Institute for
New Economic Thinking
AT THE OXFORD MARTIN SCHOOL

Supporting carbon taxes: The role of fairness

Stephan Sommer, Linus Mattauch and Michael Pahle

19th October 2020

INET Oxford Working Paper No. 2020-23

Supporting carbon taxes: The role of fairness

Stephan Sommer[*], Linus Mattauch[†], Michael Pahle[‡]

October 19, 2020

Abstract

We conduct a discrete choice experiment with a sample of 6,000 German household heads to examine how fairness preferences influence the support for carbon taxes and revenue-recycling options. While it is well-known that carbon taxes are effective in reducing emissions and can be made progressive, they remain fairly unpopular with German citizens. Consequently, best practice to build public support for them remains a relevant question for which there is no consensus. We obtain two major results: First, while green spending is more popular in general, it is significantly more popular among those who are pro-environment and trust the government. Second, when restricted to options for direct revenue redistribution, Germans prefer lump-sum payments over directing payments to the poorest or the most affected. Importantly, choices over these options depend both on genuinely different conceptions of fairness and respondents' economic circumstances. Our findings have implications for building support for effective climate change mitigation policies with those who are not yet convinced.

Keywords: carbon pricing, climate change mitigation, fairness, redistribution, environmental tax reform

JEL codes: A13, H23, Q54

Correspondence: Stephan Sommer, RWI – Leibniz Institute for Economic Research, Hohenzollernstr. 1–3, D-45128 Essen, sommer@rwi-essen.de

Acknowledgments: We thank Johanna Arlinghaus, Simon Dietz, Franziska Funke, David Klenert, Christina Roolfs, Benjamin Tereick, as well as seminar audiences in Berlin, Leipzig, and Oxford for useful discussions. We gratefully acknowledge financial support by the German Federal Ministry for Economic Affairs and Energy (BMWi, grant 03EI5213). The experiment in this paper was pre-registered in the AEA RCT Registry (AEARCTR-0004829; http://www.socialscienceregistry.org/trials/4829).

[*]RWI Leibniz Institute for Economic Research

[†]Institute for New Economic Thinking at the Oxford Martin School and Environmental Change Institute, School of Geography and the Environment, University of Oxford

[‡]Potsdam-Institute for Climate Impact Research

1 Introduction

Many governments currently struggle to regulate the carbon emissions of their economies so that their national climate targets are met. One hundred years after the publication of Pigou's "The Economics of Welfare" (Pigou, 2013), there can be no question that pricing carbon is the most efficient way to reduce emissions. Recent work in environmental public economics additionally has clarified that carbon pricing, when the revenue is recycled progressively, has better distributional implications than regulations by efficiency standards (Fullerton and Muehlegger, 2019; Levinson, 2019; Davis and Knittel, 2019) . So if carbon pricing is both efficient and can be made equitable, why does the public – which does demand more climate action by large majorities in many countries – not strongly support carbon pricing? We introduce a novel approach to examining carbon pricing design by studying it from the premise of what citizens think is fair. We find fairness is crucial for political support, which implies that a broader understanding of fairness is an important piece of solving this "Pigouvian puzzle".

In normative social science, different conceptions of fairness exist, which lead to diverging positions about recommended policies (Fleurbaey and Maniquet, 2011). For example, these different conceptions imply that fair allocations could be based on equality, equity, merits, needs or still further principles (Deutsch, 1975; Folger et al., 1995). Moreover, empirical research has established that different groups in society entertain alternative views about morality (Haidt, 2007; Greene, 2013). Surprisingly, real differences about fairness conceptions have not been connected so far to policy evaluations of environmental tax reforms. Instead, the focus has mostly been on designing policies to be progressive in their impact on income inequality, taking the entailed fairness conception as given and ethically desirable.

To wit, a large body of literature has studied the effects of taxation on income equality (Atkinson and Stiglitz, 1976; Piketty, 2003). Specifically, in environmental economics, the distributional effects of energy taxes (Fullerton, 2011; Jacobs and van der

Ploeg, 2019; Pizer and Sexton, 2019), the optimal carbon tax (Nordhaus, 1992; Gerlagh and Liski, 2018; Sallee, 2019), and the trade-off between income equality and efficiency (Goulder et al., 2019) are well studied. However, research about the fairness perceptions of environmental tax reforms by citizens is scarce (see Dietz and Atkinson, 2010 for an exception), even though the perception of a tax reform could be decisive for its political feasibility (Goulder, 2020). Furthermore, a nascent strand of environmental economics has found that many policies are viewed widely as normatively desirable by economists, but are unpopular with the public and unsuccessful in the policy process (Douenne and Fabre, 2019; Carattini et al., 2017; Kallbekken et al., 2011; Maestre-Andrés et al., 2019). The extent to which this hinges on different fairness conceptions beyond income inequality is unclear.

In this paper, we analyze the importance of fairness preferences for the support of carbon prices and its interaction with revenue recycling schemes. Guided by theoretical motivation on fairness in political theory and behavioral economics to rationalize *policy choices*, we conduct a survey and embed a discrete-choice experiment with randomized information treatments. In the experiment, we explain different fairness conceptions and their distributional implications to respondents in the treatment group and measure the effect on the support for a carbon tax in a representative sample covering about 6,000 German household heads.

Research on public support for carbon taxes (Douenne and Fabre, 2019; Carattini et al., 2017; Kallbekken et al., 2011; Maestre-Andrés et al., 2019) has not conclusively settled two debates of high policy relevance: First, on the one hand, scholars advocate for forms of direct redistribution to alleviate fairness concerns. On the other hand, some studies suggest that green spending, at least in a European context, is the best option for policy-makers to increase public support of environmental pricing. This emphasizes that citizens find the idea of reducing pollution by a price so unintuitive that green spending is needed to convince them of the environmental policy's impact. In other words, carbon pricing is not perceived as a mean in itself, but rather as a source of financing for other measures to reduce emissions. Second, if the tax revenue

is used for redistribution, there is disagreement whether a lump-sum payment to all citizens (popularized as carbon dividend by the Climate Leadership Council; Akerlof et al., 2019) or more targeted transfers to either the poorest or the most affected by a higher carbon price should be applied. The role of fairness motives on this choice have not been disentangled so far.

We find the following specific results to address these debates: Only carbon prices of EUR 10 / t CO_2 would be generally supported by a majority of respondents; unsurprisingly, the support decreases with higher carbon taxes and this decrease is particularly strong for respondents who are more affected. Our experimental design permits to shed new light, however, on the two debates about revenue redistribution: First, we show that while green spending is indeed the most popular revenue recycling option overall, it is significantly more popular with those who have pro-environmental attitudes, believe climate change is real, trust the government, and are on the political left. It is more unpopular among residents who would financially suffer most from carbon prices. This has important implications: Green spending, while popular, might thus run the risk of "preaching to the converted" rather than building societal support with the groups that tend to oppose climate action. As such, it may lead to further polarization of an already polarized issue. Moreover, respondents who support green spending are more likely to support carbon taxes as well. Yet, their willingness to accept a carbon tax drops particularly sharply when the tax rate increases. In contrast, the acceptance rate of a carbon tax is ultimately unaffected by higher tax rates if respondents are in favor of social cushioning, i.e. directing the revenues to the poorest.

Second, when restricting the choice to options for revenue-neutral direct redistribution, most of our respondents prefer lump-sum payments over channelling tax revenue to the poorest or the most affected. Those on the political left tend to prefer redistribution to the poorest and those personally most affected by higher carbon prices have a preference for being compensated. A lump-sum transfer is preferred by an absolute majority of our subjects. This finding may be partially explained by the fairly well developed German welfare system: giving a small amount to the rich is dwarfed

by their large tax payments. Accordingly, in fairness terms, the already pre-existing state of fairness in terms of income distribution is only marginally distorted.

Third, our treatment of explaining the fairness consequences to respondents induces some individuals to rethink their fairness preferences. In particular, respondents are steered away from their preference for the lump-sum payment and rather prefer channeling revenues to the poorest or the most affected individuals. When the preferred revenue-recycling scheme is implemented, the support rate increases by some 16%. Nevertheless, this implies that household's genuine fairness views are fairly stable and perhaps not as closely associated with their views about specific policy instruments as one might think. Increasing public support may be necessary for passage and preservation of carbon prices – and fairness views matter to understand support, but beyond that might not be a good guide for designing policies creating a just society.

Our article builds upon a sizeable recent literature on public support for carbon pricing, mostly in a European context: In a recent meta-study, Maestre-Andrés et al. (2019) propose three fairness-related aspects regarding carbon taxation: (1) personal, i.e. related to individual consequences, (2) distributional, i.e. related to others or everyone, and (3) procedural, i.e. related to the application of rules relevant to a procedure. Most of the literature has focused on distributional fairness, i.e. regarding the consequences to others for which the scheme to redistribute carbon pricing revenues is a well-known policy lever (e.g. Klenert et al., 2018a). There is already an extensive and growing literature on the distributional effects of carbon taxes (Rausch et al., 2011; Klenert and Mattauch, 2016; Klenert et al., 2018b; Douenne, 2020) and the willingness-to-pay (WTP) for carbon taxes. For instance, Alberini et al. (2018a) show that the mean WTP to avoid one ton of CO_2 emissions amounts to EUR 94 and EUR 133 in the Czech Republic and Italy, respectively. Similiary, Kotchen et al. (2017) find that the average American citizen is willing to pay USD 144 for a tax on fossil fuels. Recently, Douenne and Fabre (2020) document a large rejection for carbon taxes in France.

Furthermore, the literature has established a great deal of heterogeneity with respect to individual characteristics and policy attributes (Alberini et al., 2018b; Thal-

mann, 2004; Svenningsen and Thorsen, 2019), the interaction with nudges (Hagmann et al., 2019), cultural worldviews (Cherry et al., 2017), and pereceived environmental (Baranzini and Carattini, 2017; Kallbekken and Sælen, 2011) as well as monetary effects (Douenne and Fabre, 2019). In addition, the support for carbon taxes may depend on how the revenues are used. For instance, Kotchen et al. (2017) detect that Americans are most supportive of using the revenues to invest in clean infrastructure (so-called green spending), while less than half of the respondents support an equal redistribution to all citizens (lump-sum payment). Similarly, Baranzini and Carattini (2017) show that public support for a carbon tax increases with green spending, while Kallbekken et al. (2011) find that recycling the revenues to more narrowly targeted groups seems to increase the support for taxation. In an international survey, Carattini et al. (2019) show that lowering income taxes, redistributing revenues domestically, and green spending receive majority support. Carattini et al. (2017) find that making distributional effects of revenue recycling schemes more salient increases the demand for progressive designs. Inquiring about the acceptability of a carbon tax among US and German citizens, Beiser-McGrath and Bernauer (2019) detect that it increases when other countries introduce a similar carbon tax.

However, this research has so far paid little attention to the fact that different conceptions of fairness exist and preferences for them vary across people. Participants in surveys are typically informed about the distributional impacts of different policy choices, and asked to choose between compensatory measures. The influence of both factors (distributional impacts, compensatory measures) on the support is interpreted as being due to perceived fairness (Maestre-Andrés et al., 2019). But different conceptions of fairness exist, and correspondingly people differ in what they think is fair. Accordingly, our methodical contribution is to extend the empirical approach to public support for carbon pricing by taking into account that a given distributional impact or compensatory measure may be judged both as fair and unfair depending on the person's fairness preferences.

Our study is of policy-relevance for anyone concerned with building higher sup-

port for Pigouvian pricing. Politicians are well-advised to not use all environmental tax proceeds for green spending purposes, as it could leave those disengaged about the environment outside of the conversation. A lump-sum payment appears to have broadest appeal because it seems to address a wide variety of fairness motives and own economic interests.[1] Rich countries that enacted a major carbon price reform in the past used the revenue for several modes of spending at the same time (see Klenert et al., 2018a). Our study underlines that such revenue use to make carbon pricing work for all citizens is an essential feature, rather than a political bug of political successful environmental taxation, which is not the case for naïve double dividend proposals that entail the reduction of other taxes for instance. What is more, with increasingly ambitious climate policies in the future both the distributional impacts as well as the revenues are bound to grow. Sooner or later the question of recycling will thus become conflated with questions of broader societal redistribution. If anything, this will make the issue of fairness only more relevant.

2 Theoretical Motivation

Our study draws on three different theoretical frames: (i) properties of carbon price reforms; (ii) political philosophy of different fairness conceptions; (iii) behavioral economics of social preferences. Here we propose an overarching framework for connecting these three frames when analysing public support for climate policy proposals.

First, regarding inequality implications of carbon price designs, it is theoretically well-established that a carbon tax is regressive because of subsistence consumption, i.e. poorer households spend a larger share of their income on carbon-intensive goods to fulfill their basic needs such as heating. However, high-income households spend more on carbon-intensive goods in absolute terms. (Grainger and Kolstad, 2010; Flues and Thomas, 2015). These properties of a carbon price imply that it can be made progressive by both lump-sum transfers or directed transfers to poor households (Klenert

[1] Interestingly, Germans are more in favor of this kind of policy than the French (Douenne and Fabre, 2020), more on a par with Americans (Kotchen et al., 2017).

and Mattauch, 2016; Klenert et al., 2018b). However, recent empirical work has observed that beyond such vertical inequalities also horizontal inequalities matter: in the same income percentile, some citizens are hit harder by higher carbon prices because they have more expensive heating systems or commute longer distances (e.g. see Farrell, 2017; Douenne, 2020). For example, Fischer and Pizer (2019) show that such horizontal inequalities, especially when evaluated in combination with loss aversion, are difficult to address through typical redistribution schemes and might dominate aggregate social cost. Recently, Douenne and Fabre (2019) show that people's perception of these mechanisms is not accurate and, moreover, subject to motivated reasoning.

Second, there is no definitive or exhaustive list of fairness principles considered in political philosophy (but see Deutsch, 1975; Folger et al., 1995; Sen, 2009; Miller, 2017; Gosepath, 2011, for extensive discussions). Our survey elicits the established general fairness principles of equality, equity, and merit as established for instance by Schmitt et al. (1995). These denote allocations in which resources to be distributed should be given to everyone, to the poorest or most vulnerable or to those who create most value for society. However, the most commonly suggested revenue-recycling options for environmental taxation do not fit established principles one-to-one. We associate a *lump-sum transfer* (fee and dividend), i.e. the same payment to all citizens, with equality. We attribute both targeted transfers *to the poorest* (vertical inequity) or *to the most pollution-intensive* (horizontal inequity) households with the equity principle, relating to the nuanced choices for environmental tax design highlighted above. Compensating the most-pollution-intensive households could also be associated with a "needs" view on fairness.[2] Figure 1 summarizes the correspondence between general fairness principles and revenue redistribution options.

Third, social preferences, i.e. motives, such as altruism and reciprocity (Bowles and Polania-Reyes, 2012), have been extensively theorized by behavioral economics in the

[2]In discussions on climate change mitigation policy, it is sometimes mentioned that an advantage of a carbon tax over an emission trading scheme is that there is an individual incentive for climate-friendly behavior when a tax is imposed, but that this does not exist for an emissions trading system. However, a merit-based allocation of carbon price revenues would mean to give tax proceeds to those with the most climate-friendly lifestyle. This has not been proposed in the context of climate policy to our knowledge, perhaps because carbon pricing happens against a background of high income inequality.

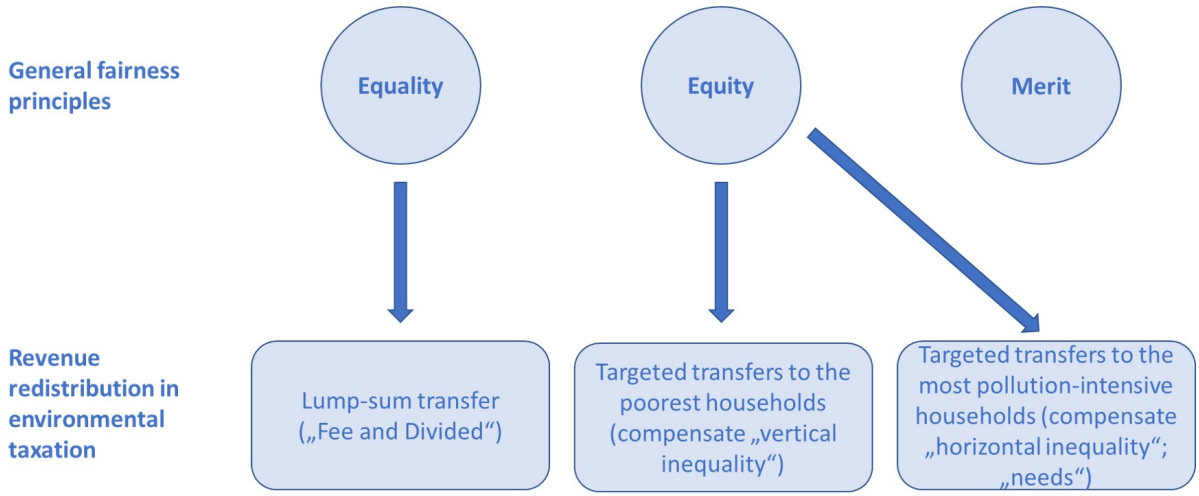


Figure 1: General fairness principles elicited by the survey and their correspondence to revenue-recycling schemes

past. For example, in their seminal contribution Fehr and Schmidt (1999) show that a simple formulation of choice behavior as utility explains a wide variety of fairness motives by positing that subjects are inequity-averse, but more so if they are personally affected. To fix ideas, let there be n individuals and a vector of a consumption good $x = (x_1, \ldots x_n)$. Then utility of individual i is given by

$$U_i(x) = x_i - 1/(n-1) \sum_{j \neq i} \left(\alpha_i \max |x_j - x_i, 0| - \beta_i \max |x_i - x_j, 0| \right), \tag{1}$$

with $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$ (Fehr and Schmidt, 1999, p. 822).

However, as Fehr and Schmidt (1999) acknowledge themselves, this formulation may be too limited to apply to a setting of support for real-world policy proposals such as discussed in this paper. To explain, an inequity-averse individual dislikes outcomes that are *perceived* as inequitable: "This definition raises, of course, the difficult question of how individuals measure or perceive the fairness of outcomes. [...] In a laboratory it is usually much simpler to define what is perceived as an equitable allocation by the subjects. [...] Thus, it is natural to assume that [...] the reference point, i.e. the equitable outcome, is given by the *egalitarian* outcome" (Fehr and Schmidt, 1999, p. 820ff., emphasis added).

As we shall show below and in line with the second strand of theory just ex-

pounded, disagreements about fairness positions are real among our subjects. Furthermore, as we are considering hypothetical choices primarily about policy options that only indirectly lead to monetary payoffs, these disagreements are compounded by the fact that policies imply different reference points for different subjects. When eliciting fairness views and support for policy design options of individuals below, we apply the following setting. Let $P = (p_1, \ldots, p_n)$ be specific policy designs, including the level of the carbon price and the redistribution option. We study how individual support for policy choices increases or decreases. Given significant concern about the state of the climate itself, we compare individuals' utility of policy choices, where x is the *perceived change* in income. The justification for merely considering the change, rather than total income, is that in considering the effects of a policy reform, citizens take the status quo as a reference point – in line with Prospect Theory (Kahneman and Tversky, 1979).[3] Climate protection in itself is important for some but not all citizens and thus y is the *perceived* improvement to the state of the climate (measured e. g. in emission reductions). Citizen i prefers policy p_l over policy p_m if

$$U_i(x(p_l), y(p_l)) > U_i(x(p_m), y(p_m)). \tag{2}$$

Here

$$\begin{aligned} U_i(x(p_l), y(p_l)) = x_i(p_l) - \\ \frac{1}{(n-1)} \sum_{j \neq i} \left(\alpha_i \max |x_j(p_l) - x_i(p_l), 0| - \beta_i \max |x_i(p_l) - x_j(p_l), 0| \right) + f_i(y(p_l), \end{aligned} \tag{3}$$

where U is in monetary terms and α_i, β_i, and f_i translate factors unrelated to own monetary payoff into monetary units (and these can differ for different individuals). The difference to a standard public economics model of a government acting on households' choices is as that we are subsequently interested in a positive understanding of how Equation 3 represents a citizen's view on policy. We note the following four

[3] Since the sums involved in our scenarios are small compared to total annual income and income tax payments in Germany, we believe a setting akin to Fehr and Schmidt (1999) is appropriate to understand relevant effects.

attributes of Equation 3, which we examine empirically below: (1) Individuals support policies both from an egoistic and an altruistic motive (Fehr and Schmidt, 1999), (2) individuals perception of the effects of the policy may not be accurate (Douenne and Fabre, 2019), (3) for some, but not all, individuals climate protection is important, varying with f, which can be 0 (Diederich and Goeschl, 2014), (4) similarly citizens' disagreements on fairness are genuine, varying with α and β.

This is so far an entirely positive approach to policy design. From a normative perspective, because the economic case for protecting the climate by some form of carbon pricing is so strong, it should be the empirical question of which design increases the chance for passage and preservation of carbon pricing that significantly determines which carbon pricing design is introduced (see Goulder, 2020, for a related point). That implies that understanding empirically which carbon pricing design receives the greatest public support seems a high priority.

3 Experimental Design

Our analysis aims at identifying how fairness preferences influence the support for different carbon pricing and revenue recycling schemes. To this end, we designed a discrete-choice experiment that consists of several steps.[4] We first asked the respondents whether they generally support the idea of higher energy prices to contribute to climate protection. Afterward, we informed the participants about the carbon emissions per capita and the carbon intensity of different activities. Subsequently, we asked them whether they are willing to accept the introduction of a carbon tax where we randomly assigned a tax rate of EUR 10, 50, 100 per ton CO_2 to each participant.

Next, we informed the participants about three different revenue-recycling schemes heavily discussed in Germany – a lump-sum payment to all citizens, a payment exclusively to poor households, and a payment exclusively to households with high energy costs. These three schemes reflect two different fairness conceptions – equality and

[4]See the appendix for a translation of the experiment.

equity, which can be designed to compensate vertical or horizontal inequity (Deutsch, 1975; Folger et al., 1995; see also Figure 1). After mentioning the concepts, we asked the respondents to rank the three fairness conceptions according to their preferences.

As a next step, we randomly split the participants into a control and a treatment group. In the control group, we merely informed the participants about the temporal evolution of the level of carbon emissions in Germany. Respondents in the treatment group received the same information, but in addition, they received an extensive explanation of the fairness conceptions of the three revenue recycling schemes. Afterward, we asked the respondents in both experimental conditions again to rank the revenue recycling schemes according to their preferences and whether they would accept the introduction of a carbon tax conditional on the implementation of their preferred revenue recycling scheme. Last, we inquired about the respondents' belief about whether they would benefit from the application of the equity principle, i.e. reducing vertical or horizontal inequity.

Our main hypothesis of the treatment is that communicating the different fairness conceptions raises the support for a carbon tax because respondents have a deeper understanding of these conceptions – or more generally by actively acting the fairness frame (World Bank, 2018) – and pay more attention to fairness-related issues, potentially counteracting pre-existing scepticism. Moreover, we hypothesize that the willingness to support a carbon tax is lower among respondents who perceive that they would be adversely affected by it, but that it increases when it is designed according to the respondent's preferences. In general, as motivated by the theoretical framing, we will analyze the trade-off between fairness perceptions and selfish policy choices.

4 Data

Our experiment was incorporated in an online survey that was conducted in collaboration with the German survey institute *forsa* using its panel that is representative for German population aged 14 and above (information on the panel is available at

http://www.forsa.com/). The survey addressed the household heads who are defined as those individuals who are responsible for financial decisions at the household level. A pre-test including around 125 participants served to prepare the survey and indicated that it is well understood.

Subsequently, the survey was sent out to a total of 9,842 individuals between October 9 and November 6, 2019 and we retrieved 6,549 answers, resulting in a response rate of 66.5% that is comparable to other studies that use *forsa*'s household panel (e.g. Andor et al., 2018a, 2020). The respondents could interrupt and continue the survey at any time, but 432 respondents (6.6%) discontinued the survey at some point.

Along with our experiment, we gathered data on a plethora of socio-economic characteristics and attitudes (Table 1). For instance, the mean age of the respondents is 54.5 years and around 42% of the respondents are female. Moreover, about a quarter of the respondents have a college degree. Almost two thirds of the participants have kids and around 57% live in their own property. About two thirds of the respondents live in rural areas, which are characterized by a population density of less than 100 inhabitants per km^2. Overall, the socio-economic characteristics are in line with the official statistics, with some exceptions as indicated by Table A1 in the appendix. For instance, our sample contains less single and more two person households and is somewhat more affluent.

Besides socio-economic characteristics, we also elicited characteristics related to the introduction of a carbon tax (Panel (B) of Table 1). Objectively, households that own a car and heat with oil will be particuclarly hit by a carbon tax. In our sample, almost 90% of the households have at least one car and about a quarter heats with oil. Moreover, we elicited the subjectively perceived consequences. About 40% of the respondents indicate that they currently incur high energy costs. Moreover, 18% and 13%, respectively, report that they would benefit from a recycling scheme that aims at generating vertical and horizonal equity.

Regarding attitudes (Panel (C) of Table 1), 80% of our sample believes that climate change is currently happening, which is in line with Andor et al. (2018b). On a discrete

Table 1: Summary statistics

	Control	Treatment	Difference	t-Statistic
(A) Socioeconomic characteristics				
Age	54.624	54.422	0.202	0.427
Female	0.421	0.413	0.008	0.624
College degree	0.252	0.259	-0.007	-0.626
Household size	2.105	2.084	0.021	0.913
Household net income (€)	3,088	3,077	11.857	0.306
Has kids	0.629	0.608	0.021	1.704
Homeowner	0.574	0.568	0.006	0.486
East Germany	0.231	0.240	-0.009	-0.865
Rural	0.634	0.653	-0.019	-1.542
(B) Carbon tax related characteristics				
Car owner	0.894	0.898	-0.004	-0.545
Gas heating	0.492	0.503	-0.011	-0.880
Oil heating	0.224	0.221	0.003	0.267
Other heating	0.285	0.276	0.008	0.732
Benefit from vertical equity	0.177	0.176	0.002	0.157
Benefit from horizontal equity	0.133	0.143	-0.010	-1.081
Incur high energy cost	0.394	0.403	-0.009	-0.726
(C) Attitudes				
Climate change exists	0.794	0.782	0.012	1.157
Pro-environmental attitudes	0.726	0.725	0.001	0.303
Rather left	0.640	0.660	-0.021	-1.647
AfD voter	0.069	0.070	-0.001	-0.107
Equality principle	10.334	10.167	0.167	2.167*
Equity principle	10.639	10.486	0.153	1.920*
Merit principle	8.937	8.874	0.063	0.835
Trust in government	0.381	0.381	0.000	0.018

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

scale running from one to ten, about two thirds of the respondents classify themselves as rather left. About 7% are inclined toward to Germany's populist party (AfD). We also elicited the general fairness perceptions (see Figure 1) of respondents using three different hypothetical situations based on Schmitt et al. (1995), Schmitt et al. (1997), and Fischer et al. (2017): On a five-point Likert scale, respondents could indicate how much they agreed with a fairness principle (equality, equity, merit) in three different domains, welfare, friendship, and work. The values in Table 1 represent the sum of the respective Likert scale. Accordingly, we find that respondents exhibit the highest score for the equity principle.

Pro-environmental attitudes are measured by a shorter variant of the Diekmann-Preisendörfer (1998) scale, covering all its three spheres – affectitve, cognitive, and

conative – yielding a Cronbach's (1951) Alpha of α=0.785, which is very similar to the mean Alpha for measuring attitudes in the meta analysis conducted by (Peterson, 1994). Note that for the estimations, we normalize the scores reported in Table 1 for both fairness conceptions and pro-environmental attitudes by substracting the mean and dividing by the standard deviation of the respective variable.

As a result of randomization, the means of most covariates are virtually indistinguishable across experimental conditions (Table 1): using t tests for differences in means, we cannot reject the null hypothesis of no difference across groups at the 5% significance level for all socio-economic characteristics and attitudinal variables. Solely regarding the general fairness conceptions, we find that respondents in the treatment group exhibit slightly lower scores for supporting the equality and the equity principle.

Because of successful randomization, we start our analysis by taking the simple difference in outcomes across treatment groups, as this captures the average treatment effect (Angrist and Pischke, 2009). We obtain the difference in means between treatment and control groups from a linear regression models. To obtain further insights into the determinants of carbon taxes and prefernces for revenue recycling schemes, we incorporate further covariates (from Table 1) into the regression model. When we ask the respondents to rank revenue recycling schemes according to preferences, we estimate a standard multionomial logit model (MNL) and display the marginal effects (Greene, 2003, p. 843ff.).

5 Results

In this section, we first analyze the support for carbon taxation in general (Subsection 5.1). Subsequently, we delve deeper into the support for different revenue recycling schemes (Subsection 5.2). Lastly, we analyze how the support for a carbon tax changes in response to different revenue recycling schemes (Subsection 5.3) and additional information on fairness (Subsection 5.4). Table 2 summarizes our main re-

sults. Note that the options lump sum, social cushioning, and needs principle from the central panel are conceptually congruent with fee and dividend, vertical equity, horizontal equity from the lower panel of Table 2. For the sake of clarity, we distinguish them verbally where the latter constitute the options from the discrete choice experiment.

In a nutshell, we detect that more than half of the respondents express a general willingness to bear higher cost to prevent climate change, but this percentage shrinks when we ask for the more specific policy of a carbon tax. Moreover, using revenues for green spending (energy or transport infrastructure) is the most popular choice when giving participants a broad range of options.[5] However, when restricted to options for direct revenue redistribution, our respondents prefer lump-sum payments (fee and dividend) over directing payments to the poorest (vertical equity) or the most affected (horizontal equity).[6] Last, we detect that the introduction of a carbon tax would receive a higher support if it was implemented conditional on the respondent's preferences.

5.1 Carbon Taxation

Our results show that 57% of the respondents are principally willing to bear higher cost for fuel and gas to help prevent climate change (Table 2). Yet, when we ask for a more specific measure, namely a carbon tax, we detect that the support drops to 47%. This finding of a lower support when asking about a specific measure is in line with Cherry et al. (2017). As expected, the support decreases with the amount of the carbon tax. Precisely, 57% of the respondents are willing to pay a carbon tax of EUR 10 / t CO_2, while only 38% support a carbon tax of EUR 100 EUR / t CO_2. Hence, only a relatively low carbon tax of EUR 10 / t CO_2 yields a support by the majority. Compared to Beiser-McGrath and Bernauer (2019), who have conducted the only study on the

[5] See Question 8 in the appendix for the exact wording of the redistribution schemes.

[6] In our analysis, we focus only on the first preference of the respondents. For the full distribution of the preferences, see Table A2 in the appendix.

Table 2: Support of a carbon tax and revenue recycling schemes

Variable	All	10 EUR / t CO_2	50 EUR / t CO_2	100 EUR / t CO_2
Support of increasing energy cost				
Higher cost	0.571	–	–	–
	–	–	–	–
Carbon tax	0.469	0.572	0.451	0.384
	–	–	(7.565**)	(11.943**)
Support for recycling schemes				
Green energy	0.725	0.730	0.716	0.729
	–	–	(0.996)	(0.103)
Green transport	0.759	0.755	0.753	0.770
	–	–	(0.136)	(-1.089)
Fiscal revenue	0.107	0.114	0.095	0.113
	–	–	(1.912)	(0.044)
Lump sum	0.460	0.454	0.456	0.470
	–	–	(-0.234)	(-0.998)
Social cushioning	0.363	0.368	0.361	0.360
	–	–	(0.514)	(0.553)
Double dividend	0.237	0.240	0.232	0.238
	–	–	(0.580)	(0.119)
Needs principle	0.401	0.397	0.397	0.408
	–	–	(-0.025)	(-0.692)
Preferred direct redistribution schemes				
Fee and dividend	0.520	0.507	0.523	0.529
	–	–	(-1.020)	(-1.418)
Vertical equity	0.379	0.397	0.387	0.365
	–	–	(0.151)	(1.451)
Horizontal equity	0.101	0.106	0.092	0.106
	–	–	(1.459)	(0.019)
Conditional carbon tax	0.619	0.673	0.617	0.564
	–	–	(3.626**)	(7.016**)

Results from a two-sided t-test for equal means compared to the EUR 10 group are reported in parentheses. ** denotes statistical significance at the 1% level.

public support for a carbon tax in Germany so far, our numbers are slightly higher.[7]

To shed light on the support for a carbon tax, we investigate response heterogeneity by controlling for several socio-economic characteristics and attitudes (Table 3). Column (1) of Table 3 demonstrates that the descriptive results from Table 2 hold once we control for socio-economic characteristics. In addition, we find that respondents

[7]During our survey period, on October 23, 2019, the German government stipulated a new climate package that entailed a carbon price of EUR 10 for the transport and buildung sector. Splitting the sample according to this date indicates that the support of higher carbon prices is somewhat lower after the stipulation of the climate package, but the differences are not statistically different (Table A4).

with higher incomes, women, as well as college graduates exhibit a higher support for a carbon tax, while residents of East Germany and in rural areas tend to be less supportive.

Table 3: OLS results for the support of a carbon tax

	(1)		(2)		(3)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
50 Euro	-0.110**	(0.017)	-0.117**	(0.017)	-0.113**	(0.016)
100 Euro	-0.185**	(0.017)	-0.187**	(0.017)	-0.188**	(0.017)
Age	0.001	(0.001)	0.001	(0.001)	0.000	(0.001)
Female	0.031*	(0.014)	0.032*	(0.015)	-0.019	(0.015)
College degree	0.159**	(0.016)	0.116**	(0.017)	0.059**	(0.016)
Household size = 2	-0.064**	(0.020)	-0.026	(0.021)	-0.026	(0.020)
Household size = 3	-0.072*	(0.028)	-0.038	(0.029)	-0.034	(0.028)
Household size $>$ 3	-0.080**	(0.031)	-0.035	(0.032)	-0.052	(0.030)
ln(Net income)	0.109**	(0.017)	0.071**	(0.020)	0.078**	(0.019)
Has kids	-0.010	(0.017)	0.005	(0.018)	-0.009	(0.017)
Homeowner	0.006	(0.016)	0.019	(0.017)	0.039*	(0.016)
East Germany	-0.129**	(0.016)	-0.112**	(0.017)	-0.063**	(0.016)
Rural	-0.086**	(0.015)	-0.047**	(0.016)	-0.032*	(0.015)
Car owner	–	–	-0.137**	(0.027)	-0.079**	(0.027)
Gas heating	–	–	-0.000	(0.017)	-0.012	(0.016)
Oil heating	–	–	-0.109**	(0.021)	-0.095**	(0.020)
Benfit from vertical equity	–	–	0.062**	(0.021)	0.032	(0.020)
Benefit from horizontal equity	–	–	0.022	(0.021)	0.039*	(0.020)
Incur high energy cost	–	–	-0.273**	(0.016)	-0.185**	(0.015)
Climate change exisits	–	–	–	–	0.102**	(0.018)
Pro-environmental attitudes	–	–	–	–	0.148**	(0.007)
Rather left	–	–	–	–	0.069**	(0.016)
AfD voter	–	–	–	–	-0.067**	(0.022)
Equality principle	–	–	–	–	-0.010	(0.008)
Equity principle	–	–	–	–	0.034**	(0.009)
Merit principle	–	–	–	–	-0.018*	(0.008)
Trust in government	–	–	–	–	0.125**	(0.015)
Constant	-0.239	(0.135)	0.230	(0.154)	-0.021	(0.144)
No. of observations	4,873		4,191		3,851	

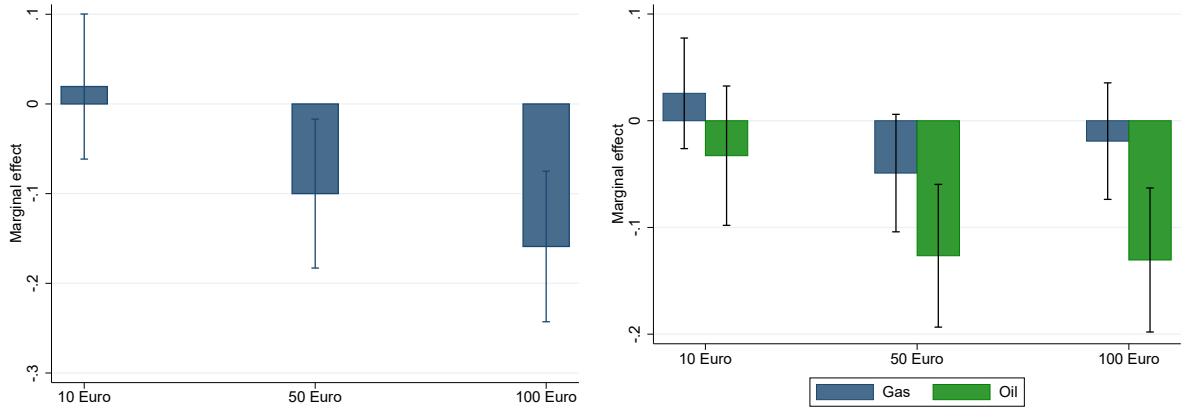
Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

In line with Baranzini and Carattini (2017), the opposition to a carbon tax is higher if the personal financial burden is higher as indicated by the ownership of a car, heating by oil, and incuring high energy cost (Column (2) of Table 3). Further controlling for attitudes (Column (3) of Table 3) indicates that respondents who trust in the government (see also Baranzini and Carattini, 2017), believe that climate change is happening, identify themselves as rather left, and have pro-environmental attiudes exhibit

a higher propensity to support a carbon tax.

To dig deeper into the mechanims underlying the support for a carbon tax, we estimate a model specification that involves interaction terms between the amount of the carbon tax and the individual financial burden. Figure 2 illustrates that the negative effect of higher carbon taxes is particularly pronounced among car owners and respondents who heat with gas or oil.

Figure 2: Effects of car ownership and heating system on the support of a carbon tax



(a) Car ownership

(b) Heating system

5.2 General support for revenue recycling schemes

Using the revenues from a carbon tax for green spending receives the largest support (Table 2), as around three quarters of the respondents support the idea of financing the deployment for renewables or climate-friendly transport infrastrucutre. Less than half of the respondents (45%) support a lump sum payment to all citizens. The redistribution based on the needs concept (to households that suffer particularly from a carbon tax) and social cushioning (support low-income households) are supported by about 36% and 40%, respectively. Finally, the respondents least support lowering other taxes (23%) or raising fiscal revenues (10%). The low support of reducing other taxes and increasing fiscal revenues is in line with, for intance, Kotchen et al. (2017), Beiser-McGrath and Bernauer (2019), and Carattini et al. (2017).

Next, we analyze the support to different recycling schemes by including the same

covariates as in the previous analysis (Table 4). The results suggest, for instance, that college graduates and respondents who trust the government are more likely to support earmarking the revenues for investments in cleaner transport infrastructure as well as adding them to the fiscal budget. Furthermore, respondents who tend to vote rather left and have strong pro-environmental attitudes show a higher preference for green spending.

Table 4: OLS results for the support of recycling schemes

	Green energy		Green transport		Fiscal revenue		Lump sum		Social cushion		Double dividend		Needs	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
50 Euro	-0.017	(0.016)	-0.013	(0.015)	-0.023	(0.012)	0.005	(0.019)	-0.005	(0.018)	-0.008	(0.016)	0.005	(0.018)
100 Euro	-0.005	(0.015)	0.010	(0.015)	-0.011	(0.012)	0.022	(0.019)	-0.015	(0.018)	0.011	(0.016)	0.014	(0.018)
Age	-0.001**	(0.001)	0.001	(0.001)	0.001*	(0.000)	0.000	(0.001)	0.002**	(0.001)	-0.002**	(0.001)	0.003**	(0.001)
Female	-0.014	(0.013)	0.006	(0.013)	0.001	(0.010)	0.026	(0.017)	-0.060**	(0.016)	0.041**	(0.014)	-0.029	(0.016)
College degree	0.018	(0.014)	0.040**	(0.014)	0.034**	(0.012)	-0.035	(0.019)	-0.049**	(0.017)	-0.032*	(0.015)	-0.049**	(0.017)
Household size = 2	-0.030	(0.019)	-0.001	(0.018)	-0.009	(0.014)	-0.024	(0.023)	-0.006	(0.022)	-0.009	(0.019)	-0.014	(0.022)
Household size = 3	-0.020	(0.027)	-0.028	(0.027)	-0.023	(0.020)	-0.070*	(0.033)	0.019	(0.031)	0.018	(0.028)	0.003	(0.031)
Household size > 3	0.004	(0.028)	-0.002	(0.028)	0.010	(0.023)	-0.080*	(0.035)	-0.007	(0.033)	0.029	(0.030)	0.012	(0.033)
ln(Net income)	0.035	(0.018)	0.034	(0.018)	0.001	(0.014)	0.021	(0.023)	-0.082**	(0.021)	0.017	(0.018)	-0.080**	(0.021)
Has kids	-0.001	(0.017)	0.011	(0.016)	0.006	(0.012)	0.040*	(0.020)	-0.020	(0.018)	-0.027	(0.016)	-0.000	(0.019)
Homeowner	0.007	(0.015)	-0.004	(0.015)	-0.049**	(0.012)	-0.009	(0.019)	-0.020	(0.017)	-0.006	(0.016)	-0.007	(0.018)
East Germany	-0.067**	(0.017)	0.004	(0.015)	0.016	(0.013)	0.009	(0.020)	-0.012	(0.018)	0.037*	(0.016)	-0.015	(0.019)
Rural	-0.021	(0.014)	0.019	(0.014)	-0.000	(0.011)	-0.005	(0.018)	-0.025	(0.016)	0.021	(0.014)	-0.018	(0.017)
Car owner	-0.030	(0.023)	-0.070**	(0.021)	0.026	(0.018)	-0.037	(0.030)	-0.016	(0.028)	0.009	(0.024)	0.023	(0.028)
Gas heating	0.022	(0.015)	0.032*	(0.014)	0.007	(0.012)	-0.000	(0.019)	-0.028	(0.017)	0.002	(0.015)	0.001	(0.018)
Oil heating	0.020	(0.019)	-0.014	(0.019)	0.007	(0.014)	-0.007	(0.023)	-0.023	(0.021)	0.003	(0.019)	0.033	(0.022)
Benfit from vertical equity	-0.012	(0.020)	0.004	(0.018)	0.006	(0.014)	0.088**	(0.023)	0.089**	(0.022)	0.017	(0.020)	0.050*	(0.022)
Benefit from horizontal equity	0.011	(0.018)	-0.045*	(0.019)	0.030*	(0.015)	-0.032	(0.022)	0.027	(0.020)	0.022	(0.020)	0.104**	(0.022)
Incur high energy cost	-0.064**	(0.015)	-0.057**	(0.014)	-0.014	(0.011)	0.017	(0.018)	0.018	(0.016)	0.033*	(0.015)	0.064**	(0.017)
Climate change exisits	0.080**	(0.019)	0.058**	(0.018)	-0.014	(0.013)	-0.006	(0.021)	0.016	(0.019)	-0.089**	(0.019)	-0.021	(0.020)
Pro-environmental attitudes	0.100**	(0.008)	0.107**	(0.007)	-0.009	(0.006)	0.006	(0.009)	0.039**	(0.008)	-0.050**	(0.008)	0.003	(0.008)
Rather left	0.060**	(0.015)	0.063**	(0.015)	0.005	(0.011)	-0.037*	(0.018)	0.079**	(0.017)	-0.078**	(0.016)	0.066**	(0.017)
AfD voter	-0.150**	(0.032)	-0.085**	(0.032)	0.004	(0.022)	-0.049	(0.033)	0.056	(0.030)	0.020	(0.032)	0.072*	(0.032)
Equality principle	0.017*	(0.008)	0.006	(0.008)	0.000	(0.006)	0.049**	(0.010)	-0.007	(0.009)	0.021**	(0.008)	0.002	(0.009)
Equity principle	0.016	(0.009)	0.032**	(0.008)	-0.020**	(0.007)	0.016	(0.011)	0.106**	(0.010)	-0.018*	(0.009)	0.090**	(0.010)
Merit principle	0.015*	(0.008)	-0.001	(0.007)	0.013*	(0.006)	-0.005	(0.010)	-0.048**	(0.009)	0.025**	(0.008)	-0.022*	(0.009)
Trust in government	0.082**	(0.013)	0.065**	(0.013)	0.023*	(0.011)	0.021	(0.017)	-0.028	(0.016)	-0.051**	(0.013)	-0.000	(0.016)
Constant	0.491**	(0.143)	0.400**	(0.140)	0.043	(0.107)	0.303	(0.178)	0.918**	(0.163)	0.289*	(0.144)	0.763**	(0.167)
No. of observations	4,013		4,014		3,977		3,959		3,988		3,975		3,980	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Regarding the alternatives where revenues are redistributed to the citizens, we detect that women show reluctance to social cushioning. College graduates are more skeptical toward all options, while more affluent respondents tend to reject directing the revenues from a carbon tax to households with low incomes (social cushioning) or high energy costs (needs). In line with their general fairness principles, respondents who tend to favor the equality principle have a higher propensity to support the lump sum payment, while respondents who prefer the equity principle tend to support social cushioning and the needs-based redistribution as hypothesized by Figure 1. Respondents who report to incur high energy cost are much less often in favor

of green spending, but rather prefer redistribution based on the needs principle. Moreover, respondents who report that they would benefit from reducing vertical inequity strongly support social cushioning and respondents who report that they would benefit from horizontal equity tend to support the needs-based principle. Thus, the main take-away from our analysis so far is that people tend to support revenue recycling schemes that benefit themselves individually and that overlap with their fairness perceptions.

Next, we link our results so far by testing whether the support of a specific revenue recycling scheme is correlated with the support of a carbon tax (Table 5). The results suggest that respondents who support green spending (energy or transport) have a 20 percentage points higher probability of supporting the introduction of a carbon tax. In contrast, respondents who support a reduction of other taxes (double dividend) are less likely to support a carbon tax. Following Kallbekken et al. (2011) and Dresner et al. (2006), it might be that respondents view taxes solely as a means to raise revenue rather than an incentive to reduce emissions. This view could be particularly prevalent among respondents with pro-environmental attitudes as shown by Figure A1 in the appendix.

In contrast to Carattini et al. (2017), we do not find that supporting a lump sum payment is associated with a higher support for a carbon tax. Moreover, contrasting Beiser-McGrath and Bernauer (2019), we detect that using the revenues from a carbon tax to support citizens with high energy cost (needs principle) decreases the support for a carbon tax. The results can be confirmed when we control for socio-economic characteristics, albeit the point estimates shrink notably (Column (2) of Table 5).

Interestingly, we find heterogeneous effects depending on the amount of the carbon tax by interacting it with the revenue recycling schemes (Figure 3). With increasing tax levels, the support for using the revenues to invest in green energy infrastructure diminishes particularly strongly. We observe the same pattern (but less clear) among respondents who support the needs-based principle. In contrast, the negative effect of higher carbon taxes is smaller for respondents who are in favor of lump-sum payments

Table 5: OLS results for the association of supporting a carbon tax and revenue recycling schemes

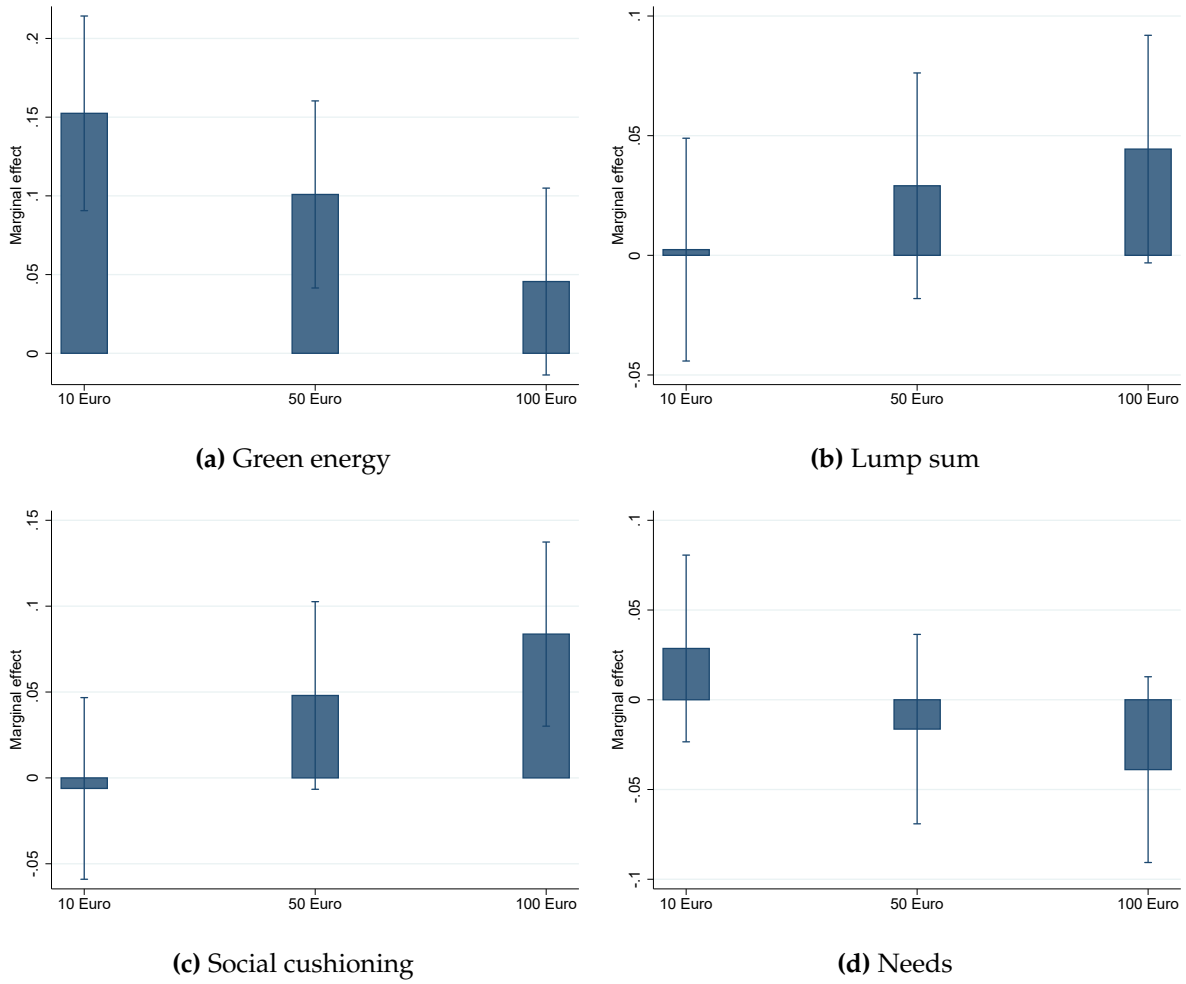
	(1)		(2)	
	Coeff.	Std. Err.	Coeff.	Std. Err.
50 Euro	-0.117**	(0.015)	-0.116**	(0.017)
100 Euro	-0.193**	(0.015)	-0.187**	(0.017)
Green spending	0.226**	(0.016)	0.101**	(0.018)
Traffic infrastructure	0.199**	(0.016)	0.063**	(0.019)
Fiscal revenue	0.017	(0.021)	0.001	(0.023)
Lump sum	0.019	(0.013)	0.022	(0.014)
Social cushioning	0.075**	(0.015)	0.040*	(0.016)
Double dividend	-0.172**	(0.015)	-0.096**	(0.017)
Needs principle	-0.037**	(0.014)	-0.009	(0.016)
Age	–	–	0.000	(0.001)
Female	–	–	-0.011	(0.015)
College degree	–	–	0.053**	(0.016)
Household size = 2	–	–	-0.016	(0.020)
Household size = 3	–	–	-0.037	(0.028)
Household size $>$ 3	–	–	-0.041	(0.030)
ln(Net income)	–	–	0.071**	(0.019)
Has kids	–	–	-0.009	(0.017)
Homeowner	–	–	0.040*	(0.016)
East Germany	–	–	-0.054**	(0.016)
Rural	–	–	-0.026	(0.016)
Car owner	–	–	-0.070**	(0.027)
Gas heating	–	–	-0.022	(0.016)
Oil heating	–	–	-0.100**	(0.020)
Benfit from vertical equity	–	–	0.034	(0.021)
Benefit from horizontal equity	–	–	0.045*	(0.020)
Incur high energy cost	–	–	-0.169**	(0.016)
Climate change exisits	–	–	0.088**	(0.018)
Pro-environmental attitudes	–	–	0.123**	(0.008)
Rather left	–	–	0.052**	(0.016)
AfD voter	–	–	-0.046*	(0.022)
Equality principle	–	–	-0.011	(0.009)
Equity principle	–	–	0.023*	(0.010)
Merit principle	–	–	-0.018*	(0.008)
Trust in government	–	–	0.106**	(0.015)
Constant	0.290**	(0.018)	-0.063	(0.147)
No. of observations	5,259		3,679	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

or social cushioning. This result could become more important with increasingly ambitious climate policy: in the future both the distributional impacts of carbon pricing as well as the amonunt of revenues will increase. It is likely that the question of carbon tax design will thus become conflated with questions of broader societal redistribution, highlighting the importance of perceived fairness. Therefore, in the following,

we restrict ourselves to options that directly channel the revenues generated from a carbon tax back to the citizens.

Figure 3: Effects of redistribution schemes conditional on amount of carbon tax



(a) Green energy

(b) Lump sum

(c) Social cushioning

(d) Needs

5.3 Support for redistribution-based revenue recycling

One shortcoming of the previous analysis is that the respondents could indicate a high support for all options of revenue recycling. To overcome this, we designed an experiment outlined in Section 3 that starts out with the task to rank three redistribution schemes (fee and dividend, vertical equity, and horizonal equity) according to the individual preferences, that is, from fair to unfair. We focus on direct redistribution schemes to households as identifyfing their determinants constitutes our main research question.

Table 2 shows that the fee and dividend scheme, which coincides with the equality conception in Figure 1, is the most popular of these three measures as 52% of the respondents rank it first. Furthermore, 38% of the respondents prioritize enhancing vertical equity and the remainder reports enhancing horizontal equity as the preferred option. Interestingly, the amount of the carbon tax does not seem to have a bearing on the preference map. Hence, the support of a revenue recycling scheme seems to be independent from the amount that is required to be paid. Morever, although respondents slightly prefer the equity principle when asked how fair these are in general (Table 1), for a carbon tax design, respondents tend to prefer the equality principle, expressed as a fee and dividend scheme Table 2.

In this set up, we find that women, respondents from East Germany, and respondents with high incomes are more likely to rank redistribution based on the equality concept (fee and dividend) first and are less inclined toward the equity concept expressed by reducing vertical inequity (Table 6). Moreover, respondents with high pro-environmental attitudes and who identify themselves as rather left on the political spectrum tend to reject the fee and dividend scheme. These respondents in turn are more likely to support social cushioning (vertical equity). We do not find many determinants for ranking the goal of horizonal equity first, not even among respondents who would benefit from it, namely car owners and respondents who heat with oil or report to incur high energy cost. A potential explanation is that these respondents do not link these activities with being entitled to it.

This intuition is substantiated by the fact that respondents who believe that they would benefit from this kind of redistribution have a higher probability to prioritize the achievement of horizontal equity. Hence, we replicate our previous findings that participants respond according to own needs. Given that the percentage of respondents who rank the reduction of horizontal inequity first amount to 10% (Table 2), the maginitude (7.7 percentage points) of this effect is substantial.

In addition, the preferences are determined by general fairness conceptions. For instance, people who have strong preferences for the equality principle tend to prioritize

Table 6: MNL results for the preference of revenue recycling schemes

	Fee and dividend		Vertical equity		Horizontal equity	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
50 Euro	0.020	(0.019)	0.003	(0.019)	-0.022	(0.012)
100 Euro	0.030	(0.019)	-0.035	(0.018)	0.005	(0.012)
Age	-0.002*	(0.001)	0.000	(0.001)	0.001**	(0.000)
Female	0.052**	(0.017)	-0.062**	(0.016)	0.010	(0.011)
College degree	-0.027	(0.019)	0.004	(0.018)	0.022	(0.012)
Household size = 2	-0.031	(0.023)	0.026	(0.022)	0.005	(0.014)
Household size = 3	-0.030	(0.033)	0.028	(0.032)	0.002	(0.020)
Household size $>$ 3	0.003	(0.036)	0.003	(0.034)	-0.006	(0.022)
ln(Net income)	0.065**	(0.022)	-0.078**	(0.021)	0.012	(0.014)
Has kids	0.007	(0.020)	-0.005	(0.019)	-0.002	(0.012)
Homeowner	0.019	(0.019)	-0.012	(0.018)	-0.007	(0.011)
East Germany	0.067**	(0.020)	-0.058**	(0.019)	-0.010	(0.012)
Rural	0.015	(0.018)	-0.010	(0.017)	-0.005	(0.011)
Car owner	0.004	(0.030)	-0.010	(0.029)	0.006	(0.019)
Gas heating	0.015	(0.019)	-0.015	(0.018)	0.000	(0.011)
Oil heating	-0.023	(0.023)	-0.002	(0.022)	0.025	(0.015)
Benfit from vertical equity	-0.038	(0.023)	0.038	(0.023)	-0.000	(0.014)
Benefit from horizontal equity	-0.029	(0.022)	-0.047*	(0.021)	0.077**	(0.016)
Incur high energy cost	0.004	(0.018)	-0.023	(0.017)	0.018	(0.011)
Climate change exisits	-0.018	(0.021)	0.040*	(0.020)	-0.022	(0.013)
Pro-environmental attitudes	-0.054**	(0.009)	0.062**	(0.009)	-0.008	(0.005)
Rather left	-0.062**	(0.018)	0.071**	(0.018)	-0.009	(0.012)
AfD voter	-0.112**	(0.034)	0.130**	(0.035)	-0.019	(0.018)
Equality principle	0.037**	(0.010)	-0.026**	(0.010)	-0.011	(0.006)
Equity principle	-0.075**	(0.011)	0.094**	(0.010)	-0.019**	(0.006)
Merit principle	0.032**	(0.010)	-0.044**	(0.009)	0.012*	(0.006)
Trust in government	0.015	(0.017)	0.001	(0.016)	-0.016	(0.010)
No. of observations	3,842					

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

the equality-based concept of fee and dividend. Specifically, a one standard deviation increase on the equality principle scale translates into a 3.7 percentage points higher likelihood to report the fee and dividend scheme as the preferred option. In addition, respondents who support the equity concept have a particularly strong preference for the reduction of vertical inequality: An increase of one standard deviation on the equity principle scale increases the likelihood to choose vertical equity by 9.4 percentage points, which is almost 50% larger than the effect of pro-environmental attitudes.

5.4 The effect of additional information on fairness

After dividing the sample into the control and the treatment condition where the latter conveys information about the fairness principles, we asked the respondents again to rank the revenue recycling schemes. Regressing a binary variable that indicates whether respondents changed their first preference of the redistribution scheme after receiving additional information, we detect that the share in the control condition amounts to 24%.[8] Yet, our treatment leads to an even stronger adjustment that amounts to 4.6 percentage points (Column (1) of Table 7). Column (2) of Table 7 demonstrates that the results do not change qualitatively when we control for the same covariates as in the previous analyses.

Table 7: OLS results for the changing the preference of revenue recycling schemes

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Treatment	0.046**	(0.012)	0.068**	(0.014)	0.073**	(0.014)	0.075**	(0.027)
50 Euro	–	–	-0.031	(0.018)	-0.022	(0.017)	-0.042	(0.022)
100 Euro	–	–	-0.036*	(0.017)	-0.037*	(0.017)	-0.039	(0.022)
Rural	–	–	0.025	(0.016)	0.026	(0.015)	0.025	(0.015)
Vertical equity	–	–	–	–	0.042**	(0.015)	0.062**	(0.020)
Horizontal equity	–	–	–	–	0.433**	(0.027)	0.444**	(0.037)
Treatment × 50 Euro	–	–	–	–	–	–	0.040	(0.034)
Treatment × 100 Euro	–	–	–	–	–	–	0.005	(0.033)
Treatment × Vertical equity	–	–	–	–	–	–	-0.038	(0.029)
Treatment × Horizontal equity	–	–	–	–	–	–	-0.020	(0.052)
Constant	0.238**	(0.008)	0.179	(0.155)	0.170	(0.149)	0.173	(0.149)
Further controls	No		Yes		Yes		Yes	
No. of observations	5,535		3,741		3,741		3,741	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

In Column (3) of Table 7, we include the rank from the first ranking question in the regression and find that respondents who ranked horizontal equity first are particularly likely to change the preference. Interacting the treatment indicator with first preferences shows that our treatment was particularly effective in changing redistri-

[8] This high share of changing preferences in the control is surprising. It might be due to the fact that at this stage, the order of the revenue schemes was again randomized. Therefore, it could be caused by inattention. The effect size of the treatment should be unaffected. We measured the time the respondents needed to answer the two questions, but controlling for it in the estimations does not have a significant bearing on the choice probabilities.

bution preferences when the fee and dividend scheme was the first preference (Column (4) of Table 7).[9] Hence, informing about the consequences of the redistribution schemes induces respondents to rethink the equality concept and renders them more likely to prefer another redistribution scheme. Analogously, our treatment was less successful in rethinking redistribution preferences when respondents chose schemes according to vertical or horizonal equity in the first place. Interestingly, the amount of the carbon tax does not have a significant bearing on the magnitude of the treatment effect.[10]

After the second elicitation of the preferences, we asked the respondents again about their support for a carbon tax. Table 2 shows that the acceptance of a carbon tax increases by about 15 percentage points if it is implemented according to the respondent's preference. Specifically, almost 70% of the respondents are willing to support a carbon tax of EUR 10 / t CO_2 if its implemented in combination with a lump sum payment. The support decreases to 62% and 58% if the carbon tax amounts to EUR 50 and 100 / t CO_2, respectively. Nevertheless, our results indicate a substantially higher support for a carbon tax coupled with a lump sum payment than for instance Douenne and Fabre (2020).

In the following analysis, we code the dependent variable as unity if respondents are willing to support a carbon tax *only* if its implemented with the own preference.[11] The additional support for a carbon tax is somewhat lower in the treatment group (Table 8). In addition, the conditional support of a carbon tax occurs substantially more often when the tax rate increases to 50 and 100 EUR, respectively (Column (2) of Table 8). This would indicate that redistribution becomes more imporant as the tax rate increases.

Column (3) of Table 8 suggests that the conditional acceptability of a carbon tax

[9] See Table A3 in the appendix for the exact change patterns and Table A5 for the determinants.

[10] The null hypothesis of F-tests on the joint insignifiance of the amount of the carbon tax and the interaction with the first preference cannot be rejected at the 5% level: $F(1,\ 3706) = 3.42;\ p = 0.0601$ for 50 EUR and $F(1,\ 3706) = 3.09;\ p = 0.0790$, respecticely.

[11] See Table A6 in the appendix for an analysis in the fashion of Table 6. We identify the determinants of the redistribution preference when we use the second elicitation of preferences as the dependent variable. Overall, we find similar results.

Table 8: OLS results for the support of a carbon tax when the preferred revenue recycling scheme is implemented

	(1)		(2)		(3)		(4)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Treatment	-0.018	(0.010)	-0.025*	(0.012)	-0.024*	(0.012)	-0.014	(0.024)
50 Euro	–	–	0.042**	(0.014)	0.047**	(0.015)	0.054*	(0.021)
100 Euro	–	–	0.052**	(0.014)	0.052**	(0.015)	0.057**	(0.021)
Rural	–	–	0.000	(0.013)	-0.002	(0.014)	-0.002	(0.014)
Vertical equity	–	–	–	–	-0.048**	(0.013)	-0.039*	(0.019)
Horizontal equity	–	–	–	–	-0.086**	(0.019)	-0.119**	(0.027)
Treatment × 50 Euro	–	–	–	–	–	–	-0.014	(0.029)
Treatment × 100 Euro	–	–	–	–	–	–	-0.010	(0.029)
Treatment × Vertical equity	–	–	–	–	–	–	-0.018	(0.026)
Treatment × Horizontal equity	–	–	–	–	–	–	0.058	(0.039)
Constant	0.166**	(0.007)	0.348**	(0.129)	0.432**	(0.133)	0.429**	(0.134)
Further controls	No		Yes		Yes		Yes	
No. of observations	5,497		3,770		3,578		3578	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

increases most when the respondents prefer redistribution to the citizens via a lump sum (fee and dividend) and is significantly lower when they prefer an equity principle (vertical or horizontal). Hence, the overall preference for lump-sum payments when it comes to the redistribution of carbon tax revenues translates into a higher support for a carbon tax when it is coupled with a lump-sum payment.

Our treatment of informing about the functioning of the redistribution schemes does not induce differential effects across tax rates (Column (4) of Table 8). Yet, the negative effect of prefering horizontal equity is moderated by our treatment. Presumably, this effect arises because now respondents in the treatment group have a better understanding of the equity (or needs) principle. Yet, we do not find further heterogeneous effects based on whether households would benefit from the recycling scheme they support.

6 Conclusion

At the end of 2019 Germany enacted a major environmental tax reform: from 2021 on there will be a gradually increasing national carbon price for the building and trans-

port sectors. Whether this policy can be preserved and carbon prices can increase as planned crucially depends on public support. By conducting a survey with 6,000 German household heads that comprises a theoretically-motivated discrete choice experiment, we shed light on the policy preferences over carbon pricing designs. Specifically, we analyze preferences for different recycling schemes derived from different fairness conceptions and their capacity to increase the support for the policy.

We find the following results: We confirm that that only a low carbon tax of 10 EUR / t CO_2 is supported by the majority of our sample; with higher tax rates the support diminishes. While high-income individuals tend to favor the introduction of a carbon tax, individuals who would suffer from it – such as respondents who heat with oil and already incur high energy cost – tend to oppose it.

Furthermore, our findings shed new light on the use of revenues and support for carbon pricing. We also confirm that green spending, i.e. financing the deployment of renewables or low-carbon transport options, is the most popular revenue recycling option. It also has the highest positive correlation with the support of a carbon tax. Taken together, this means that those individuals who support a carbon tax are less interested in channeling the revenues to the population. Thus, respondents view carbon taxes solely as a means to raise revenue rather than an incentive to reduce emissions and therefore require further climate action by investments into clean energy and transport infrastructure.

Importantly, our study advances understanding how to raise the support of a carbon tax by means of using revenues by two novel insights: First, green spending is significantly more popular with people who are pro-environment, politically left, have a college degree, and trust the government. In contrast, reducing other taxes is significantly more popular with people who would incur high costs form carbon pricing. Therefore, despite its popularity, green spending might run the risk of "preaching to the converted" rather than building societal support with the groups that tend to oppose climate action. As such, it may further polarization of an already polarized issue. Moreover, with higher price levels the support for green spending decreases sharply,

while the support for lump sum payments and social cushioning is much less affected. In other words, the "green spenders" seem to get a social conscience, and become more concerned about the distributional impacts for the sake of paying for green projects. This is an essential insight as with increasingly ambitious climate goals the role of distributional issues is likely to become more important, intertwining social with climate policy.

Second, when restricted to options for direct revenue redistribution, Germans prefer lump-sum payments over directing payments to the poorest households or those who would be most affected by a carbon tax. Importantly, our results indicate that the choice of the preferred redistribution scheme is driven by *both* general fairness preferences and by own economic interests – as predicted by applying behavioural economic theory to citizens' views on policy proposals. Our treatment of informing households about distributional implications of different revenue recycling schemes has a limited effect. Yet, we find that it steers people away from the option of lump-sum redistribution. Thus, illustrating in detail the distributional consequences of the redistribution schemes induces respondents to think harder about underlying fairness principles and renders them more likely to prioritize more equity-related schemes.

Finally, we observe that the introduction of a carbon tax would receive higher support if it was implemented according to the respondent's preferences. In particular, the support of a carbon tax increases by around 15 percentage points provided that the respondents' preferred revenue recycling scheme is implemented.

Taking all results together, the overall message from our study for policy is that the support of a carbon tax would be highest if it was coupled with lump-sum redistribution in Germany. Importantly, even a carbon tax of 100 EUR / t CO_2 would be supported by the majority of respondents if it was combined with a lump-sum payment. From a policy perspective, this combination could make a carbon tax work for citizens: for instance in Switzerland a carbon price level at this order of magnitude is already imposed and the lump-sum payment is effected via the health insurance. In addition, the government could implement an option to not pay out the lump-sum

and invest it into green energy or transport infrastructure if an individual would prefer green spending over lump-sum payments. Time will tell whether planned increases in the German carbon price to up to 65 EUR / t CO_2 by 2026 will come with such measures to keep public support for further climate action high.

Appendix

A Tables and Figures

Table A1: Comparison with German population of main income earners

Variable	Germany	Sample
1 person household	0.423	0.274
2 person household	0.332	0.473
3 person household	0.119	0.135
4+ person household	0.164	0.119
Age $<$ 35 years	0.196	0.108
Age 35–65 years	0.524	0.537
Age $>$ 65years	0.279	0.355
Income $<$ EUR 1,200	0.184	0.079
Income EUR 1,200–2,200	0.209	0.228
Income EUR2,200–4,700	0.445	0.539
Income $>$ EUR 4,700	0.163	0.154
College degree	0.224	0.256
East Germany	0.206	0.235
Female	0.359	0.417

Note: The population data is drawn from Destatis (2020). While we ask the household head to complete the survey, Destatis (2020) asks the main income earner.

Table A2: Distribution of preferences for direct redistribution schemes

	1st preference	2nd preference	3rd preference
Fee and dividend	0.520	0.368	0.113
Vertical equity	0.379	0.427	0.195
Horizontal equity	0.102	0.206	0.693

Table A3: Changes in the preference for a recycling scheme in percentages

From	To	Control group	Treatment group	Difference	t-Statistic
Fee and dividend	Vertical equity	0.053	0.078	-0.025	-3.809**
Fee and dividend	Horizontal equity	0.028	0.048	-0.020	-3.864**
Vertical equity	Fee and dividend	0.075	0.074	0.001	0.124
Vertical equity	Horizontal equity	0.019	0.025	-0.006	-1.627
Horizontal equity	Fee and dividend	0.036	0.031	0.005	1.005
Horizontal equity	Vertical equity	0.027	0.027	-0.000	-0.005
No change		0.762	0.716	0.046	3.881**

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

Table A4: OLS results for the support of a carbon tax depending on the date of answering the survey

	Before October 23		After October 23	
	Coeff.	Std. Err.	Coeff.	Std. Err.
50 Euro	-0.134**	(0.020)	-0.069*	(0.030)
100 Euro	-0.199**	(0.020)	-0.162**	(0.030)
Age	0.001	(0.001)	-0.001	(0.001)
Female	-0.031	(0.018)	-0.003	(0.026)
College degree	0.073**	(0.019)	0.038	(0.028)
Household size = 2	-0.039	(0.024)	0.002	(0.035)
Household size = 3	-0.029	(0.034)	-0.035	(0.049)
Household size $>$ 3	-0.032	(0.037)	-0.086	(0.051)
ln(Net income)	0.086**	(0.023)	0.054	(0.033)
Has kids	-0.025	(0.020)	0.024	(0.030)
Homeowner	0.027	(0.019)	0.063*	(0.029)
East Germany	-0.063**	(0.019)	-0.053	(0.032)
Rural	-0.018	(0.019)	-0.056*	(0.028)
Car owner	-0.064*	(0.032)	-0.115*	(0.051)
Gas heating	-0.014	(0.019)	-0.013	(0.029)
Oil heating	-0.089**	(0.024)	-0.111**	(0.036)
Benfit from vertical equity	0.041	(0.025)	0.012	(0.037)
Benefit from horizontal equity	0.057*	(0.025)	0.003	(0.034)
Incur high energy cost	-0.180**	(0.019)	-0.199**	(0.028)
Climate change exisits	0.096**	(0.021)	0.106**	(0.033)
Pro-environmental attitudes	0.151**	(0.009)	0.142**	(0.013)
Rather left	0.064**	(0.019)	0.076*	(0.029)
AfD voter	-0.059*	(0.027)	-0.084*	(0.040)
Equality principle	-0.011	(0.010)	-0.005	(0.016)
Equity principle	0.025*	(0.011)	0.056**	(0.016)
Merit principle	-0.028**	(0.010)	-0.001	(0.014)
Trust in government	0.128**	(0.018)	0.120**	(0.027)
Constant	-0.129	(0.176)	0.243	(0.257)
No. of observations	2,656		1,195	

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table A5: MNL results for the change in preferences for a recycling scheme

	No Change		Fee and Dividend Vertical equity		Fee and Dividend Horizontal equity		Vertical equity Fee and dividend		Vertical equity Horizontal equity		Horizontal equity Fee and Dividend		Horizontal equity Vertical equity	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Treatment	-0.068**	(0.014)	0.027**	(0.008)	0.020**	(0.006)	0.006	(0.009)	0.013**	(0.005)	-0.001	(0.006)	0.003	(0.005)
Age	-0.002**	(0.001)	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.001*	(0.000)	0.001**	(0.000)
Female	-0.021	(0.016)	0.011	(0.009)	0.005	(0.007)	-0.003	(0.009)	0.005	(0.006)	0.004	(0.006)	-0.000	(0.006)
College degree	0.041*	(0.016)	-0.026**	(0.009)	-0.005	(0.007)	-0.012	(0.010)	-0.008	(0.005)	0.010	(0.007)	-0.001	(0.007)
Household size = 2	-0.032	(0.020)	0.014	(0.011)	0.003	(0.008)	0.003	(0.012)	0.005	(0.006)	0.004	(0.009)	0.004	(0.008)
Household size = 3	-0.049	(0.030)	0.011	(0.016)	0.019	(0.013)	0.009	(0.019)	0.002	(0.009)	-0.009	(0.010)	0.016	(0.014)
Household size $>$ 3	-0.036	(0.033)	0.015	(0.018)	0.020	(0.018)	-0.004	(0.019)	0.003	(0.010)	-0.001	(0.013)	0.003	(0.013)
ln(Net income)	0.011	(0.020)	-0.010	(0.011)	0.003	(0.009)	-0.015	(0.012)	0.000	(0.006)	0.006	(0.008)	0.005	(0.008)
Has kids	0.018	(0.018)	-0.001	(0.010)	-0.017*	(0.009)	0.001	(0.011)	0.002	(0.005)	0.002	(0.007)	-0.004	(0.007)
Homeowner	0.015	(0.017)	-0.002	(0.010)	-0.004	(0.007)	0.006	(0.010)	-0.003	(0.006)	-0.006	(0.007)	-0.006	(0.006)
East Germany	0.018	(0.017)	0.017	(0.011)	0.010	(0.008)	-0.024*	(0.009)	0.002	(0.006)	-0.014*	(0.006)	-0.010	(0.006)
Rural	-0.024	(0.016)	0.006	(0.009)	0.009	(0.006)	0.009	(0.010)	-0.001	(0.005)	0.005	(0.007)	-0.004	(0.006)
Car owner	-0.049	(0.026)	0.006	(0.015)	0.004	(0.012)	0.037**	(0.012)	-0.001	(0.010)	-0.002	(0.013)	0.006	(0.010)
Gas heating	-0.005	(0.017)	0.006	(0.010)	0.012	(0.007)	-0.014	(0.011)	0.002	(0.006)	-0.002	(0.007)	0.002	(0.006)
Oil heating	-0.014	(0.021)	-0.011	(0.011)	0.006	(0.008)	-0.001	(0.013)	0.001	(0.007)	0.002	(0.009)	0.016	(0.008)
Benfit from vertical equity	-0.032	(0.021)	-0.011	(0.011)	-0.002	(0.009)	0.021	(0.014)	0.004	(0.008)	0.020	(0.011)	0.000	(0.008)
Benefit from horizontal equity	-0.042*	(0.021)	-0.000	(0.012)	0.010	(0.009)	-0.015	(0.011)	0.005	(0.007)	0.029**	(0.010)	0.013	(0.009)
Incur high energy cost	-0.007	(0.016)	0.003	(0.009)	0.003	(0.007)	0.004	(0.009)	-0.006	(0.005)	0.002	(0.007)	0.002	(0.006)
Climate change exisits	0.045*	(0.019)	0.000	(0.011)	-0.008	(0.008)	-0.002	(0.011)	-0.010	(0.007)	-0.010	(0.008)	-0.015	(0.008)
Pro-environmental attitudes	-0.009	(0.008)	0.001	(0.005)	-0.004	(0.003)	0.013**	(0.005)	0.000	(0.003)	-0.003	(0.003)	0.001	(0.003)
Rather left	0.007	(0.017)	0.003	(0.010)	-0.003	(0.007)	0.009	(0.010)	-0.009	(0.006)	-0.005	(0.007)	-0.002	(0.006)
AfD voter	0.080**	(0.027)	-0.025	(0.014)	-0.011	(0.010)	-0.014	(0.018)	-0.002	(0.008)	-0.020*	(0.009)	-0.008	(0.010)
Equality principle	0.012	(0.009)	-0.007	(0.005)	0.002	(0.004)	-0.003	(0.005)	-0.001	(0.003)	0.002	(0.004)	-0.005	(0.003)
Equity principle	0.015	(0.010)	0.005	(0.005)	-0.012**	(0.004)	-0.002	(0.005)	0.005	(0.004)	-0.009*	(0.004)	-0.002	(0.004)
Merit principle	-0.005	(0.009)	-0.006	(0.005)	0.006	(0.004)	-0.000	(0.005)	0.002	(0.003)	0.004	(0.004)	-0.001	(0.003)
Trust in government	-0.003	(0.015)	0.007	(0.009)	-0.001	(0.007)	0.010	(0.009)	-0.005	(0.005)	0.000	(0.006)	-0.007	(0.006)
No. of observations	3,741													

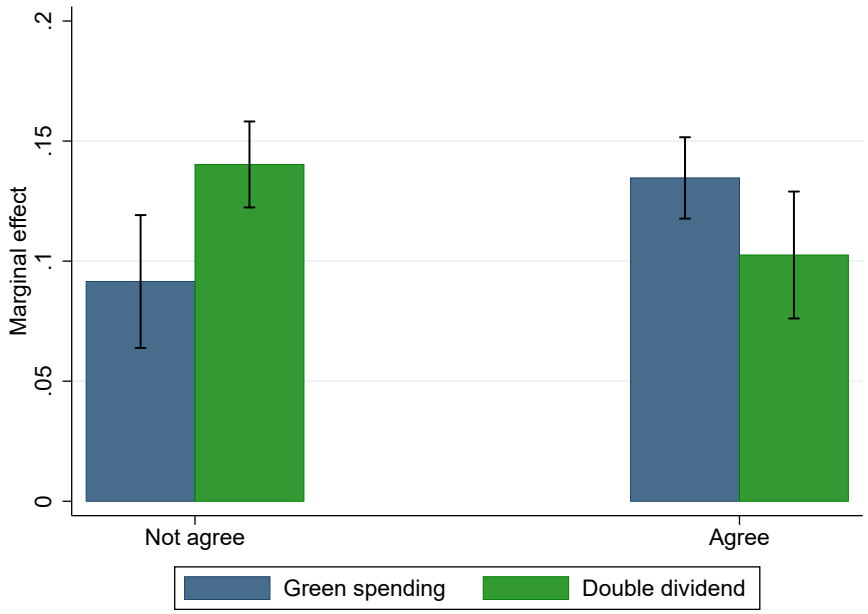
Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Table A6: MNL results for the second elicitation of preferences for revenue recycling schemes

	Fee and dividend		Vertical equity		Horizontal equity	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
Treatment	-0.031	(0.016)	0.008	(0.015)	0.022*	(0.009)
50 Euro	0.011	(0.019)	-0.006	(0.019)	-0.005	(0.012)
100 Euro	0.030	(0.019)	-0.022	(0.019)	-0.008	(0.011)
Age	-0.001	(0.001)	0.001	(0.001)	0.000	(0.000)
Female	0.031	(0.017)	-0.053**	(0.016)	0.022*	(0.011)
College degree	0.007	(0.019)	-0.007	(0.018)	0.000	(0.011)
Household size = 2	-0.033	(0.023)	0.036	(0.021)	-0.003	(0.014)
Household size = 3	-0.049	(0.033)	0.044	(0.032)	0.005	(0.019)
Household size $>$ 3	-0.023	(0.036)	0.030	(0.034)	-0.007	(0.021)
ln(Net income)	0.061**	(0.022)	-0.071**	(0.021)	0.010	(0.013)
Has kids	0.030	(0.020)	-0.018	(0.019)	-0.012	(0.012)
Homeowner	0.021	(0.019)	-0.023	(0.018)	0.002	(0.011)
East Germany	-0.000	(0.020)	-0.028	(0.019)	0.029*	(0.012)
Rural	0.009	(0.018)	-0.017	(0.017)	0.008	(0.010)
Car owner	0.035	(0.030)	-0.029	(0.029)	-0.006	(0.020)
Gas heating	-0.020	(0.019)	0.004	(0.018)	0.016	(0.011)
Oil heating	-0.022	(0.023)	-0.001	(0.022)	0.023	(0.014)
Benfit from vertical equity	0.018	(0.023)	-0.006	(0.022)	-0.013	(0.013)
Benefit from horizontal equity	-0.026	(0.023)	-0.026	(0.021)	0.052**	(0.015)
Incur high energy cost	0.004	(0.018)	-0.020	(0.017)	0.016	(0.011)
Climate change exisits	-0.024	(0.021)	0.040*	(0.020)	-0.016	(0.013)
Pro-environmental attitudes	-0.042**	(0.009)	0.050**	(0.009)	-0.008	(0.005)
Rather left	-0.057**	(0.019)	0.069**	(0.018)	-0.012	(0.011)
AfD voter	-0.101**	(0.034)	0.102**	(0.035)	-0.000	(0.018)
Equality principle	0.042**	(0.010)	-0.032**	(0.010)	-0.010	(0.006)
Equity principle	-0.081**	(0.011)	0.097**	(0.010)	-0.016*	(0.006)
Merit principle	0.038**	(0.010)	-0.054**	(0.009)	0.017**	(0.006)
Trust in government	0.021	(0.017)	-0.005	(0.016)	-0.017	(0.010)
No. of observations	3,830					

Note: Robust standard errors are reported in parentheses. ** and * denote statistical significance at the 1 % and 5 %, level, respectively.

Figure A1: Effects of pro-environmental attitudes on supporting a carbon tax conditional on revenue recycling scheme

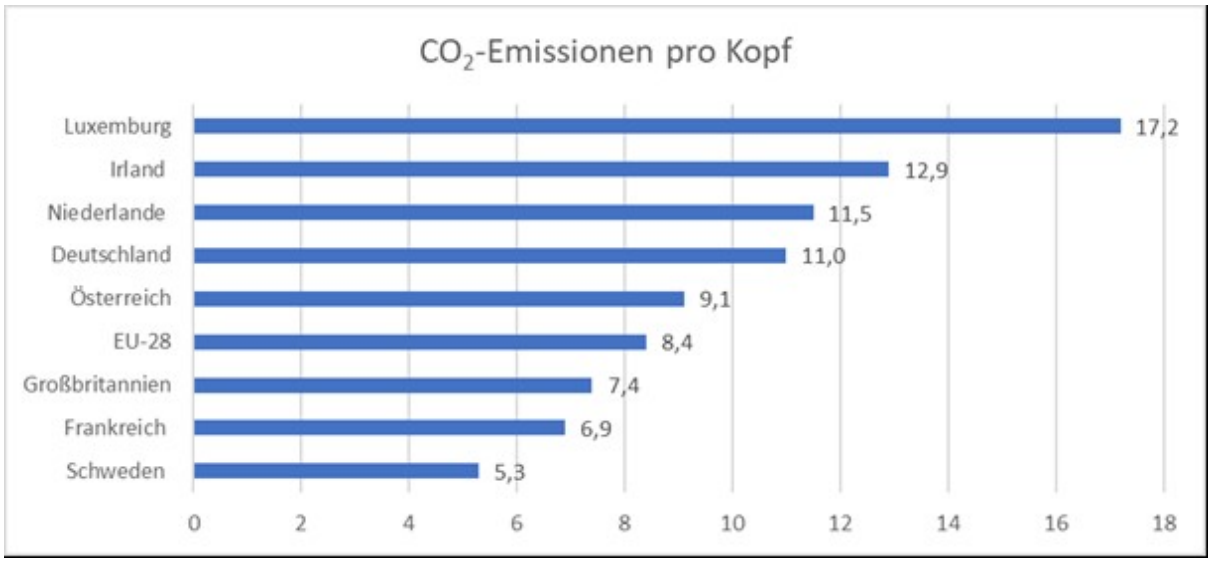


B Wording of the experiment

Question 1: Are you generally willing to bear higher costs for fuel and heating oil or natural gas in order to contribute to climate protection?

- Yes
- No
- Do not know

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 tonne 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

Question 2: The introduction of a CO_2 tax of EUR 10/50/100 per ton of CO_2 would result in an increase of EUR 2.62/5.24/7.85 in the cost of driving from Berlin to Munich (including VAT), EUR 59.26/118.52/177.79 for operating the gas heating and EUR 151.13/302.26/453.39 for operating the oil heating. Would you agree to the introduction of a CO_2 tax of EUR 25/50/100 per ton? (*The CO_2 tax of EUR 10, 50, and 100 along with the corresponding cost increases are randomly assigned to the participants.*)

- Yes
- No
- Do not know

The CO_2 tax would burden households differently depending on their disposable household income. In addition, households with above-average energy costs would be affected more heavily. For this reason, the revenue from the CO_2 tax is to be redistributed to the population. Three different repayment mechanisms are currently being discussed:

- The revenue should be equally redistributed to the entire population.
- The revenues should be redistributed exclusively to low-income households.
- The revenue should be redistributed exclusively to households with particularly high energy costs.

The repayment would be made by a government agency for each household member (i.e. including children).

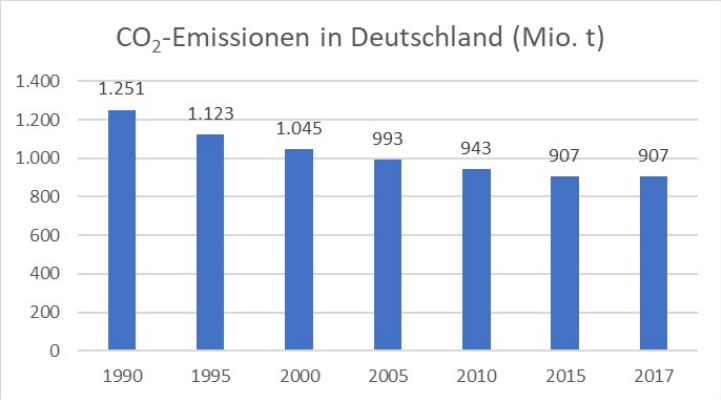
Question 3: Which of the above-mentioned redistribution systems do you find best? Please put the redistribution systems in the order you prefer.

1. _____
2. _____
3. _____

   Do not know

Here, we split the sample into the control and the treatment group. Both experimental conditions receive the following information:

In the following, we would like to inform you about the development of CO_2 emissions in Germany. The information is drawn from the Federal Environment Agency.



CO_2 emissions in Germany have developed as follows:

- In 1990: 1,251 million tons of CO_2
- In 2000: 1,045 million tons of CO_2
- In 2010: 943 million tons of CO_2
- In 2017: 907 million tons of CO_2

The treatment group additionally receives the following information (the order is randomized):

We will now explain the different repayment options.

#1 When redistributed to the entire population, each resident receives the same amount. This is fair because everyone receives the same amount. Since all citizens are equally entitled to good environmental conditions, in a just society everyone should be equally relieved. This also applies, for example, to the fact that all citizens have one vote in elections.

#2 When redistributed to low-income households, each inhabitant below a predetermined income threshold receives a different amount. Households with particularly low incomes receive a particularly high repayment. This is fair because society should help those who are particularly vulnerable. A society can only be just if it helps the most vulnerable first. This also applies, for example, to social assistance.

#3 When redistributed to households with particularly high energy costs, each inhabitant receives a different amount above a previously defined energy cost threshold. Households with particularly high energy costs receive a particularly high repayment.

This is fair, because those who are most affected should also receive the most. Those who have special needs are the ones that a society needs to pay special attention to. This also applies to the commuter allowance, for example.

Question 4: After you have received this information, we would like to ask you once again to evaluate the three redistribution systems. Which of the mentioned redistribution systems do you find best? Please put the redistribution systems in the order you prefer.

1. _____
2. _____
3. _____

   Do not know

Question 5: If it were guaranteed that the revenue would be redistributed to the entire population in the same amount per capita/exclusively to low-income households/to households with high energy costs, would you agree to the introduction of the CO_2 tax of EUR 10/50/100 per ton (*the first preference from Question 4 is used*)?

- Yes
- No
- Do not know

Question 6: Do you think that you would personally benefit if the repayment was made to low-income households?

- Yes
- No
- Do not know

Question 7: Do you think that you would personally benefit if the repayment was made to households with high energy costs?

- Yes
- No
- Do not know

Question 8: 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. 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 revenue*).
- ... 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*).

References

Akerlof, G., Aumann, R., Deaton, A., Diamond, P., Engle, R., Fama, E., Hansen, L., Hart, O., Holmström, B., Kahneman, D., et al. (2019). Economists' statement on carbon dividends. Wall Street Journal.

Alberini, A., Bigano, A., Ščasnỳ, M., and Zvěřinová, I. (2018a). Preferences for energy efficiency vs. renewables: what is the willingness to pay to reduce CO2 emissions? *Ecological Economics*, 144:171–185.

Alberini, A., Ščasnỳ, M., and Bigano, A. (2018b). Policy-v. individual heterogeneity in the benefits of climate change mitigation: Evidence from a stated-preference survey. *Energy Policy*, 121:565–575.

Andor, M., Gerster, A., and Sommer, S. (2020). Consumer inattention, heuristic thinking and the role of energy labels. *The Energy Journal*, 41(1):83–122.

Andor, M. A., Frondel, M., and Sommer, S. (2018a). Equity and the willingness to pay for green electricity in Germany. *Nature Energy*, 3(10):876–881.

Andor, M. A., Schmidt, C. M., and Sommer, S. (2018b). Climate change, population ageing and public spending: Evidence on individual preferences. *Ecological Economics*, 151:173–183.

Angrist, J. D. and Pischke, J.-S. (2009). *Mostly harmless Econometrics: An Empiricist's companion*. Princeton and Oxford and Princeton University Press.

Atkinson, A. B. and Stiglitz, J. E. (1976). The design of tax structure: Direct versus indirect taxation. *Journal of Public Economics*, 6(1-2):55–75.

Baranzini, A. and Carattini, S. (2017). Effectiveness, earmarking and labeling: Testing the acceptability of carbon taxes with survey data. *Environmental Economics and Policy Studies*, 19(1):197–227.

Beiser-McGrath, L. F. and Bernauer, T. (2019). Could revenue recycling make effective carbon taxation politically feasible? *Science Advances*, 5(9):eaax3323.

Bowles, S. and Polania-Reyes, S. (2012). Economic incentives and social preferences: Substitutes or complements? *Journal of Economic Literature*, 50(2):368–425.

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., and Vöhringer, F. (2017). Green taxes in a post-Paris world: Are millions of nays inevitable? *Environmental and Resource Economics*, 68(1):97–128.

Carattini, S., Kallbekken, S., and Orlov, A. (2019). How to win public support for a global carbon tax. *Nature*, 565:289–291.

Cherry, T. L., Kallbekken, S., and Kroll, S. (2017). Accepting market failure: Cultural worldviews and the opposition to corrective environmental policies. *Journal of Environmental Economics and Management*, 85:193–204.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3):297–334.

Davis, L. W. and Knittel, C. R. (2019). Are fuel economy standards regressive? *Journal of the Association of Environmental and Resource Economists*, 6(S1):S37–S63.

Destatis (2020). Bevölkerung und Erwerbstätigkeit. Report ID: 201030019700. Statistisches Bundesamt, Wiesbaden.

Deutsch, M. (1975). Equity, equality, and need: What determines which value will be used as the basis of distributive justice? *Journal of Social Issues*, 31(3):137–149.

Diederich, J. and Goeschl, T. (2014). Willingness to pay for voluntary climate action and its determinants: Field-experimental evidence. *Environmental and Resource Economics*, 57(3):405–429.

Diekmann, A. and Preisendörfer, P. (1998). Environmental behavior: Discrepancies between aspirations and reality. *Rationality and Society*, 10(1):79–102.

Dietz, S. and Atkinson, G. (2010). The equity-efficiency trade-off in environmental policy: Evidence from stated preferences. *Land Economics*, 86(3):423–443.

Douenne, T. (2020). The vertical and horizontal distributive effects of energy taxes: A case study of a french policy. *The Energy Journal*, 41(3).

Douenne, T. and Fabre, A. (2019). Can we reconcile French people with the carbon tax? Disentangling beliefs from preferences. FAERE Working Paper, 2019.10.

Douenne, T. and Fabre, A. (2020). French attitudes on climate change, carbon taxation and other climate policies. *Ecological Economics*, 169:106496.

Dresner, S., Dunne, L., Clinch, P., and Beuermann, C. (2006). Social and political responses to ecological tax reform in Europe: An introduction to the special issue. *Energy Policy*, 34(8):895–904.

Farrell, N. (2017). What factors drive inequalities in carbon tax incidence? Decomposing socioeconomic inequalities in carbon tax incidence in Ireland. *Ecological Economics*, 142:31–45.

Fehr, E. and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *The Quarterly Journal of Economics*, 114(3):817–868.

Fischer, C., Baumert, A., and Schmitt, M. (2017). Skala zur Messung von Einstellungen zu Prinzipien der Verteilungsgerechtigkeit (EPriVerge). Zusammenstellung sozialwissenschaftlicher Items und Skalen (ZIS). https://doi.org/10.6102/zis253.

Fischer, C. and Pizer, W. A. (2019). Horizontal equity effects in energy regulation. *Journal of the Association of Environmental and Resource Economists*, 6(S1):S209–S237.

Fleurbaey, M. and Maniquet, F. (2011). *A theory of fairness and social welfare*, volume 48. Cambridge University Press, Cambridge.

Flues, F. and Thomas, A. (2015). The distributional effects of energy taxes. OECD, Paris.

Folger, R., Sheppard, B. H., and Buttram, R. T. (1995). Equity, equality, and need: Three faces of social justice. In *The Jossey-Bass management series and The Jossey-Bass conflict resolution series. Conflict, cooperation, and justice: Essays inspired by the work of Morton Deutsch*, pages 261–289. Jossey-Bass.

Fullerton, D. (2011). Six distributional effects of environmental policy. *Risk Analysis: An International Journal*, 31(6):923–929.

Fullerton, D. and Muehlegger, E. (2019). Who bears the economic burdens of environmental regulations? *Review of Environmental Economics and Policy*, 13(1):62–82.

Gerlagh, R. and Liski, M. (2018). Carbon prices for the next hundred years. *The Economic Journal*, 128(609):728–757.

Gosepath, S. (2011). Equality. In Zalta, E. N., editor, *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, spring 2011 edition.

Goulder, L. H. (2020). Timing is everything: How economists can better address the urgency of stronger climate policy. *Review of Environmental Economics and Policy*, 14(1):143–156.

Goulder, L. H., Hafstead, M. A., Kim, G., and Long, X. (2019). Impacts of a carbon tax across US household income groups: What are the equity-efficiency trade-offs? *Journal of Public Economics*, 175:44–64.

Grainger, C. A. and Kolstad, C. D. (2010). Who pays a price on carbon? *Environmental and Resource Economics*, 46(3):359–376.

Greene, J. (2013). *Moral tribes: Emotion, reason, and the gap between us and them*. Penguin Press, New York.

Greene, W. H. (2003). *Econometric analysis*. Pearson Education India.

Hagmann, D., Ho, E. H., and Loewenstein, G. (2019). Nudging out support for a carbon tax. *Nature Climate Change*, 9(6):484–489.

Haidt, J. (2007). The new synthesis in moral psychology. *Science*, 316(5827):998–1002.

Jacobs, B. and van der Ploeg, F. (2019). Redistribution and pollution taxes with non-linear Engel curves. *Journal of Environmental Economics and Management*, 95:198–226.

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47:263–292.

Kallbekken, S., Kroll, S., and Cherry, T. L. (2011). Do you not like Pigou, or do you not understand him? Tax aversion and revenue recycling in the lab. *Journal of Environmental Economics and Management*, 62(1):53–64.

Kallbekken, S. and Sælen, H. (2011). Public acceptance for environmental taxes: Self-interest, environmental and distributional concerns. *Energy Policy*, 39(5):2966–2973.

Klenert, D. and Mattauch, L. (2016). How to make a carbon tax reform progressive: The role of subsistence consumption. *Economics Letters*, 138:100–103.

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., and Stern, N. (2018a). Making carbon pricing work for citizens. *Nature Climate Change*, 8(8):669–677.

Klenert, D., Schwerhoff, G., Edenhofer, O., and Mattauch, L. (2018b). Environmental taxation, inequality and Engel's law: The double dividend of redistribution. *Environmental and Resource Economics*, 71(3):605–624.

Kotchen, M. J., Turk, Z. M., and Leiserowitz, A. A. (2017). Public willingness to pay for a US carbon tax and preferences for spending the revenue. *Environmental Research Letters*, 12(9):094012.

Levinson, A. (2019). Energy efficiency standards are more regressive than energy taxes: Theory and evidence. *Journal of the Association of Environmental and Resource Economists*, 6(S1):S7–S36.

Maestre-Andrés, S., Drews, S., and van den Bergh, J. (2019). Perceived fairness and public acceptability of carbon pricing: A review of the literature. *Climate Policy*, 19(9):1186–1204.

Miller, D. (2017). Justice. In Zalta, E. N., editor, *The Stanford Encyclopedia of Philosophy*. Metaphysics Research Lab, Stanford University, fall 2017 edition.

Nordhaus, W. D. (1992). An optimal transition path for controlling greenhouse gases. *Science*, 258(5086):1315–1319.

Peterson, R. A. (1994). A meta-analysis of Cronbach's coefficient alpha. *Journal of Consumer Research*, 21(2):381–391.

Pigou, A. C. (1920/2013). *The economics of welfare*. Palgrave Macmillan.

Piketty, T. (2003). Income inequality in France, 1901–1998. *Journal of Political Economy*, 111(5):1004–1042.

Pizer, W. A. and Sexton, S. (2019). The distributional impacts of energy taxes. *Review of Environmental Economics and Policy*, 13(1):104–123.

Rausch, S., Metcalf, G. E., and Reilly, J. M. (2011). Distributional impacts of carbon pricing: A general equilibrium approach with micro-data for households. *Energy Economics*, 33:S20–S33.

Sallee, J. M. (2019). Pigou creates losers: On the implausibility of achieving pareto improvements from efficiency-enhancing policies. NBER Working Paper 25831.

Schmitt, M., Maes, J., and Schmal, A. (1995). Einstellungen zu Verteilungsprinzipien, Ungerechtigkeitssensibilität und Glaube an eine gerechte Welt als Kovariate. Berichte aus der Arbeitsgruppe "Verantwortung, Gerechtigkeit, Moral". Universität Trier).

Schmitt, M., Maes, J., and Schmal, A. (1997). Gerechtigkeit als innerdeutsches Problem: Einstellungen zu Verteilungsprinzipien, Ungerechtigkeitssensibilität und Glaube an eine gerechte Welt als Kovariate. Berichte aus der Arbeitsgruppe "Verantwortung, Gerechtigkeit, Moral". Universität Trier).

Sen, A. K. (2009). *The idea of justice*. Harvard University Press, Cambridge, MS.

Svenningsen, L. S. and Thorsen, B. J. (2019). Preferences for distributional impacts of climate policy. *Environmental and Resource Economics*, 75(1):1–24.

Thalmann, P. (2004). The public acceptance of green taxes: 2 million voters express their opinion. *Public Choice*, 119(1-2):179–217.

World Bank (2018). Guide to communicating carbon pricing. World Bank, Washington, DC.