**	0.664	(14.527)**
(C) Attitudes					
Believe in climate change	0.806	0.894	(7.158)**	0.919	(9.244)**
Pro-environmental attitudes	10.975	11.049	(0.707)	11.507	(5.052)**
Rather left	0.305	0.191	(-7.308)**	0.208	(-6.688)**
AfD	0.077	0.066	(-1.193)	0.056	(-2.312)**
Trust	0.385	0.509	(6.704)**	0.482	(5.244)**
(D) Contextual variables					
No. of weekly climate-related articles	22.5	23.2	(4.001)**	14.2	(-52.518)**
Monthly Covid-19 cases in county	0.000	269.4	(0.784)	12,539	(36.476)**

Note: We report t-test statistics for the equality of means between 2019 and 2021 and 2022, respectively, in parentheses. ** denotes statistical significance at the 1% level. N=4353 with data from 1451 individuals.

However, we observe changes in areas affected by the carbon price. For starters, the use of oil heating has decreased over time. We also measure substantial differences regarding the perceived energy cost. The share of respondents who state that they incur high energy cost increases from 40% in the first wave to 45% in the second and to 66% in the third wave. The distribution of other variables is relatively constant over time. In all three waves, more than 90% of the respondents declare owning a car, and the main heating source for the dwelling remains natural gas.

Turning to attitudes, we find that the share of respondents who believe in climate change increases from roughly 80% to more than 90% between the first and the third survey wave. The share of respondents who report to trust the government in the second and third survey exceeds the one of the first survey by about ten percentage points. We also elicit pro-environmental attitudes, using a short version of the Diekmann and Preisendörfer (1998) index. For each of the three spheres – affective, cognitive, and conative – we use one item instead of three like on the original scale, and each item is measured using a five-point Likert scale. In the first two survey waves, the mean value amounts to roughly 11 on a range between 3 and 15 and increases to 11.5 in the third wave. In the analysis, we standardize the index using the z-score, yielding a Cronbach's (1951) Alpha of 0.78.

Regarding contextual variables, we include the number of Covid-19 cases in the county of the respondents' residence in the month the respondent took the survey. In addition, we include the media coverage of climate policy by counting the number of articles in eleven major news outlets that mention climate-related keywords in the week before the respondent took the the survey. [4]

3 Results

In autumn 2019, almost 60% of the respondents supported a carbon price of €10 per ton of CO_2 (Figure 2). The support declines to 50% for a carbon price of €50 and to 40% for a carbon price of €100. Overall, we detect that the support for the higher price levels has remained stable over time. In the group assigned to the lowest carbon price, we also find that support is roughly constant despite the gradual increase in the price

[4] For more details, see Appendix D.

level from €10 in 2019 to €30 in 2022 (note the larger variability because of a smaller sample size). Importantly, the support rates in the last survey wave are very similar to the first two despite the spike in energy prices.

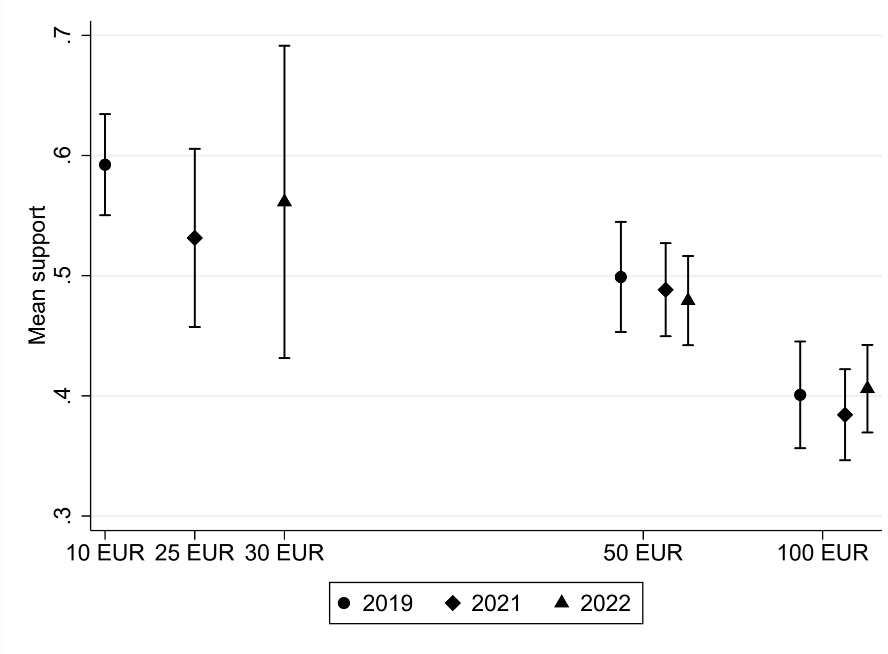


Figure 2: Support of carbon pricing over time

Note: The dots, diamonds, and triangles present the mean in of support rates and the whiskers represent the 95% confidence intervals. N=4353 with data from 1451 individuals.

In line with findings of other studies on the determinants of the support for carbon pricing (e.g. Maestre-Andrés et al., 2019; Bergquist et al., 2022), the cross-sectional analysis of the pooled data (see Appendix B) shows that support is positively linked to having pro-environmental attitudes, believing in climate change, trusting the government and being on the left of the political spectrum. Conversely, owning a car, heating with fossil fuels and having high energy costs are negatively linked to the support of carbon pricing. As we observe within individual variations for most of these variables (see Table 1), we can test whether they have a significant influence on support while controlling for individual fixed effects.

3.1 Longitudinal support for carbon pricing

We use the following fixed-effects model that exploits the variation within individuals over time and estimate it using Ordinary Least Squares :

$$y_{it} = \beta_0 + \boldsymbol{\beta}_c^T \boldsymbol{C}_{it} + \boldsymbol{\beta}_x^T \boldsymbol{X}_{it} + \boldsymbol{\beta}_p \boldsymbol{Post}_t + \mu_i + \epsilon_{it}, \quad (1)$$

where y_{it} is coded as unity if respondent i reports to support a carbon price in survey year t and zero otherwise. Vector $\boldsymbol{C}$ indicates the carbon price level the respondent faced in the hypothetical choice experiment. For the sake of readability and because of lower sample sizes for prices of €10, €25, and €30, we group these low price levels in the analysis. The parameters $\boldsymbol{\beta_c}$ therefore capture the effect of a carbon price of €50 and €100, respectively, compared to lower price levels. Vector $\boldsymbol{X}$ comprises the set of control variables and ε denotes a random error term. We include individual fixed effects μ_i that capture time-invariant characteristics and two dummy indicator variables $\boldsymbol{Post}$ that are equal to unity for the second (2021) or third survey wave (2022) and zero for the other waves. The estimation results can be found in the Table C6 in the online appendix.

This analysis based on fixed-effects reveals several important insights (Figure 3): First, increasing the price level from below €50 in the first or second survey to €50 and €100, respectively, in later surveys decreases the support. Interestingly, the effects are almost as strong as in the cross-sectional analysis. Second, the statistically insignificant coefficients on the year dummies indicate that on average support for carbon pricing has not changed a lot over time, yet it appears to be somewhat higher in the latest wave. Third, most time-variant variables exhibit rather small coefficients and yield statistically insignificant effects. In particular, variables, such as believing in climate change, being rather left or trusting the government, that are usually employed as predictors in cross-sectional analyses turn out to be negligible when exploiting longitudinal data. However, variables linked to energy use (e.g., gas heating and high energy cost) remain statistically significant Hence, realizing that energy costs are a burden might lead to opposing carbon pricing. [5]

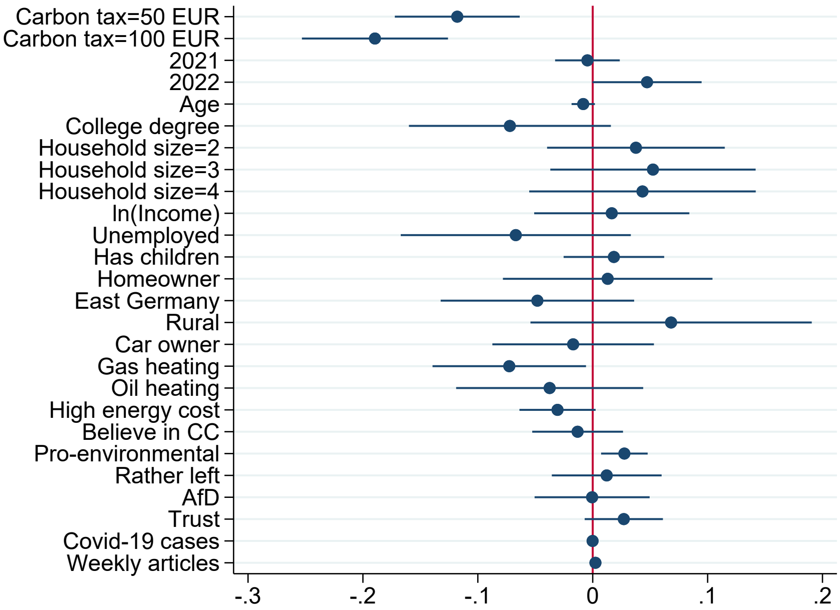


Figure 3: Drivers of the support for carbon pricing using within-variation

Note: The dots represent the point estimate from a fixed-effects regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N=4343 with data from 1451 individuals.

The absence of statistically significant effects in Figure 3 for some variables (e.g. East Germany, Car owner, and Oil heating) is largely owed to little variation in in the data. Yet, regarding political attitudes, quite a large number of 400 individuals report switching political preferences. Even though political orientation is an important determinant in cross-sectional analysis (see Supplementary Figure B1), the coefficient is indistinguishable from zero in the fixed-effects estimation. Similarly, using repeated cross-sectional data suggests that supporters of the German populist party AfD tend to reject carbon pricing, which cannot be confirmed when moving to longitudinal data. This indicates that switching political preferences or turning toward AfD does not

[5]Estimating the link between policy stringency and policy support might be subject to reverse-causation issues. In particular, it is possible that policy stringency increases due to higher political support or that autocratic regimes with lower support have a higher capacity to implement stringent policies. Earlier studies use an instrumental variable setting to circumvent this issue. For instance, Furceri et al. (2021) show that OLS estimates are biased towards zero, which indicates that public support is likely to be necessary to implement stringent policies. In our study, the increase of stringency of the carbon pricing mechanism was pre-planned and unlikely to have been affected by changes in public support. Therefore we can rule out reverse-causality. We also control for most variables that could influence both the trajectory of carbon pricing and changes in support such as trust in institutions and energy costs.

change attitudes towards carbon pricing. Instead, people who support carbon pricing are rather left, and AfD seems to attract people who reject carbon pricing to begin with (see Knollenborg and Sommer, 2023, for a similar argument).

We further show that believing that climate change is happening has large explanatory power in the cross-sectional analysis (Supplementary Figure B1), but its coefficient is indistinguishable from zero in the longitudinal analysis (Figure 3). On the contrary, higher pro-environmental preferences have a positive association with support. Therefore, in countries where there is already a strong belief in climate change, convincing more people that climate change exists may not foster further support for carbon pricing, but increasing pro-environmental preferences could.

3.2 Dynamics of support

The previous analysis is limited to analyzing the mean effect of the introduction of carbon pricing over all price levels. Yet, we are also interested in the differential pattern of the support rate depending on the price level. To this end, we extend the previous model specified in Equation (1) by including an interaction term between the price level and the year dummies (*Post*):

$$y_{it} = \gamma_0 + \boldsymbol{\gamma_c}^T \boldsymbol{C}_{it} + \gamma_p \boldsymbol{Post}_t + \gamma_{cp} \boldsymbol{C}_{it} \times \boldsymbol{Post}_t + \boldsymbol{\gamma_x}^T \boldsymbol{X}_{it} + \mu_i + \nu_{it}. \quad (2)$$

This allows us to infer whether there are differential effects of time for the different prices (see Table C7 in the appendix for the estimation results). For an easier interpretation, we calculate the marginal effect of the year dummies at all price levels, i.e. $\frac{\partial y}{\partial Post} = \gamma_p + \gamma_{cp} \times C$, which are displayed in Figure 4.

Our results indicate that the negative effects of prices below €50 are stable over time even though the carbon price gradually increases. In addition, we find that the negative price effects in 2021, that is after the introduction of the carbon pricing scheme, are similar to 2019. In 2022, however, the negative effects for prices of €50 and €100 are about 5–6 percentage points smaller compared to the first survey in

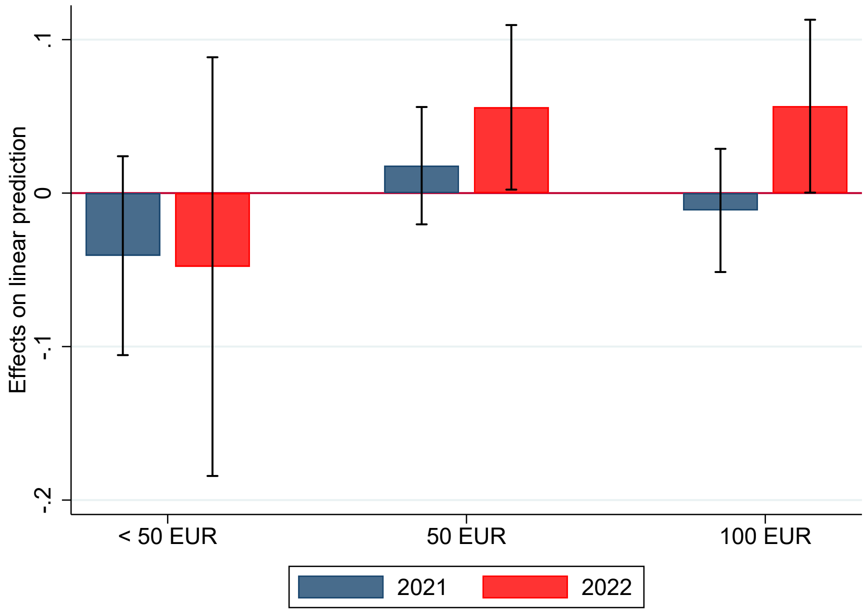


Figure 4: Effect of high price levels over time

Note: The bars represent the marginal effect of the year dummies from a fixed-effects regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N=4353 with data from 1451 individuals.

2019 (Figure 4). This suggests that support for carbon pricing at higher price levels has somewhat increased over time despite the war in Ukraine and the resulting energy crisis. Hence, the support for Germany's carbon price does not seem to decay over time despite the introduction and ramping up of this climate policy and starkly increased energy prices. On the contrary, support for high carbon prices has been constant or increased slightly over time, which is consistent with the analysis for pre-/post-implementation in Canada reported by (Mildenberger et al., 2022).

Another way to look at the support of a carbon price over time is to explicitly model a dynamic relationship. As we only observe data from three surveys, we pursue this approach by pooling our data over time periods and including the lagged dependent variable (LDV) in Equation (4), giving:

$$y_{it} = \delta_0 + \delta_l y_{i,t-1} + \delta_c^T \mathbf{C}_{it} + \delta_x^T \mathbf{X}_{it} + \epsilon_{it}, \tag{3}$$

where y denotes the support for carbon price and $y_{i,t-1}$ reflects the opinion from the previous survey (see Table C8 in the online appendix for the estimation results).

By explicitly modelling a recursive relationship for the support of carbon pricing, we find that it is highly auto-correlated over time. To be precise, respondents who stated that they support a carbon price have a roughly 40 percentage points higher probability to support the carbon price in a following survey as well. Interacting this opinion with the price level (i.e. $y_{i,t-1} \times C$ in Equation (3)) provides insights into whether this support changes with the level of the price. Figure 5 shows that the effect of the previous level support for carbon pricing is very similar across the range of prices.

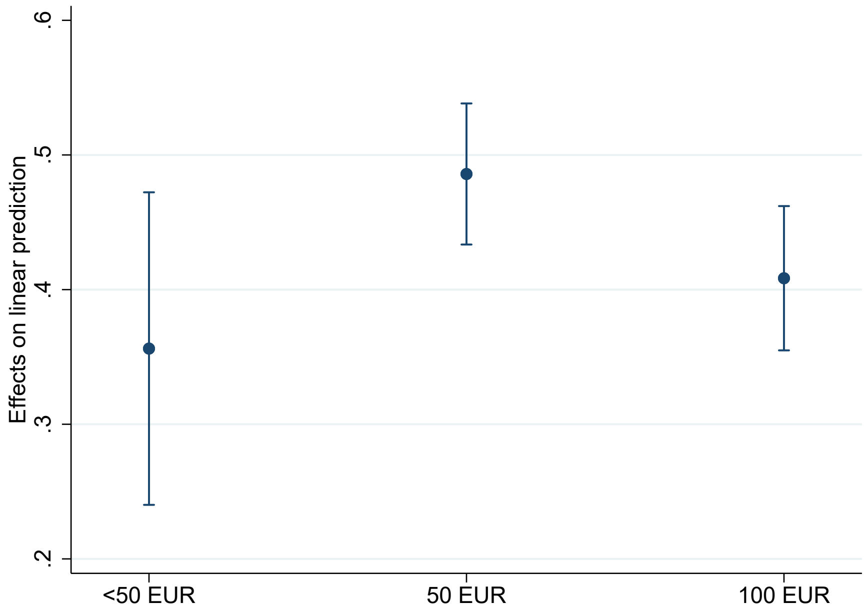


Figure 5: Effect of previous support

Note: The dots represent the marginal effect of the lagged dependent variable *LDV* from an OLS regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N=2902 with data from 1451 individuals.

This finding suggests that support for carbon pricing is very persistent. Once respondents are in favor of carbon pricing, their support seems to remain after its implementation and an unfolding energy crisis with peaking energy prices. Notably, over the entire survey period, roughly one third of the respondents always supports the carbon pricing scheme. In turn, 40% always reject it. Thus, the remainder off roughly 30% switches between supporting and rejecting a specific carbon pricing design.

3.3 Heterogeneity analysis for support

Beyond mean effects we are also interested in heterogeneous effects on the support of carbon pricing. As the marginal effects of the year dummies are similar across the price levels, we drop the interaction term $\delta_{cp}\boldsymbol{C}_{it} \times Post_t$ from Equation (2). Instead, we incorporate interaction effects $\beta_{wp}\boldsymbol{W}_{it} \times Post_t$, where W is a subset of variables within $\boldsymbol{X}$. For the sake of an easier interpretation, we create a new *Post* dummy that equals unity if the survey was conducted in 2021 or 2022 and zero otherwise. We systematically interact our control variables with the *Post* dummy and run three models in which $\boldsymbol{W}$ encompasses the categories (A), (B), and (C)-(D) from Table 1 (see Table C9 in the appendix for the estimation results).

Calculating the marginal effects of *Post* (Figure 6), we show that there are heterogeneous effects of time on the support of a carbon price. We observe notable interaction effects for variables that reflect the economic burden for individuals from energy use. Hence, the change in the support for carbon pricing depends largely on its effect on energy and transport related activities (B), but is does not vary with socio-economic characteristics (A), attitudes (C), and only slightly with the news coverage (D). For starters, we detect that the support for a carbon price decreases somewhat stronger for individuals who state to incur high energy cost compared to those who do not report this even though the effect is only statistically significant at the 10% level. Regarding the heating source, the interaction effect on using oil as a primary heating source suggests that the support rate increases somewhat over time. This might indicate that the perceived financial burden from a carbon price has not manifested itself.

3.4 Support for revenue use

One particularly interesting aspect of the newly introduced carbon price regards the use of the revenues it generates. In Germany, the discussion about the revenue use centered around three options (see Sommer et al., 2022, for a more detailed discussion): investments into green infrastructure (green spending), a lump-sum payment, and

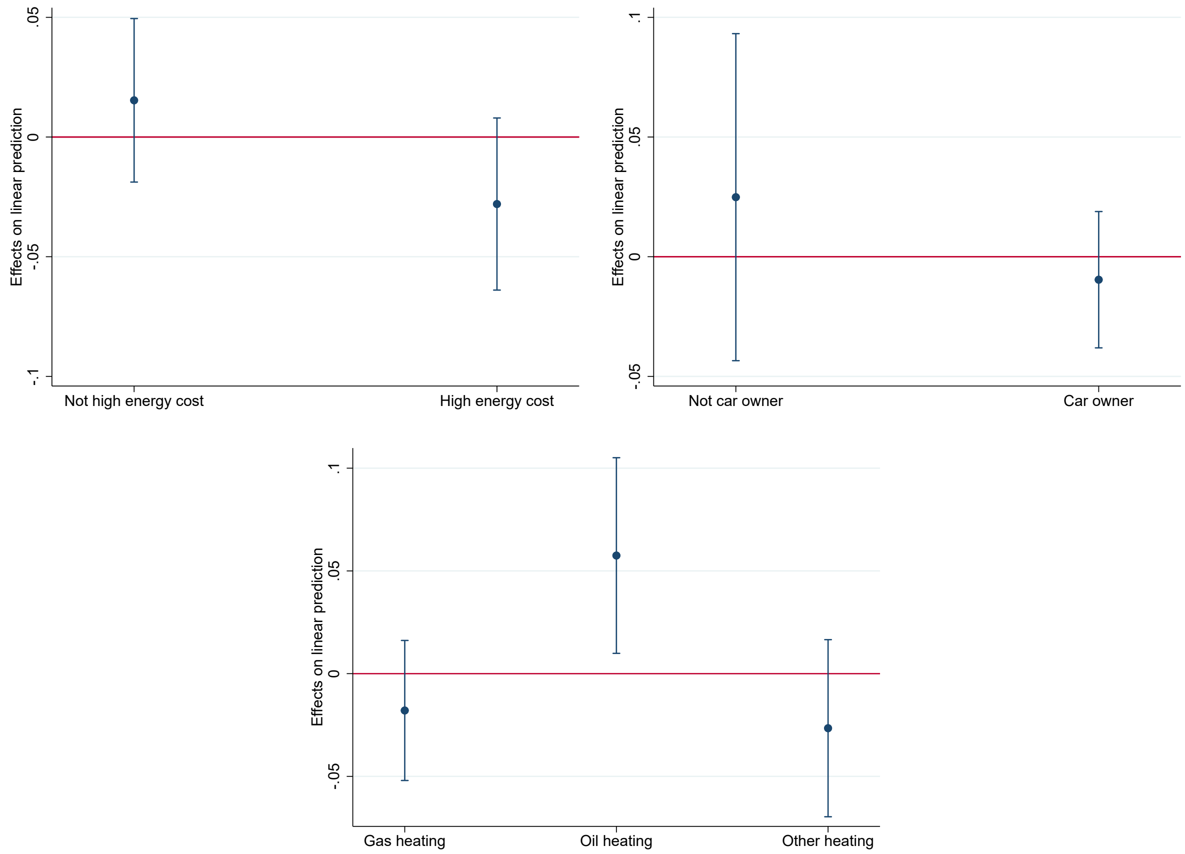


Figure 6: Effect of carbon price-related variables over time

Note: The dots represent the marginal effect of *Post* from a fixed-effects regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. Note: N=4248 with data from 1416 individuals.

compensating the financial burden for low-income households (social cushioning). In all three surveys, we asked for the support of these options on a five-point Likert scale and dichotomized the answers for our purposes. We are mainly interested in how the support for these revenue uses changes once the carbon price was introduced.

To this end, we estimate Equation (1) with the support for the revenue scheme as dependent variable (see Table C10 for the estimation results). We find substantial effects of time on the support of revenue uses (Figure 7). The support for green spending decreases by roughly 10 percentage points from 87% to about 76% between 2019 and the following years. Regarding the lump-sum payment we find that in 2019 about 46% of respondents support this revenue use. We also find that support for this scheme decreases by a somewhat larger extent in 2021 compared to 2022 even though the difference between these two is not statistically different from zero. In contrast, social cushioning has become more popular over time, as the support increases from 38% in 2019 to 49% in 2021.[6]

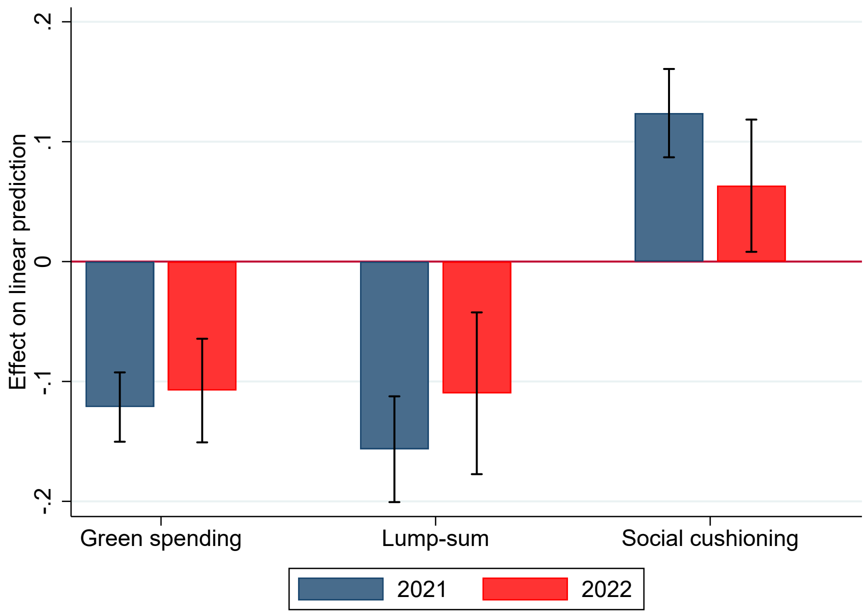
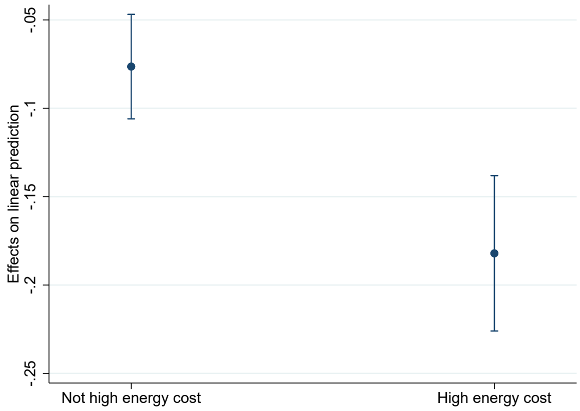


Figure 7: Support for revenue uses

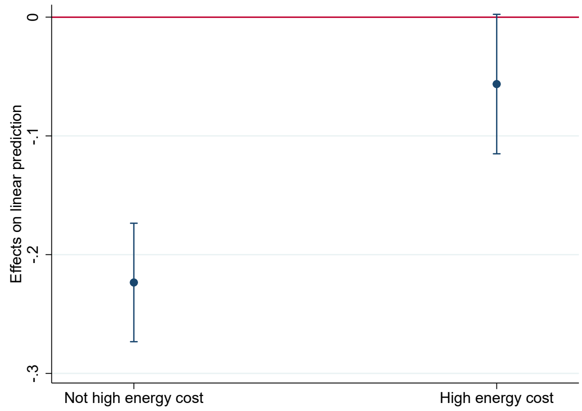
Note: The bars represent the marginal effect of the year dummies from a fixed-effects regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. Note: N=4353 with data from 1451 individuals.

Furthermore, our results show that respondents with strong environmental attitudes are more likely to support green-spending, likely because of its higher perceived effectiveness. In contrast, car-ownership and perception of high energy-costs are negatively associated with support for green-spending (Supplementary Table C10). This suggests that people who expect large personal costs from climate policies are less likely to support them without direct redistribution. More precisely, Figure 8 shows that respondents who report to have high energy costs lower their support for green spending. In turn, in this group, lump-sum payments become more popular.

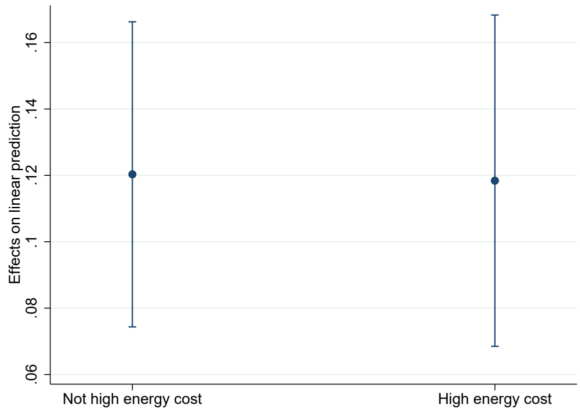
[6]Note that the survey text was slightly adjusted between 2019 and 2021 as we merged two categories of green spending (green energy and green transport infrastructure) into a single one. Yet, when excluding the year 2019 from the regression, our results are largely unchanged.



Green spending



Lump sum



Social cushioning

Figure 8: Effect of time on support for revenue uses

Note: The dots represent the marginal effect of *Post* from a fixed-effects regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. Note: N=4341, 4286, and 4312 with data from 1451 individuals.

4 Conclusion

At the outset of 2021, the German government introduced a price on carbon of €25 per ton for the housing and the transport sector that will gradually increase over time. There was a considerable public debate on the carbon price, particularly regarding its distributional aspects and revenue use. Whether the carbon price can be increased as planned crucially depends on public support. By conducting a longitudinal study on the support of the carbon price with surveys before and after its introduction among the same respondents, we shed light on whether preferences for carbon pricing change once it is implemented.

Our findings contribute to a better understanding of support for real carbon pricing. They show that the support for carbon pricing remained fairly stable over time, as established by Mildenberger et al. (2022). For instance, roughly 60% of the respondents support a carbon price of €10, €25 or €30 per ton, while the support drops to about 50% for a price of €50 per ton, and the support for a carbon price of €100 per ton decreases slightly from 40% in 2019 to 35% in 2021. In addition, most drivers and barriers for support are also constant over time. For instance, well-educated individuals and high-income owners are more likely to support carbon pricing, while respondents who have relatively high personal costs reject it more frequently, namely car owners, respondents who heat with oil, and respondents who perceive their energy cost as high. To be precise, respondents who believe that they incur high energy cost have a 20 percentage point lower probability to support carbon pricing. In fact, respondents who incur high energy costs represent the only group of respondents that notably reduces their support over time. It might be that they perceive that the burden of higher energy costs has increased due to the introduction of a carbon price or the war in Ukraine. Thus, increasing the stringency of a broadly accepted carbon price, which is needed to mitigate climate change, might not reduce support in general.

Moreover, we document that respondents who support carbon pricing in one survey, are substantially more likely to also support it in following surveys. Hence, generating support for an environmental policy early on is key, as support is likely to persist. However, our study does not support the idea of imposing an unpopular climate policy, hoping that public opinion will become much more supportive over time. This finding contrasts with previous results from Schuitema et al. (2010) about congestion pricing, even though we find that the large effect of high prices becomes less strong over time. The reason for such differences could be that costs and benefits are more salient to people in the case of road pricing. People find it more difficult to estimate accurately costs of carbon prices (Douenne and Fabre, 2022) since they are not restricted to one particular good.

One crucial aspect to ensure continued support of carbon pricing is the use of generated revenues. We find that green spending is the most popular way to use the revenues, but its popularity has shrunk by almost ten percentage points over time. Likewise, the payment of a lump-sum to each citizen has become less popular. In turn, using the revenues to alleviate the financial burden of vulnerable groups, such as low-income households has become more popular over time and is supported by half of the respondents in the second survey. Notably, among respondents with high energy cost, we observe a particularly strong decline in the support of green spending and conversely a rise in the popularity of lump-sum payments. To maintain strong public support for climate action, policymakers can pair stringent policies with visible compensation and adapt measures to external events that increase the vulnerability of households to high energy prices.

Taken together, from a policy-making perspective, it is key to generate support of an environmental policy before its implementation as it is likely to continue afterwards. While we do not find that support increases within a particular group, people who perceive their energy cost as high, tend to decrease their support. To keep their support level also high, policy-makers could accompany environmental policy with a visible compensation for vulnerable households. Moreover, information policies aimed at convincing the public that climate change is real are unlikely to affect public support for environmental policies.

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Online Appendix

How resilient is support for carbon pricing? Evidence from Germany

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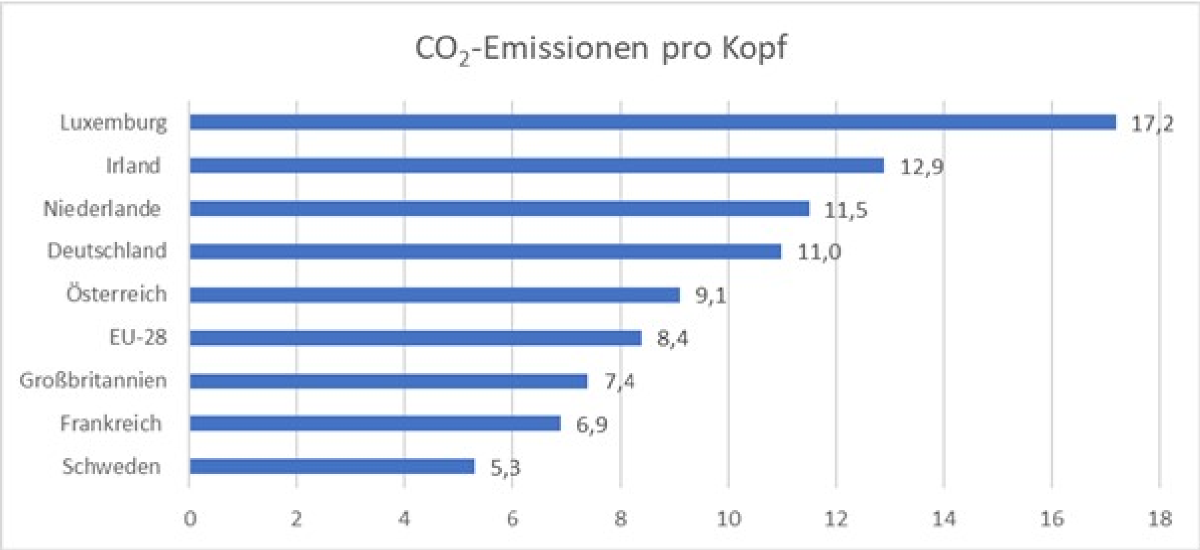
In this online appendix, we first document the wording of the stated-choice experiments (Appendix A). Second, we report the results of the cross-sectional analysis (Appendix B) Third, we display the regression tables for the analyses displayed in the main text of the article (Appendix C). Fourth, we provide some information on the scrapper we use to count the number of climate-related articles (Appendix D)

A Wording of the experiment

A.1 Experiment in 2019 survey

In Germany, annual CO_2 emissions per capita amount to around 11 tons. This puts Germany well above the average for the European Union.



To achieve the climate target for 2030 – the reduction of CO_2 emissions by 55% compared to 1990 – annual emissions must be reduced to 6.8 tons per capita.

Against this backdrop, there are discussions in Germany about introducing a CO_2 tax on fuel, natural gas, and heating oil consumption, which would be levied per ton of CO_2 emitted. For your information, we have prepared a list with the average CO_2 emissions of various activities:

- Car trip from Berlin to Munich: 0.11 tons of CO_2
- Gas heating (112 cubic metres m^3; corresponds to the annual consumption of an average household) 2.49 tons of CO_2
- Oil heating (2,000 liters; corresponds to the annual consumption of an average household) 6.35 tons of CO_2

The respondents are split equally into three groups with a carbon price of €10, €50, €100.

Question 1: The introduction of a CO_2 tax of €10/50/100 per ton of CO_2 would result in an increase of €2.62/5.24/7.85 in the cost of driving from Berlin to Munich (including VAT), €59.26/118.52/177.79 for operating the gas heating and €151.13/302.26/453.39 for operating the oil heating. Would you agree to the introduction of a CO_2 tax of €10/50/100 per ton?

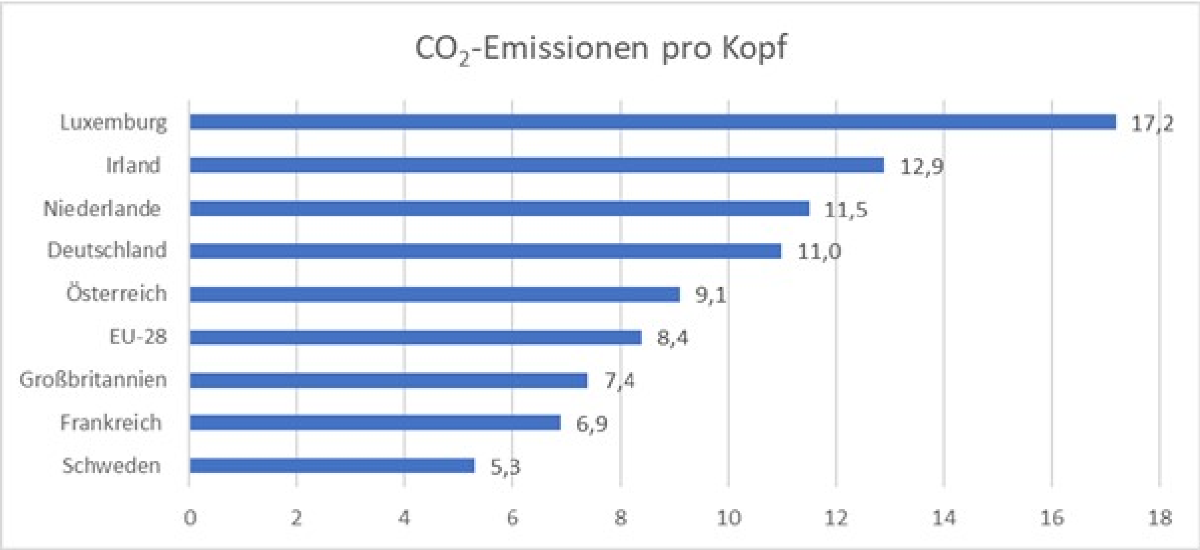
- Yes
- No
- Do not know

Question 2: To sum up, we have now put together some further suggestions as to how the Federal Government could use the additional revenues from the introduction of the CO_2 tax. Please indicate to what extent you are in favor or against the following measures. The revenues from the CO_2 tax should be ... (*The order of the items is randomized. The respondents indicated their level of agreement on a five-point Likert scale.*)

- ... used for the expansion of renewable energy sources such as wind, solar and hydro power (*green energy*).
- ... used for the development of a climate-friendly transport system, for example by financing cycle paths and the expansion of railways and local public transport (*green transport*).
- ... treated as government revenue like other tax revenues and included in the federal budget (*fiscal purposes*).
- ... returned to all citizens in the same amount as a direct annual payment (*lump sum*).
- ... used to directly support low-income households (*social cushioning*).
- ... used to reduce other taxes such as income tax (*double dividend*).
- ... used specifically for households that suffer particularly from the levy (*needs principle*).

A.2 Experiment in 2021 survey

In Germany, annual CO_2 emissions per capita amount to around 11 tons. This puts Germany well above the average for the European Union.



To achieve the climate target for 2030 – the reduction of CO_2 emissions by 55% compared to 1990 – annual emissions must be reduced to 6.8 tons per capita.

Against this backdrop, Germany has introduced a CO_2 tax on fuel, natural gas, and heating oil consumption, which are levied per ton of CO_2 emitted. For your information, we have prepared a list with the average CO_2 emissions of various activities:

- Car trip from Berlin to Munich: 0.11 tons of CO_2
- Gas heating (112 cubic metres m^3; corresponds to the annual consumption of an average household) 2.49 tons of CO_2
- Oil heating (2,000 liters; corresponds to the annual consumption of an average household) 6.35 tons of CO_2

The respondents are split equally into three groups with a carbon price of €25, €50, €100.

Question 1 for participants with a carbon price of €25: The introduction of a CO_2 tax of €25 per ton of CO_2 has resulted in an increase of €2.75 in the cost of driving from Berlin to Munich (including VAT), €62.25 for operating the gas heating and €158.75 for operating the oil heating. Do you support the CO_2 tax of €25 per ton?

- Yes
- No
- Do not know

Question 1 for participants with a carbon price of €50 and €100: In the future, higher CO_2 prices will be necessary to mitigate climate change. Raising the CO_2 price to €50/100 per ton of CO_2 would increase the cost of driving from Berlin to Munich (including VAT) by €5.50/11.00. The cost of operating the gas heating would increase by €124.50/249.00, and the cost of operating the oil heating would increase by €317.50/635.00. Would you agree to the introduction of a CO_2 tax of €50/100 per ton?

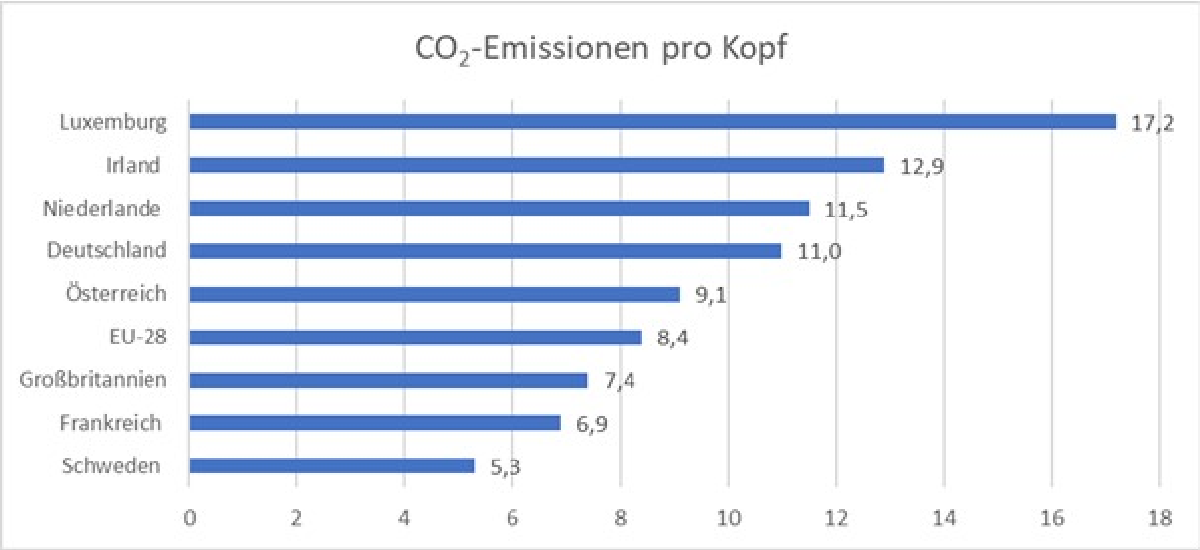
- Yes
- No
- Do not know

Question 2: We have now put together several suggestions as to how the Federal Government could use the additional revenues from the introduction of the CO_2 tax. Please indicate to what extent you are in favor or against the following measures. The revenues from the CO_2 tax should be ... (*The order of the items is randomized. The respondents indicated their level of agreement on a five-point Likert scale.*)

- ... used for the expansion of renewable energy sources such as wind, solar and hydro power or a climate-friendly transport system, for example by financing cycle paths and the expansion of railways and local public transport (*green spending*).
- ... returned to all citizens in the same amount as a direct annual payment (*lump sum*).
- ... used to directly support low-income households (*social cushioning*).
- ... used to lower the price of electricity by lowering the EEG levy.

A.3 Experiment in 2022 survey

In Germany, annual CO_2 emissions per capita amount to around 11 tons. This puts Germany well above the average for the European Union.



To achieve the climate target for 2030 – the reduction of CO_2 emissions by 55% compared to 1990 – annual emissions must be reduced to 6.8 tons per capita.

Against this backdrop, Germany has introduced a CO_2 tax on fuel, natural gas, and heating oil consumption, which are levied per ton of CO_2 emitted. For your information, we have prepared a list with the average CO_2 emissions of various activities:

- Car trip from Berlin to Munich: 0.11 tons of CO_2
- Gas heating (112 cubic metres m^3; corresponds to the annual consumption of an average household) 2.49 tons of CO_2
- Oil heating (2,000 liters; corresponds to the annual consumption of an average household) 6.35 tons of CO_2

The respondents are split equally into three groups with a carbon price of €30, €50, €100.

Question 1 for participants with a carbon price of €30: The introduction of a CO_2 tax of €30 per ton of CO_2 has resulted in an increase of €3.30 in the cost of driving from Berlin to Munich (including VAT), €74.70 for operating the gas heating and €190.5 for operating the oil heating. Do you support the CO_2 tax of €30 per ton?

- Yes
- No
- Do not know

Question 1 for participants with a carbon price of €50 and €100: In the future, higher CO_2 prices will be necessary to mitigate climate change. Raising the CO_2 price to €50/100 per ton of CO_2 would increase the cost of driving from Berlin to Munich (including VAT) by €5.50/11.00. The cost of operating the gas heating would increase by €124.50/249.00, and the cost of operating the oil heating would increase by €317.50/635.00. Would you agree to the introduction of a CO_2 tax of €50/100 per ton?

- Yes
- No
- Do not know

Question 2: We have now put together several suggestions as to how the Federal Government could use the additional revenues from the introduction of the CO_2 tax. Please indicate to what extent you are in favor or against the following measures. The revenues from the CO_2 tax should be ... (*The order of the items is randomized. The respondents indicated their level of agreement on a five-point Likert scale.*)

- ... used for the expansion of renewable energy sources such as wind, solar and hydro power or a climate-friendly transport system, for example by financing cycle paths and the expansion of railways and local public transport (*green spending*).
- ... returned to all citizens in the same amount as a direct annual payment (*lump sum*).
- ... used to directly support low-income households (*social cushioning*).
- ... used to lower the price of electricity by lowering the EEG levy.

B Repeated cross-sectional analysis

We analyze the drivers for the support of a carbon price using repeated cross-sectional methods. We follow the analysis by Sommer et al. (2022) for the reduced sample of the respondents who took part in all three surveys. We estimate the following linear probability model (LPM):

$$y_i = \alpha_0 + \boldsymbol{\alpha}_c^T \boldsymbol{C}_i + \boldsymbol{\alpha}_x^T \boldsymbol{X}_i + \varepsilon_i, \tag{4}$$

where y_i is coded as unity if respondent i reports to support a carbon price and zero otherwise. Vector $\boldsymbol{C}$ indicates the carbon price level the respondent faced in the hypothetical choice experiment. For the sake of readability and because of lower sample sizes for prices of €25 and €30, we group these price levels in the analysis. The parameters $\boldsymbol{\alpha}_c$ therefore capture the effect of a carbon price of €50 and €100, respectively, compared to lower price levels. Vector $\boldsymbol{X}$ comprises the set of control variables and ε denotes a random error term.

Estimating Equation (4) allows us to replicate the results of Sommer et al. (2022), as documented by Table C3 in the online appendix and Figure B1. We can confirm our previous graphical results from Figure 2 as the coefficients on the price levels concur with the differences in the means in the graph despite adding a large suite of explanatory variables. Regarding socio-economic characteristics, support of a carbon price is higher among college graduates and richer individuals, while it is negatively correlated with residing in East Germany. We also detect that respondents who are hit harder by carbon pricing, i.e. individuals who have a car or heat with oil exhibit significantly lower support rates. Controlling for attitudes, we find that the support for carbon pricing varies with political affiliation. Respondents who state to be politically rather left are more likely to support a carbon price, while the supporters of Germany's right wing party AfD are less likely to do so. Finally, the support for a carbon price is higher among respondents who trust the German government.

Comparing the three panels of Figure B1, we find that the coefficients of the variables considered in our analysis are roughly the same (see also Table C4 and Table C5). For instance, in all survey waves, respondents who state that they incur high energy cost have a lower probability, of about 20 percentage points, to support carbon pricing. Thus, we tend to confirm results from earlier studies that own economic consequences might be a major driver for the support of climate policies (Baranzini and Carattini 2017, Groh and Ziegler 2018). Moreover, the positive coefficient on trust in the government amounts to roughly 10 percentage points in both surveys. This emphasizes that trust is correlated with the support of carbon taxes as also suggested by Ewald et al. (2022), Hammar and Jagers (2006), Rafaty (2018), and Fairbrother et al. (2019).

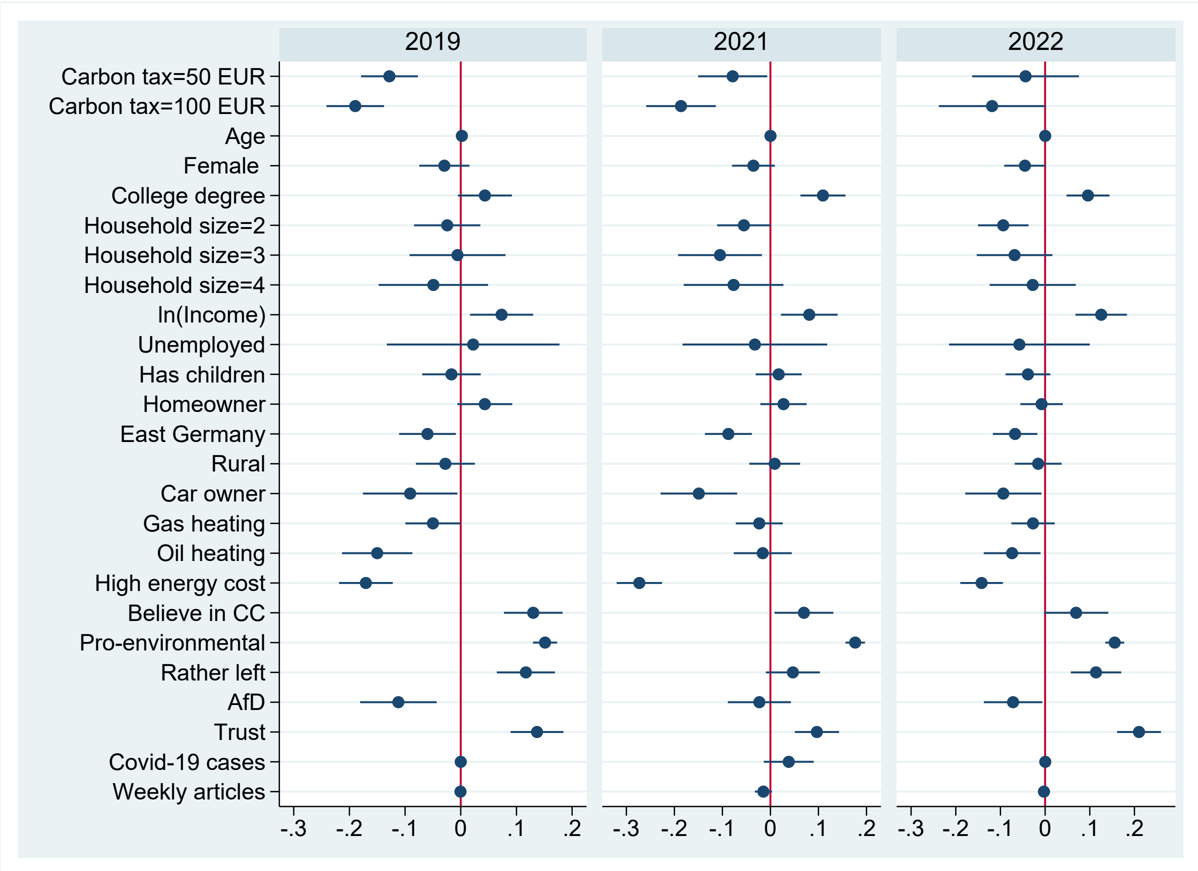


Figure B1: Determinants of support for carbon tax

Note: The dots represent the point estimate from an OLS regression and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N=4353 with data from 1453 individuals.

C Tables

Table C1: Attrition across survey waves

	(1)		(2)	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	0.030	(0.015)	0.032	(0.018)
Carbon tax=100 EUR	0.022	(0.015)	-0.001	(0.018)
Age	–	–	-0.000	(0.001)
Female	–	–	-0.025	(0.015)
College degree	–	–	-0.086**	(0.017)
Household size=2	–	–	0.026	(0.021)
Household size=3	–	–	0.084**	(0.030)
Household size=4	–	–	0.131**	(0.033)
ln(Income)	–	–	-0.042*	(0.020)
Unemployed	–	–	-0.044	(0.051)
Has children	–	–	-0.031	(0.018)
Homeowner	–	–	-0.004	(0.017)
East Germany	–	–	-0.033	(0.018)
Rural	–	–	-0.000	(0.018)
Car owner	–	–	-0.038	(0.027)
Gas heating	–	–	-0.005	(0.017)
Oil heating	–	–	0.014	(0.021)
High energy cost	–	–	-0.009	(0.016)
Believe in CC	–	–	-0.035	(0.019)
Pro-environmental	–	–	-0.007	(0.008)
Rather left	–	–	-0.012	(0.017)
AfD	–	–	-0.010	(0.030)
Trust	–	–	0.010	(0.016)
Constant	0.472**	(0.011)	0.900**	(0.153)
No. of observations	6371		4712	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively. The coefficient on *Female*is dropped because there is no variation in this variable over time.

Table C2: Representativeness of the sample

	Population	Sample
East Germany	0.205	0.255
Household size=1	0.408	0.314
Household size=2	0.341	0.490
Household size=3	0.120	0.114
Household size$\geq$ 4	0.131	0.827
Under 25 years 25	0.046	0.041
Between 25 and 64 years	0.667	0.556
Older than 64 years	0.287	0.440
Income below €1250	0.154	0.064
Income between €1250 and €3499	0.522	0.624
Income at least €3500	0.324	0.312
College degree	0.219	0.287

The data on the population is drawn from Destatis (2023). Instead of addressing the household head as in our sample, Destatis (2023) addresses the main income earner. The categories for reporting income are slightly different and not directly comparable. We compare the data for the year 2022.

Table C3: OLS results for the support of a carbon tax in the baseline

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.093**	(0.032)	-0.097**	(0.031)	-0.097**	(0.030)	-0.128**	(0.026)
Carbon tax=100 EUR	-0.192**	(0.031)	-0.191**	(0.031)	-0.190**	(0.029)	-0.190**	(0.026)
Age	–	–	0.002*	(0.001)	0.003**	(0.001)	0.002*	(0.001)
Female	–	–	0.039	(0.027)	0.025	(0.026)	-0.029	(0.023)
College degree	–	–	0.142**	(0.029)	0.094**	(0.028)	0.043	(0.025)
Household size=2	–	–	-0.041	(0.035)	-0.003	(0.033)	-0.024	(0.030)
Household size=3	–	–	-0.044	(0.052)	0.018	(0.049)	-0.006	(0.044)
Household size=4	–	–	-0.062	(0.059)	-0.010	(0.056)	-0.049	(0.050)
ln(Income)	–	–	0.086*	(0.034)	0.049	(0.033)	0.073*	(0.029)
Unemployed	–	–	0.074	(0.089)	0.038	(0.086)	0.022	(0.079)
Has children	–	–	-0.023	(0.031)	-0.019	(0.029)	-0.017	(0.027)
Homeowner	–	–	0.002	(0.029)	0.007	(0.028)	0.043	(0.025)
East Germany	–	–	-0.133**	(0.030)	-0.113**	(0.029)	-0.060*	(0.026)
Rural	–	–	-0.072*	(0.031)	-0.043	(0.030)	-0.028	(0.027)
Car owner	–	–	–	–	-0.134**	(0.047)	-0.091*	(0.043)
Gas heating	–	–	–	–	-0.061*	(0.029)	-0.050*	(0.025)
Oil heating	–	–	–	–	-0.179**	(0.036)	-0.150**	(0.032)
High energy cost	–	–	–	–	-0.268**	(0.026)	-0.170**	(0.025)
Believe in CC	–	–	–	–	–	–	0.130**	(0.027)
Pro-environmental	–	–	–	–	–	–	0.151**	(0.011)
Rather left	–	–	–	–	–	–	0.117**	(0.027)
AfD	–	–	–	–	–	–	-0.112**	(0.035)
Trust	–	–	–	–	–	–	0.137**	(0.024)
Covid-19 cases	–	–	–	–	–	–	0.000	(.)
Weekly articles	–	–	–	–	–	–	-0.000	(0.002)
Constant	0.592**	(0.021)	-0.179	(0.270)	0.348	(0.256)	-0.043	(0.232)
No. of observations	1451		1451		1451		1416	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively. The coefficient on *Female* is dropped because there is no variation in this variable over time.

Table C4: OLS results for the support of a carbon tax in 2021

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.043	(0.043)	-0.046	(0.042)	-0.049	(0.040)	-0.079*	(0.037)
Carbon tax=100 EUR	-0.147**	(0.042)	-0.150**	(0.042)	-0.172**	(0.040)	-0.186**	(0.037)
Age	–	–	0.002	(0.001)	0.002*	(0.001)	0.000	(0.001)
Female	–	–	0.040	(0.027)	0.022	(0.025)	-0.035	(0.023)
College degree	–	–	0.188**	(0.028)	0.122**	(0.027)	0.109**	(0.024)
Household size=2	–	–	-0.102**	(0.034)	-0.038	(0.032)	-0.055	(0.028)
Household size=3	–	–	-0.151**	(0.054)	-0.067	(0.049)	-0.105*	(0.044)
Household size=4	–	–	-0.083	(0.062)	-0.028	(0.059)	-0.077	(0.053)
ln(Income)	–	–	0.134**	(0.035)	0.045	(0.033)	0.081**	(0.030)
Unemployed	–	–	0.024	(0.091)	-0.048	(0.088)	-0.032	(0.077)
Has children	–	–	0.022	(0.030)	0.028	(0.027)	0.017	(0.024)
Homeowner	–	–	-0.026	(0.029)	-0.007	(0.027)	0.027	(0.025)
East Germany	–	–	-0.154**	(0.030)	-0.133**	(0.028)	-0.087**	(0.025)
Rural	–	–	-0.034	(0.031)	0.000	(0.029)	0.009	(0.027)
Car owner	–	–	–	–	-0.190**	(0.045)	-0.149**	(0.041)
Gas heating	–	–	–	–	-0.031	(0.027)	-0.023	(0.025)
Oil heating	–	–	–	–	-0.058	(0.034)	-0.016	(0.031)
High energy cost	–	–	–	–	-0.377**	(0.025)	-0.273**	(0.024)
Believe in CC	–	–	–	–	–	–	0.070*	(0.031)
Pro-environmental	–	–	–	–	–	–	0.176**	(0.010)
Rather left	–	–	–	–	–	–	0.047	(0.029)
AfD	–	–	–	–	–	–	-0.023	(0.033)
Trust	–	–	–	–	–	–	0.097**	(0.023)
Covid-19 cases	–	–	–	–	–	–	0.038	(0.027)
Weekly articles	–	–	–	–	–	–	-0.015	(0.009)
Constant	0.531**	(0.038)	-0.566*	(0.278)	0.448	(0.258)	0.419	(0.306)
No. of observations	1451		1451		1451		1451	

Note: ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table C5: OLS results for the support of a carbon tax in 2022

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.082	(0.068)	-0.085	(0.069)	-0.056	(0.068)	-0.044	(0.061)
Carbon tax=100 EUR	-0.155*	(0.068)	-0.161*	(0.069)	-0.144*	(0.067)	-0.119	(0.061)
Age	–	–	0.001	(0.001)	0.001	(0.001)	0.000	(0.001)
Female	–	–	0.009	(0.027)	0.003	(0.026)	-0.045	(0.024)
College degree	–	–	0.173**	(0.028)	0.148**	(0.028)	0.096**	(0.025)
Household size=2	–	–	-0.117**	(0.034)	-0.072*	(0.033)	-0.094**	(0.029)
Household size=3	–	–	-0.136**	(0.052)	-0.067	(0.050)	-0.068	(0.043)
Household size=4	–	–	-0.076	(0.060)	-0.019	(0.059)	-0.028	(0.049)
ln(Income)	–	–	0.156**	(0.034)	0.127**	(0.034)	0.126**	(0.029)
Unemployed	–	–	-0.038	(0.088)	-0.039	(0.091)	-0.058	(0.080)
Has children	–	–	-0.009	(0.030)	-0.004	(0.029)	-0.038	(0.026)
Homeowner	–	–	-0.037	(0.028)	-0.021	(0.028)	-0.008	(0.024)
East Germany	–	–	-0.168**	(0.029)	-0.157**	(0.028)	-0.067**	(0.025)
Rural	–	–	-0.060	(0.031)	-0.037	(0.031)	-0.016	(0.027)
Car owner	–	–	–	–	-0.181**	(0.047)	-0.094*	(0.043)
Gas heating	–	–	–	–	-0.019	(0.028)	-0.027	(0.025)
Oil heating	–	–	–	–	-0.115**	(0.037)	-0.074*	(0.032)
High energy cost	–	–	–	–	-0.200**	(0.028)	-0.142**	(0.024)
Believe in CC	–	–	–	–	–	–	0.069	(0.037)
Pro-environmental	–	–	–	–	–	–	0.156**	(0.011)
Rather left	–	–	–	–	–	–	0.114**	(0.029)
AfD	–	–	–	–	–	–	-0.072*	(0.033)
Trust	–	–	–	–	–	–	0.210**	(0.025)
Covid-19 cases	–	–	–	–	–	–	0.000	(0.001)
Weekly articles	–	–	–	–	–	–	-0.003	(0.003)
Constant	0.561**	(0.066)	-0.626*	(0.282)	-0.155	(0.279)	-0.340	(0.237)
No. of observations	1451		1451		1451		1451	

Note: ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table C6: Fixed effects results for the support of a carbon tax

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.117**	(0.028)	-0.118**	(0.028)	-0.118**	(0.028)	-0.118**	(0.028)
Carbon tax=100 EUR	-0.186**	(0.033)	-0.186**	(0.033)	-0.188**	(0.032)	-0.190**	(0.032)
2021	-0.017	(0.012)	-0.005	(0.014)	-0.004	(0.014)	-0.005	(0.014)
2022	-0.005	(0.013)	0.016	(0.018)	0.023	(0.019)	0.047	(0.024)
Age	–	–	-0.008	(0.005)	-0.008	(0.005)	-0.008	(0.005)
College degree	–	–	-0.071	(0.045)	-0.072	(0.045)	-0.072	(0.045)
Household size=2	–	–	0.034	(0.039)	0.037	(0.039)	0.038	(0.039)
Household size=3	–	–	0.042	(0.045)	0.048	(0.045)	0.052	(0.046)
Household size=4	–	–	0.038	(0.050)	0.045	(0.051)	0.043	(0.050)
ln(Income)	–	–	0.021	(0.035)	0.017	(0.035)	0.017	(0.034)
Unemployed	–	–	-0.066	(0.051)	-0.069	(0.051)	-0.067	(0.051)
Has children	–	–	0.022	(0.022)	0.021	(0.022)	0.018	(0.022)
Homeowner	–	–	0.012	(0.047)	0.012	(0.046)	0.013	(0.046)
East Germany	–	–	-0.048	(0.033)	-0.026	(0.044)	-0.048	(0.043)
Rural	–	–	0.063	(0.063)	0.063	(0.063)	0.068	(0.062)
Car owner	–	–	–	–	-0.019	(0.036)	-0.017	(0.036)
Gas heating	–	–	–	–	-0.071*	(0.034)	-0.073*	(0.034)
Oil heating	–	–	–	–	-0.038	(0.041)	-0.037	(0.042)
High energy cost	–	–	–	–	-0.031	(0.017)	-0.031	(0.017)
Believe in CC	–	–	–	–	–	–	-0.013	(0.020)
Pro-environmental	–	–	–	–	–	–	0.028**	(0.010)
Rather left	–	–	–	–	–	–	0.012	(0.024)
AfD	–	–	–	–	–	–	-0.001	(0.026)
Trust	–	–	–	–	–	–	0.027	(0.017)
Covid-19 cases	–	–	–	–	–	–	-0.000	(0.001)
Weekly articles	–	–	–	–	–	–	0.002	(0.001)
Constant	0.598**	(0.017)	0.861*	(0.406)	0.958*	(0.406)	0.931*	(0.405)
No. of observations	4353		4353		4353		4353	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively. The coefficient on *Female* is dropped because there is no variation in this variable over time.

Table C7: Fixed effects results for the increase of the tax rate on the support of a carbon tax

	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.136**	(0.032)
Carbon tax=100 EUR	-0.198**	(0.036)
2021	-0.041	(0.033)
2022	-0.048	(0.070)
Carbon tax=50 EUR × 2021	0.059	(0.037)
Carbon tax=50 EUR × 2022	0.104	(0.069)
Carbon tax=100 EUR × 2021	0.029	(0.037)
Carbon tax=100 EUR × 2022	0.105	(0.069)
Age	-0.008	(0.005)
College degree	-0.071	(0.044)
Household size=2	0.039	(0.039)
Household size=3	0.055	(0.046)
Household size=4	0.047	(0.050)
ln(Income)	0.015	(0.034)
Unemployed	-0.066	(0.050)
Has children	0.019	(0.022)
Homeowner	0.014	(0.047)
East Germany	-0.045	(0.044)
Rural	0.067	(0.063)
Car owner	-0.024	(0.034)
Gas heating	-0.074*	(0.034)
Oil heating	-0.039	(0.042)
High energy cost	-0.031	(0.017)
Believe in CC	-0.012	(0.020)
Pro-environmental	0.028**	(0.010)
Rather left	0.013	(0.024)
AfD	-0.002	(0.025)
Trust	0.028	(0.017)
Covid-19 cases	-0.000	(0.001)
Weekly articles	0.002	(0.001)
Constant	0.938*	(0.406)
No. of observations	4353	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively. The coefficient on *Female* is dropped because there is no variation in this variable over time.

Table C8: Dynamic model results for the support of a carbon tax

	(1)		(2)	
	Coeff.	Std. Err.	Coeff.	Std. Err.
LDV	0.440**	(0.022)	0.356**	(0.059)
Carbon tax=50 EUR	-0.034	(0.027)	-0.106*	(0.043)
Carbon tax=100 EUR	-0.087**	(0.027)	-0.122**	(0.043)
LDV × Carbon tax=50 EUR	–	–	0.130*	(0.060)
LDV × Carbon tax=100 EUR	–	–	0.052	(0.061)
Age	-0.000	(0.001)	-0.000	(0.001)
Female	-0.029*	(0.014)	-0.031*	(0.014)
College degree	0.059**	(0.015)	0.060**	(0.015)
Household size=2	-0.048**	(0.017)	-0.048**	(0.017)
Household size=3	-0.053*	(0.027)	-0.052*	(0.026)
Household size=4	-0.013	(0.032)	-0.012	(0.031)
ln(Income)	0.057**	(0.018)	0.053**	(0.018)
Unemployed	-0.028	(0.046)	-0.033	(0.045)
Has children	-0.004	(0.016)	-0.006	(0.016)
Homeowner	-0.003	(0.015)	-0.002	(0.015)
East Germany	-0.050**	(0.015)	-0.051**	(0.015)
Rural	-0.004	(0.017)	-0.004	(0.017)
Car owner	-0.062**	(0.024)	-0.062**	(0.024)
Gas heating	-0.010	(0.015)	-0.010	(0.015)
Oil heating	-0.010	(0.019)	-0.011	(0.018)
High energy cost	-0.125**	(0.016)	-0.126**	(0.016)
Believe in CC	0.050*	(0.021)	0.047*	(0.021)
Pro-environmental	0.094**	(0.008)	0.093**	(0.008)
Rather left	0.051**	(0.018)	0.050**	(0.018)
AfD	-0.016	(0.019)	-0.017	(0.019)
Trust	0.089**	(0.016)	0.089**	(0.016)
Covid-19 cases	0.001	(0.001)	0.001	(0.001)
Weekly articles	-0.005**	(0.001)	-0.005**	(0.001)
Constant	0.020	(0.145)	0.102	(0.151)
No. of observations	2902		2902	

Note: ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table C9: Heterogeneous fixed effects results for the increase of the tax rate on the support of a carbon tax

	(A)		(B)		(C)–(D)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	-0.111**	(0.028)	-0.113**	(0.028)	-0.119**	(0.028)
Carbon tax=100 EUR	-0.190**	(0.032)	-0.183**	(0.032)	-0.190**	(0.032)
Post	-0.001	(0.213)	0.027	(0.037)	0.118*	(0.058)
Age	-0.004	(0.005)	-0.004	(0.005)	-0.007	(0.005)
College degree	-0.101*	(0.048)	-0.074	(0.045)	-0.071	(0.045)
Household size=2	0.057	(0.044)	0.038	(0.039)	0.033	(0.039)
Household size=3	0.083	(0.052)	0.051	(0.045)	0.047	(0.046)
Household size=4	0.015	(0.057)	0.036	(0.050)	0.040	(0.050)
ln(Income)	0.014	(0.037)	0.028	(0.034)	0.025	(0.034)
Has children	0.006	(0.030)	0.018	(0.022)	0.019	(0.022)
Homeowner	0.026	(0.050)	0.015	(0.046)	0.017	(0.047)
East Germany	-0.057	(0.060)	-0.037	(0.053)	-0.055	(0.052)
Rural	0.056	(0.065)	0.057	(0.062)	0.066	(0.062)
Post × Age	-0.001	(0.001)	–	–	–	–
Post × Female	-0.005	(0.022)	–	–	–	–
Post × College degree	0.038	(0.024)	–	–	–	–
Post × Household size=2	-0.036	(0.029)	–	–	–	–
Post × Household size=3	-0.061	(0.044)	–	–	–	–
Post × Household size=4	0.040	(0.052)	–	–	–	–
Post × ln(Income)	0.011	(0.027)	–	–	–	–
Post × Has children	0.011	(0.028)	–	–	–	–
Post × Homeowner	-0.033	(0.024)	–	–	–	–
Post × East Germany	-0.028	(0.024)	–	–	–	–
Post × Rural	0.016	(0.026)	–	–	–	–
Car owner	-0.032	(0.036)	-0.006	(0.042)	-0.016	(0.036)
Gas heating	-0.066	(0.034)	-0.075	(0.039)	-0.072*	(0.034)
Oil heating	-0.035	(0.042)	-0.085	(0.046)	-0.038	(0.042)
High energy cost	-0.025	(0.017)	0.005	(0.023)	-0.029	(0.017)
Post × Car owner	–	–	-0.034	(0.036)	–	–
Post × Gas heating	–	–	0.009	(0.025)	–	–
Post × Oil heating	–	–	0.084**	(0.030)	–	–
Post × High energy cost	–	–	-0.043	(0.022)	–	–
Believe in CC	-0.009	(0.020)	-0.011	(0.020)	-0.013	(0.026)
Pro-environmental	0.030**	(0.010)	0.027**	(0.010)	0.029*	(0.013)
Rather left	0.014	(0.024)	0.014	(0.024)	0.004	(0.030)
AfD	-0.011	(0.025)	-0.005	(0.026)	-0.029	(0.032)
Trust	0.023	(0.017)	0.025	(0.017)	0.028	(0.025)
Covid-19 cases	0.001	(0.001)	0.001	(0.001)	0.000	(0.001)
Weekly articles	0.000	(0.001)	0.000	(0.001)	0.003	(0.002)
Post × Believe in CC=1	–	–	–	–	-0.003	(0.032)
Post × Pro-environmental	–	–	–	–	-0.002	(0.010)
Post × Rather left=1	–	–	–	–	0.014	(0.027)
Post × AfD=1	–	–	–	–	0.048	(0.030)
Post × Trust=1	–	–	–	–	-0.003	(0.025)
Post × Covid-19 cases	–	–	–	–	0.000	(.)
Post × Weekly articles	–	–	–	–	-0.005*	(0.002)
Constant	0.741	(0.404)	0.611	(0.384)	0.808*	(0.395)
No. of observations	4353		4353		4353	

Note: Standard errors are clustered at the individual level. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table C10: Fixed effects results for the support of revenue uses

	Green spending		Lump-sum		Social cushioning	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Carbon tax=50 EUR	0.027	(0.027)	0.009	(0.041)	-0.053	(0.034)
Carbon tax=100 EUR	0.005	(0.027)	0.025	(0.042)	-0.040	(0.034)
2021	-0.121**	(0.015)	-0.157**	(0.023)	0.124**	(0.019)
2022	-0.108**	(0.022)	-0.110**	(0.034)	0.063*	(0.028)
Age	0.005	(0.004)	0.004	(0.007)	-0.002	(0.004)
College degree	-0.052	(0.049)	-0.035	(0.068)	-0.043	(0.048)
Household size=2	0.099*	(0.045)	0.060	(0.057)	0.034	(0.050)
Household size=3	0.089	(0.055)	-0.021	(0.067)	0.025	(0.062)
Household size=4	0.089	(0.063)	-0.048	(0.081)	0.032	(0.075)
ln(Income)	0.014	(0.032)	0.015	(0.048)	0.011	(0.045)
Unemployed	0.010	(0.049)	-0.065	(0.080)	0.010	(0.084)
Has children	-0.016	(0.022)	0.037	(0.030)	0.005	(0.029)
Homeowner	0.142**	(0.048)	-0.012	(0.067)	0.117	(0.061)
East Germany	0.118	(0.235)	0.583**	(0.117)	0.233	(0.125)
Rural	0.012	(0.048)	-0.047	(0.092)	-0.015	(0.080)
Car owner	-0.156**	(0.058)	0.028	(0.070)	0.073	(0.062)
Gas heating	-0.014	(0.031)	-0.011	(0.045)	-0.042	(0.042)
Oil heating	-0.047	(0.036)	-0.002	(0.057)	-0.119**	(0.044)
High energy cost	-0.018	(0.015)	0.018	(0.022)	-0.009	(0.021)
Believe in CC	0.024	(0.023)	0.002	(0.031)	0.025	(0.028)
Pro-environmental	0.033**	(0.012)	-0.014	(0.015)	0.002	(0.015)
Rather left	0.006	(0.020)	0.005	(0.032)	-0.038	(0.030)
AfD	0.080	(0.050)	-0.077	(0.071)	0.069	(0.049)
Trust	0.018	(0.015)	-0.005	(0.023)	0.021	(0.021)
Covid-19 cases	0.000	(0.001)	-0.001	(0.001)	0.001	(0.001)
Weekly articles	-0.000	(0.001)	0.001	(0.002)	0.001	(0.002)
Constant	0.453	(0.363)	-0.122	(0.579)	0.225	(0.453)
No. of observations	4341		4286		4312	

Note: ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

D Climate-related articles

We use a google news scrapper to collect the articles referring to climate change or climate policies. We collect data starting in January 2019, until August 2022, using the following query: *'Klimawandel OR Klimapolitik OR Klimaveranderung OR Kohlenstoffssteuer OR CO2-Steuer OR CO2-Abgabe OR CO2-Preis'*.

We then filter the results and keep the articles from major medias in Germany: "Tagesspiegel", "BILD","Spiegel", "Handelsblatt", "FAZ - Frankfurter Allgemeine Zeitung", "Die Welt", "Die Zeit", "Süddeutsche Zeitung", "FOCUS Online", WirtschaftsWoche", and "ZDFheute".

The Python code can be found in this repository: link.