



ANALYSIS

How resilient is public support for carbon pricing? Longitudinal evidence from Germany

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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 and revenue use in Germany. Using panel methods, we show that support is very persistent over time. However, people who incur high energy cost decrease their support. Regarding revenue use, we find that social cushioning has become more popular over time, while support for green spending has decreased. Our findings suggest that it is crucial to adapt climate policies in response to increased energy costs.

1. Introduction

Carbon pricing is considered a key policy instrument to achieve climate change mitigation. About 75 carbon pricing initiatives are currently implemented around the world (World Bank, 2025). 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., 2018b; Maestre-Andrés et al., 2019; Dechezleprêtre et al., 2025; Sommer et al., 2022) as well as revenue use (Baranzini and Carattini, 2017; Mohamadzadeh Valencia et al., 2024). However, most empirical research has undertaken cross-sectional surveys to examine hypothetical policies, and little is known about how and why public support for carbon pricing schemes develops over time. Yet, this is problematic because decision-makers may hesitate to implement policies if they expect that support expressed through surveys from pre-adoption phases underestimates 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), even though such price schemes might run the risk of reducing support for climate policies (Bechtel et al., 2020). Understanding the dynamics of support for an increasing carbon price is therefore key to design feasible climate policies (Kallbekken, 2023).

Public support for carbon pricing also depends on revenue-use (Carattini et al., 2017; Maestre-Andrés et al., 2021). A recent body of literature has shown that optimal climate policies include direct transfers to households to alleviate regressive effects of carbon pricing (Känzig, 2023; Douenne et al., 2023). Similarly, Muth (2023) finds that countries with stringent carbon pricing tend to adopt compensatory and redistributive measures. However, most empirical studies find that people prefer to invest revenues from carbon pricing into green innovation or infrastructure projects, instead of direct redistribution schemes (Dechezleprêtre et al., 2025; Maestre-Andrés et al., 2021). For Germany, recent studies by Sommer et al. (2022) and Woerner et al. (2024) show contrasting results. Sommer et al. (2022) find that German respondents largely prefer green spending over direct transfers, while Woerner et al. (2024) clearly find the opposite. An important difference between the studies is the year of data collection: German

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citizens preferred green spending in 2019, while they showed stronger support for transfers in 2023 after energy prices peaked in the wake of the war in Ukraine. This suggests that support for revenue recycling can change over time, depending on broader economic circumstances or the level of the carbon price, as Sommer et al. (2022) also show that higher carbon prices reduce the support for green spending and increases the support of social cushioning.

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.

In this paper, we report findings from a unique longitudinal data set consisting of three panel survey waves ($N = 4095$) conducted between 2019 and 2022 in Germany among the same respondents. In this period, Germany introduced and ramped up a carbon price in the transport and heating sector. Specifically, the carbon price was introduced at a rate of €25 per ton in 2021 and increased to €30 in 2022. The revenue is earmarked to the "Climate and Transformation Fund", an investment program for the period 2023–2026. During our study, energy prices have also increased following the Russian invasion of Ukraine in February 2022. With this data set we investigate whether changes in support for carbon pricing schemes correlate with changes in socio-economic characteristics, attitudes, and energy expenditures.

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). People tend to overestimate economic costs (Douenne and Fabre, 2022), but 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). Cherry et al. (2014), Dal Bó et al. (2018), and Janusch et al. (2021) demonstrate the role of experience in lab experiments. Using survey data, Schuitema et al. (2010) show that public support for congestion pricing increased in Sweden after its implementation. Carattini et al. (2018a) report a similar finding for a waste collection tax in Switzerland. A recent study by Mildemberger 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. Moreover, media analyses suggest that while post-adoption contention over hard climate policies is generally limited, significant opposition can arise particularly in response to carbon pricing (Anisimova and Patterson, 2024).

Our results show 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. We find that support rates are very similar over time despite increases in the actual carbon price and energy-price hikes in 2022. Moreover, support is persistent at the individual-level, as respondents who support carbon pricing in one survey wave are much more likely to support it later on. Using within-individual variations, we show that variables that usually correlate with support in cross-sectional analyses, e.g. political orientation, belief in climate change, and trust (Bergquist et al., 2022), are not statistically significant to predict support. In other words, while being rather left is generally associated with a higher support for carbon pricing, we

find that changes in political orientation over time do not explain changes in support. However, we find that public support has decreased among people who switched to gas heating, and increased among people who display stronger pro-environmental preferences. While our results do not allow for a causal analysis of public support as suggested by Carattini et al. (2024), they provide interesting descriptive evidence on the support for carbon pricing.

Regarding the use of revenues from carbon pricing, 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 decrease their support for green investments and increase their support for direct transfers. This indicates that support for climate policy design depends on personal exposure to high energy prices. Adjusting revenue recycling schemes to reflect changing macro-economics conditions could increase support for carbon pricing.

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 panelists 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, just around the time the German government announced the new "climate package" on October 23, 2019. The policy package included the introduction of a carbon price for the heating and transport sectors scheduled for January, 2021 (see Edenhofer et al., 2020, for more details). This carbon price first took the form of a fixed tax of €25 per ton of CO₂, and was planned to transition to an allowance based system in 2026. 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, of which 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, €50, and €100, 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. 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. We were able to recruit 4157 panelists who took part in the first survey. Respondents who

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

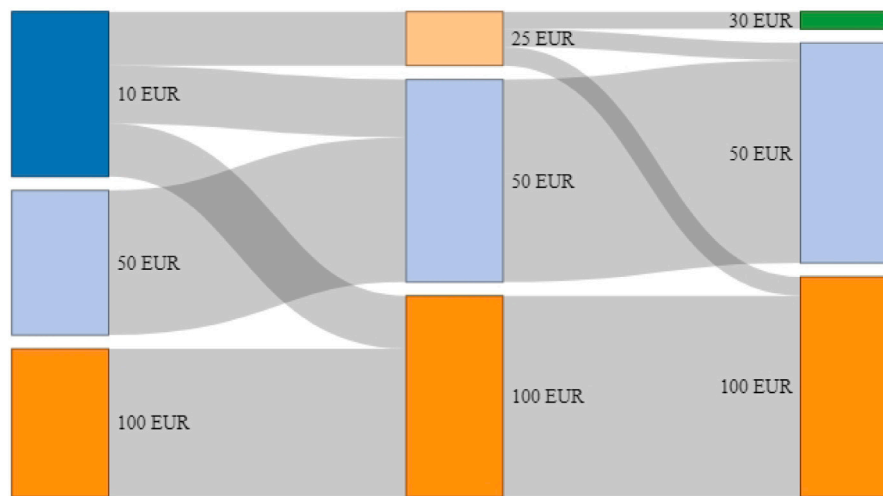


Fig. 1. Mapping of respondents over surveys. All respondents assigned to a €50 or €100 carbon price in a given wave were exposed to the same level in subsequent waves. Respondents assigned to the lower price level in a given wave were randomly assigned to the €100, €50 or low level in the next wave.

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 an increasing carbon price in a longitudinal setting.

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. We were able to recruit 3296 respondents who participated in all three surveys. A few months before the last wave, Russia invaded the Ukraine, triggering an 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 one-time 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 liter 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 a price level of €30, €50 or €100.

Beside the 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 (all socio-economic characteristics as well as support for carbon pricing and different revenue uses), resulting a final sample of 1365 individuals ($N = 4095$). Fig. 1 shows how respondents who participated in all surveys are assigned to different carbon prices across the three survey waves.

Defining a binary variable as one if an individual participated in the first survey but not in the second and/ or third survey and zero

otherwise, we can analyze the attrition in our sample. Running a simple OLS model with this dependent variable, we detect that participation in the later surveys is independent of the carbon price level in the first round of the experiment and support of carbon pricing (Table C1 in the Online Appendix). However, college graduates and more affluent individuals are less likely to drop out, whereas attrition does not seem to correlate with pro-environmental or political attitudes. Table 1 displays the summary statistics of the respondents across the three waves.² The socio-economic characteristics of our sample 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 150 inhabitants per km². 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.

We observe changes in characteristics with a direct link to carbon pricing. The use of oil heating has decreased over time while perceived energy cost have increased. The share of respondents who state that they incur high energy cost increases from 40% in the first wave to 44% in the second and to 66% in the third wave. This trend is likely due to the conflict in Ukraine and the ensuing energy crisis in Germany. 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 0.74.

We add contextual variables to control for events that could bear on support for carbon pricing. We include the number of Covid-19 cases in

² 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.

Table 1
Summary statistics.

	2019	2021		2022	
	Mean	Mean	t-Stat.	Mean	t-Stat.
(A) Socio-economic characteristics					
Age (years)	57.7	59.2	(2.638)**	60.3	(4.615)**
Female	0.333	0.333	(0.000)	0.333	(0.000)
College degree	0.291	0.290	(−0.042)	0.290	(−0.042)
Household size	2.015	1.982	(−0.963)	1.969	(−1.357)
Income (EUR)	2977	3014	(0.801)	3061	(1.804)
Unemployed	0.022	0.019	(−0.560)	0.016	(−1.120)
Has children	0.642	0.644	(0.080)	0.626	(−0.876)
Homeowner	0.578	0.585	(0.388)	0.583	(0.272)
East Germany	0.251	0.251	(−0.044)	0.255	(0.040)
Rural	0.229	0.221	(−0.506)	0.220	(−0.552)
(B) Carbon tax related					
Car owner	0.908	0.912	(0.400)	0.908	(0.067)
Gas heating	0.517	0.508	(−0.498)	0.524	(0.345)
Oil heating	0.201	0.182	(−1.285)	0.168	(−2.273)**
Other heating	0.281	0.310	(1.629)	0.308	(1.546)
High energy cost	0.395	0.440	(2.400)**	0.662	(14.323)**
(C) Attitudes					
Believe in climate change	0.805	0.894	(7.030)**	0.920	(9.122)**
Pro-environmental attitudes	10.995	11.079	(0.780)	11.556	(5.195)**
Rather left	0.310	0.193	(−7.281)**	0.201	(−6.735)**
AfD	0.073	0.069	(−1.434)	0.051	(−2.390)**
Trust	0.391	0.508	(6.133)**	0.487	(5.083)**
(D) Contextual variables					
Monthly Covid-19 cases in county	0.000	272.2	(0.765)	12,641	(35.513)**
No. of weekly climate-related articles	22.5	23.2	(3.973)**	14.2	(−50.632)**
GDP pc (EUR)	40.839	42.576	(2.512)**	45.282	(6.427)**
Unemployment rate (%)	5.173	5.845	(7.857)**	5.434	(3.055)**

Note: We report t-test statistics for the equality of means between 2019 and 2021 as well as 2019 and 2022, respectively, in parentheses. N = 4095 with data from 1365 individuals.

** Denotes statistical significance at the 1% level.

the county of the respondents' residence in the month the respondent took the survey. This allows us to better isolate the time-specific effects. 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 survey. In doing so, we control for the prominence of climate-related topics in the public debate during our three observation periods.³ Last, we control for GDP per capita and the unemployment rate in the respondent's region (NUTS 3 area) to control for local economic shocks. On average, both variables have increased between 2019 and 2022.

3. Results

3.1. Support for carbon pricing

In autumn 2019, almost 60% of the respondents supported a carbon price of €10 per ton of CO₂ (Fig. 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. For the lowest carbon price, we also find that support is roughly constant despite the gradual increase in the price level from €10 in 2019 to €30 in 2022. Importantly, the support rates in the last survey wave are very similar to the first two waves despite the spike in energy prices. This suggests a high degree of persistence among the respondents. Notably, over the entire survey period, roughly one third of the respondents always supports the carbon pricing scheme, and 40% always reject it. The remainder, roughly 30%, switches between supporting and rejecting a specific carbon pricing design.⁴

We start by analyzing the determinants of support for carbon pricing using cross-sectional data. In line with previous studies (e.g. Maestre-Andrés et al., 2019; Bergquist et al., 2022), we find that support is positively linked to education, income, having pro-environmental attitudes, believing in climate change, trusting the government, and being on the left of the political spectrum (see Appendix B). Conversely, owning a car, heating with fossil fuels and having high energy costs are negatively linked to the support of carbon pricing. Due to the sample composition (e.g. better educated and wealthier than the population), the absolute level of support might be biased upward. However, we now leverage within-individual variations (see Table 1) and test whether they have a significant influence on support when controlling for individual fixed effects.

To this end, we estimate the following linear two-way fixed-effects (TWFE) model and measure the link between changes in individual characteristics and support for carbon pricing:

$$y_{it} = \beta_0 + \beta_c^T C_{it} + \beta_x^T X_{it} + \beta_p Year_t + \mu_i + \epsilon_{it}, \quad (1)$$

where y_{it} is coded as unity if respondent i reports to support a carbon price in survey year t and zero otherwise. Vector C indicates the carbon price level the respondent faced in the hypothetical survey experiment. For the sake of readability and because of lower sample sizes for

⁴ To make this point more explicit, we estimate a linear probability model that controls for the support of carbon pricing in the previous survey. Indeed, we find that support 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 carbon pricing in a following survey as well. Interacting this with the carbon price level provides tentative evidence that the effect of previous support for carbon pricing is somewhat higher for higher carbon price levels, see Table C3 in Appendix C.

³ For more details, see Appendix D.

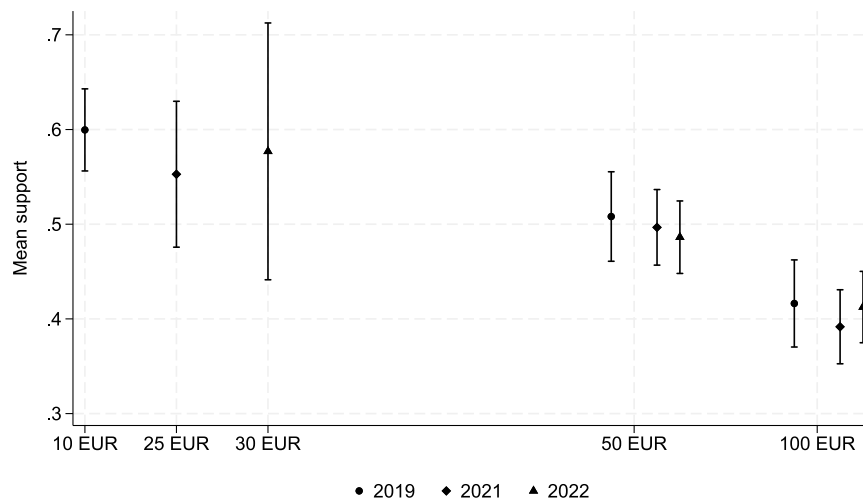


Fig. 2. Support of carbon pricing over time.

Note: The dots, diamonds, and triangles present the mean in of support rates and the whiskers represent the 95% confidence intervals. $N = 4095$ with data from 1365 individuals.

prices of €10, €25, and €30, we group these low price levels in the analysis. The parameters β_c capture the effect of a carbon price of €50 and €100, respectively, compared to lower price levels. Because respondents were randomly assigned to increased prices over time (see Fig. 1), β_c measures a causal effect of increasing carbon price on support.

Vector 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 $Year$ that are equal to unity for the second (2021) or third survey wave (2022), respectively, and zero for the first wave. Some variables in our panel data are largely time-invariant, for instance education, gender, and place of living. Hence, a TWFE model would not be able to detect a reasonable effect size, and most of the explanatory power of these variables on support would be picked up by the individual fixed-effects. We identify these variables by calculating the minimum detectable effect size based on the amount of within-individual variation we observe in the data (Table C5). In the following, we only keep variables for which the TWFE regression has enough power to measure the effect suggested by the pooled OLS model (Table C4). The estimation results can be found in Table C6 in the online appendix.

This analysis based on fixed-effects reveals several important insights (Fig. 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 over time. 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 do not explain policy support in our longitudinal analysis. In other words, changes in these characteristics are unable to predict changes in support for carbon pricing.

Only two variables are significant to explain changes in support: energy costs and pro-environmental preferences. We find that incurring high energy cost might lead to lower support for carbon pricing: people with increased energy costs show 5 percentage points lower support.⁵

⁵ Estimating the link between policy stringency and policy support might be subject to reverse-causation issues. In particular, it is possible that policy

On the other hand, people with increased pro-environmental preferences are more likely to support carbon pricing.⁶ Therefore, convincing more people that climate change exists may not foster further support for carbon pricing, but increasing pro-environmental preferences could.

Next, we estimate the differential pattern of the support rate depending on the price level. To this end, we extend the previous model specified in Eq. (1) by including an interaction term between the price level and the year dummies:

$$y_{it} = \gamma_0 + \gamma_c^T C_{it} + \gamma_p Year_t + \gamma_{cp} C_{it} \times Year_t + \gamma_x^T X_{it} + \mu_i + v_{it}. \quad (2)$$

This allows us to infer whether there are differential effects of the different prices (see Table C8 in the appendix for the estimation results). For an easier interpretation, we calculate the marginal effect of the carbon price, i.e. $\frac{\partial y}{\partial C} = \gamma_c + \gamma_{cp} \times Year$, which are displayed in Fig. 4.

Our results indicate that in 2019 carbon prices of €50 and €100 reduce support by 13 and 19 percentage points, respectively, compared to prices below €50 (Fig. 4). There is some evidence that the negative effects of higher carbon prices decline over time, i.e. in 2021 and 2022. Yet, the marginal effects are not statistically different from 2019 owed to relative large standard errors. To be precise, the negative effects for prices of €50 and €100 in 2022 are about 10 percentage points smaller compared to the first survey in 2019. 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

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.

⁶ The notable shift in climate beliefs and pro-environmental attitudes in such a short period is surprising. To delve into this, we have run a regression with attitudes as dependent variable. Yet, we fail to detect statistically significant determinants of changes in climate beliefs (Table C7). The large coefficients on the year dummies indicate that unobserved variables could drive changes in climate beliefs.

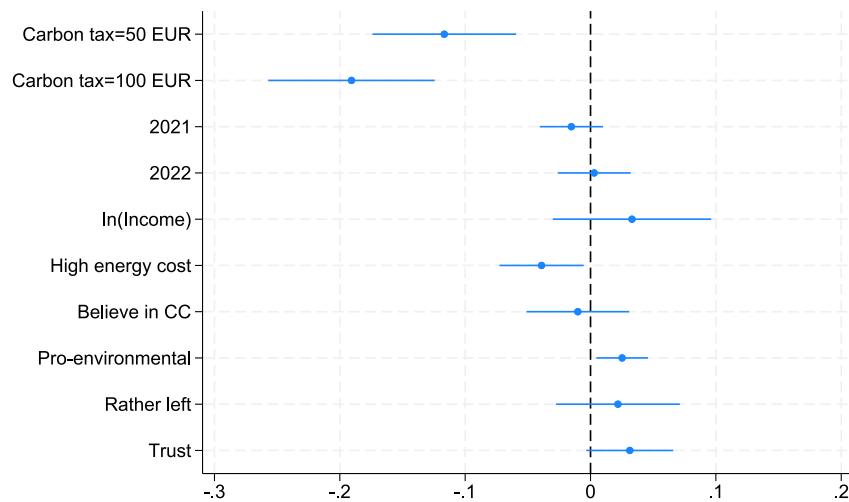


Fig. 3. Drivers of the support for carbon pricing using within-variation in a fixed-effects model.

Note: The dots represent the point estimate from a regression with individual fixed effects and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N = 4095 with data from 1365 individuals.

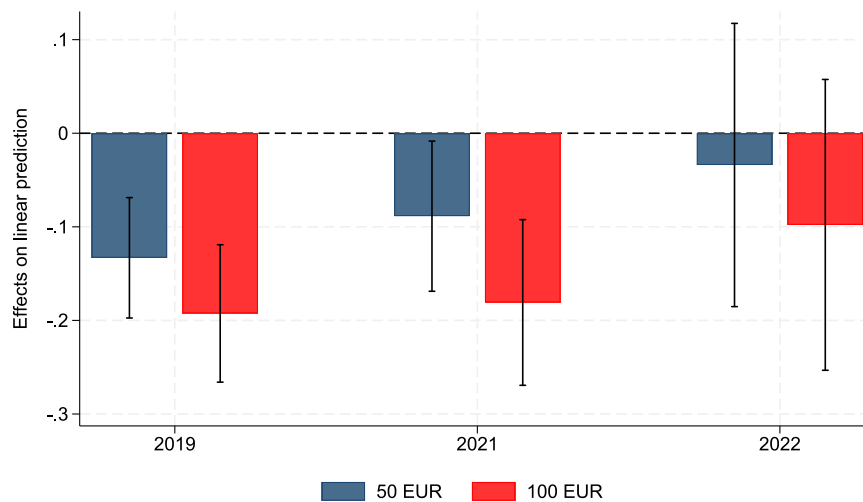


Fig. 4. Effect of high price levels over time.

Note: The bars represent the marginal effect of the carbon price from a regression with individual fixed effects and the whiskers represent the 95% confidence interval. The reference is less than 50 EUR. For the calculation of the confidence intervals, we use robust standard errors. N = 4095 with data from 1365 individuals.

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. \(2022\)](#).

In addition, we are also interested in further heterogeneous effects on the support of carbon pricing. We include additional interaction effects $\gamma_{px} X_{it} \times Year_t$ (see Table C9 in the appendix for the estimation results). Calculating the marginal effects of X provides the relationship between the variable and support for carbon pricing at different points in time. However, most interaction effects are negligible.

3.2. Support for revenue use

One particularly interesting aspect of carbon price is 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 to all citizens, and 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, where the values 1 to 3 are coded as zero, while 4 and 5 are coded as 1.

The support for green spending decreases by roughly 10 percentage points from 87% to about 76% between 2019 and the following years ([Fig. 5](#)). 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 2021.⁷

Again, we estimate the relationship between changes in support for revenue-use and variations in individual characteristics. To this end, we estimate Equation (1) with the support for the revenue scheme

⁷ 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. Our results are largely unchanged when excluding the year 2019 from the regression.

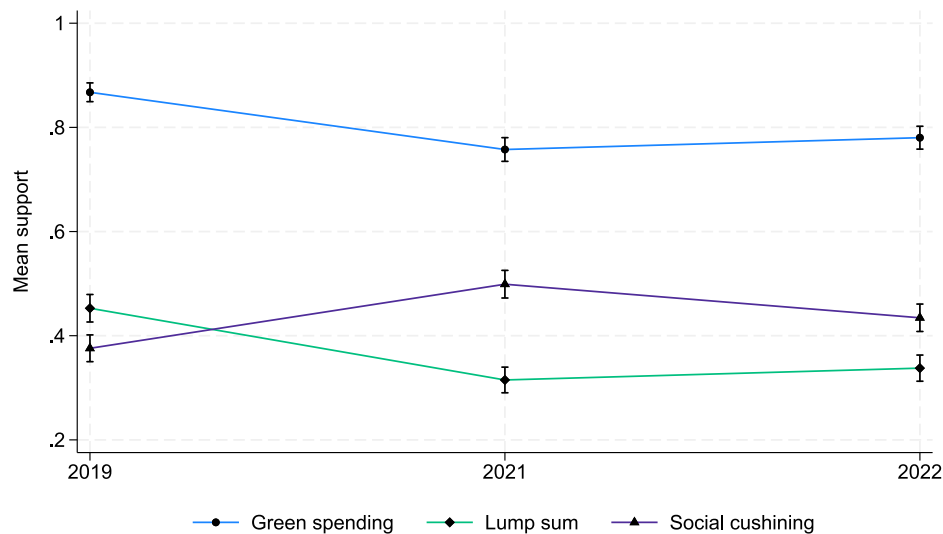


Fig. 5. Support of revenue uses over time.

Note: The dots, diamonds, and triangles present the mean of support rates and the whiskers represent the 95% confidence intervals. N = 4095 with data from 1365 individuals.

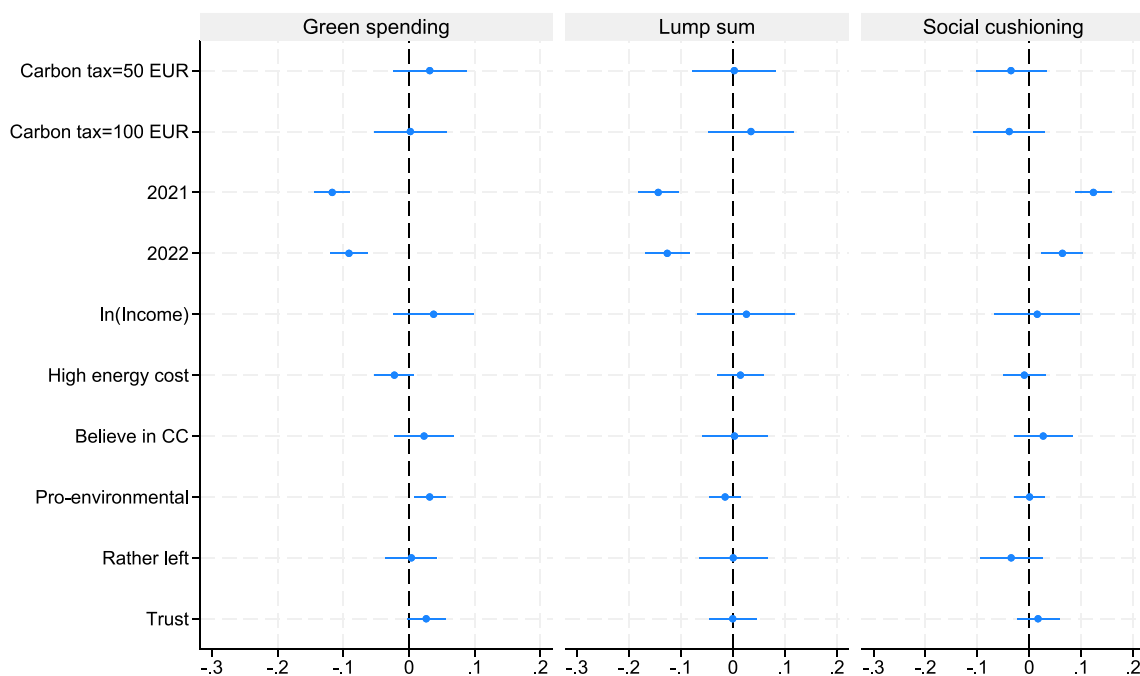


Fig. 6. Drivers of the support for revenue uses using within-variation in a fixed-effects model.

Note: The dots represent the point estimate from a regression with individual fixed effects and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. N = 4095 with data from 1365 individuals.

as dependent variable (see Table C10 and Fig. 6 for the estimation results). First, we find that increasing carbon prices have no bearing on the support for different revenue uses. Second, our results show that respondents with increasing pro-environmental attitudes become more supportive of green spending.

The declining support for green spending and the increased support for social cushioning might indicate that experience with carbon

pricing schemes shifts preferences, and is thus in line with Carattini et al. (2018a, 2017). Another explanation for the change in preferred revenue-use could be the COVID19 crisis. This explanation is consistent with Alesina and Giuliano (2011), who find that people display stronger support for redistribution after suffering from adverse shocks. We cannot test the causal effect of policy experience or external shocks on support with our design. For such an analysis, a causal policy evaluation as suggested by Carattini et al. (2024) would be necessary.

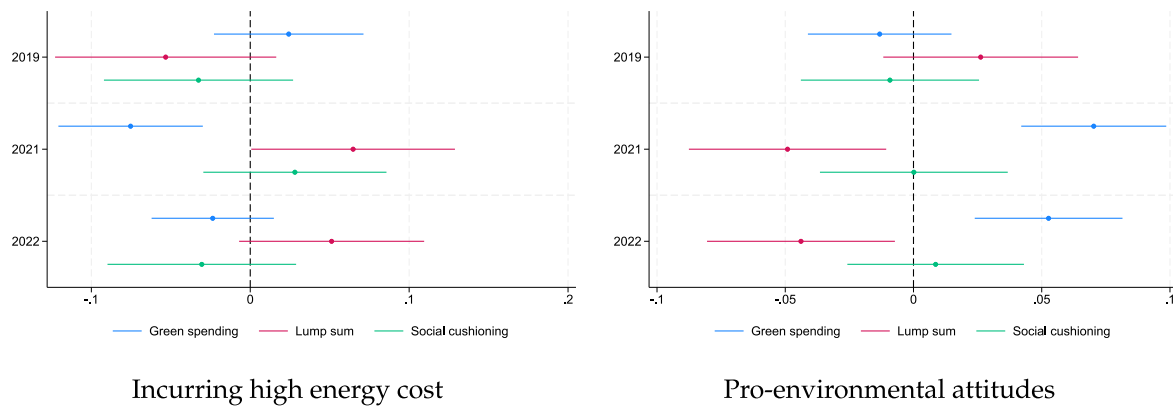


Fig. 7. Marginal effects on support for revenue uses.

Note: The dots represent the marginal effect of X 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: $N = 4095$ with data from 1365 individuals.

To provide suggestive evidence of potential reasons why support for revenue-use has changed, we estimate heterogeneous changes in support for revenue uses over time. Concretely, we interact the *Year* dummies with our control variables (Table C11). Again, changes in energy costs and pro-environmental preferences are associated to changes in support for policy design.

We find that respondents who report that they incur high energy costs lower their support for green spending significantly more than other respondents (Fig. 7). In turn, in this group, lump-sum payments become relatively more popular. We do not detect differences in support for social cushioning due to higher energy costs. Finally, we find that individuals with increased pro-environmental attitudes display higher support for green spending, while they decrease their support for lump-sum payments.

These results are consistent with previous studies on climate policy design. They show that people's preferences for revenue-use are not fixed but depend on external shocks and changes in personal circumstances. Shifts in policy preferences away from green spending toward lump-sum transfers among people with higher energy costs reflects theoretical results in Douenne et al. (2023) or Konc et al. (2022). People who stand to lose from carbon pricing become relatively more supportive of transfers offsetting its negative welfare effects. Moreover, this finding complements the sizable literature on revenues preferences, by providing evidence on the dynamics and context related to preferences for lump-sum transfers (Mohammadzadeh Valencia et al., 2024; Barrez, 2024).

3.3. Revenue use and support for carbon pricing

We measure the link between support for carbon pricing and support for revenue use (Table C12). In line with findings of other studies (e.g., Woerner et al., 2024; Mohammadzadeh Valencia et al., 2024), the cross-sectional analysis shows that support for carbon pricing is positively associated with green spending and social cushioning, whereas lump-sum payments exhibit a negative correlation in 2021 and 2022.

Next, we test whether support for revenue use is correlated with the support for carbon pricing when controlling for individual fixed effects. However, despite substantial variation in the support for revenue uses and carbon pricing, we do not find a statistically significant correlation between the two in our TWFE model (Fig. 8). Hence, changes in the support for revenue use schemes are not correlated with changes in the support for carbon pricing. This holds across the board, i.e. irrespective of the carbon price, the year of the survey, and whether respondents believe they incur high energy costs (Table C13).

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 the dynamics of preferences for climate policy design.

We show that the support for carbon pricing remained fairly stable over time. In all three survey waves, roughly 60% of the respondents support a carbon price of €10, €25 or €30 per ton, 50% support a price of €50 per ton, and 40% support a price of €100 per ton. In addition, most drivers and barriers for support are also constant over time. Well-educated individuals and high-income owners are more likely to support carbon pricing. People who have relatively high individual costs, such as respondents who heat with fossil fuels, reject carbon pricing more frequently. To be precise, respondents who believe that they incur high energy cost have a 20 percentage point lower probability to support carbon pricing.

Using panel methods, we show that variations in most socio-economic characteristics and political attitudes, which are significant in our cross-sectional analysis, do not explain variations in support for carbon pricing. On the other hand, changes in energy costs and pro-environmental preferences can predict the dynamics of support. This also holds when the same respondents are exposed to higher carbon prices over time. This latter finding is particularly relevant, as carbon prices are expected to increase over time to reach Germany's climate targets. Our results highlight the importance of using panel data to establish more robust findings on the determinant of support for climate policies.

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 negative effect of high carbon prices becomes weaker 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. Another potential source of variation is that beliefs about an abstract, hypothetical policy might differ from beliefs about an actual, concrete policy (as shown by Schuitema et al., 2010).

One crucial aspect to ensure continued support of carbon pricing is the use of generated revenues. We find that green spending is the

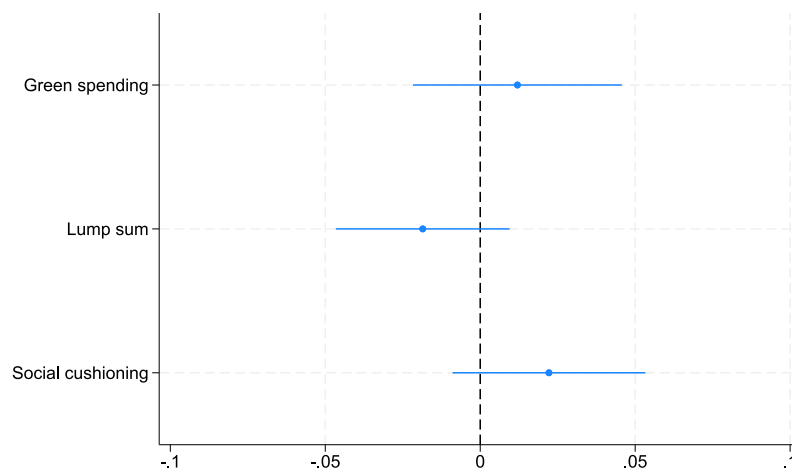


Fig. 8. Support of revenue use and carbon pricing.

Note: The dots represent the point estimate from a regression with individual fixed effects and the whiskers represent the 95% confidence interval. For the calculation of the confidence intervals, we use robust standard errors. $N = 4095$ with data from 1365 individuals.

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. Interestingly, among respondents who believe that they incur high energy cost, the decline in support for green spending is particularly large, while the decline in support for lump-sum payments is much weaker. This suggests that the own (perceived) financial effects matter for the support of revenue uses, consistent with theoretical models of climate policy. Yet, this does not have a strong bearing on the support for carbon pricing in general. Only changes in the support for social cushioning are weakly associated with changes in the support for carbon pricing.

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, which resonates a lot with Anisimova and Patterson (2024). 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.

CRediT authorship contribution statement

Stephan Sommer: Writing – review & editing, Writing – original draft, Visualization, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Théo Konc:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Stefan Drews:** Writing – review & editing, Writing – original draft, Validation, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at <https://doi.org/10.1016/j.ecolecon.2026.108970>.

Data availability

Data will be made available on request.

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