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Carbon Pricing, Carbon Dividends and Cooperation: Experimental Evidence

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Abstract

Anthropogenic climate change is one of the most pressing global issues today and finding means of mitigation is of utmost importance. To this end, we investigate whether carbon taxes on their own and coupled with revenue recycling schemes (symmetric or asymmetric carbon dividends) improve cooperative behavior in a modified threshold public goods game of loss avoidance. We implement a randomized controlled trial on a large sample of the U.S. population and measure the portion of groups who successfully remain below a critical consumption threshold. We find that a carbon tax with symmetric dividends reduces harmful consumption levels, but coupling the tax with asymmetric dividends not only enhances consumption reduction but also significantly improves group cooperation in avoiding simulated climate change. Our results show that the application of a carbon tax and asymmetric carbon dividends reduces the failure rate to about one-fourth (6%), compared to the 22% observed in a baseline condition. We find that environmental attitudes, conservatism, education, and gender are significantly associated with success rates in staying below the threshold.
JEL: C92, H23, H30, H41, Q54
Keywords: climate change, carbon pricing, carbon tax, carbon dividend, revenue recycling, cooperation

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1. Introduction

The challenge of anthropogenic climate change is often modelled as a prisoner's dilemma (Robèrt and Broman, 2017). By this logic, collectively, countries and individuals would be better off cooperating and changing production and consumption patterns to mitigate global climate change, but individually they have an incentive to continue emitting greenhouse gases (Barrett and Dannenberg, 2012). Policymakers have grappled with means to address the climate crisis, and finding effective mechanisms and incentive structures to decrease individual CO_2 emissions remains a challenge. It is estimated that about 60% to 72% of global greenhouse gas emissions and 50% to 80% of total global land, material, and water use are associated with the production and use of products and services consumed by households, specifically within the mobility, housing, and food sectors (see e.g., Hertwich and Peters, 2009; Ivanova et al., 2016). To achieve the necessary emission reductions within these areas, individual behavior change and effective regulatory measures are key (Theurl et al., 2020).

A carbon tax, a fee paid by the polluter per unit of pollution (Kolstad, 2000), can be a powerful tool for reducing emissions that drive climate change (Metcalf, 2019). A carbon tax can incentivize businesses to switch to less polluting production methods and to encourage consumers to shift their demand towards less environmentally harmful goods and services (Kolstad, 1994; Mongin, 2006; Marron and Morris, 2016). Critics have pointed out that the income effect associated with carbon taxes hits financially disadvantaged individuals particularly hard, rendering this measure regressive (Grainger and Kolstad, 2010). However, a so-called carbon dividend, a refund to tax-payers as a revenue recycling policy, can be coupled with a carbon tax. This would make low and middle income individuals net beneficiaries of such a taxation structure. Thus, carbon dividends can help build political support for carbon taxation by mitigating the average individual's financial burden of the tax (see e.g., Fremstad and Paul, 2017; Klenert et al., 2018). Support for this idea comes, among others, from the 2019 "Economists Statement on Carbon Dividends", which was signed by 3,623 U.S. economists and 28 Nobel laureates in The Wall Street Journal (Climate Leadership Council, 2019). Indeed, the feasibility of practical implementation is demonstrated e.g., by Austria, Canada and Switzerland, which have all recently introduced a carbon dividend.

Part of the threat of climate change stems from the risk of reaching a tipping point, the surpassing of which would have disastrous and potentially irreversible global consequences.[1] Game-theoretically, when individuals are sufficiently fearful of the prospect of crossing a detrimental threshold, the trade-off of collective versus individual gains can best be characterized as a coordination game, rather than a prisoner's dilemma (Barrett and Dannenberg, 2012). Within this context, the Collective Risk Social Dilemma (CRSD) has been widely applied in the experimental environmental economics literature, principally to model coordination behavior between political decision-makers (see e.g., Milinski et al., 2008; Barrett and Dannenberg, 2012). The classical CRSD is a threshold public goods game of loss avoidance. If the collective contributions of all group members meet or exceed a contribution threshold, the group avoids a collective loss of income and all members retain the uncontributed remainder of their initial endowment. If the group's collective contributions do not reach the threshold, participants are exposed to collective risk.

[1] Examples include the collapse of the Atlantic Thermohaline Circulation, decay of the Greenland ice sheet, and ecosystem collapse (Dannenberg et al., 2015).

Within this framework, we have identified two research gaps. First, despite its societal importance, the use of tax revenues to compensate citizens in the form of carbon dividends has received relatively little attention in the economics literature. To our knowledge, no experimental evidence currently exists investigating the effects of a Pigouvian carbon tax and carbon dividend as a means of revenue recycling (redistribution) on cooperation. Second, experimental studies in the CRSD context have primarily relied on laboratory student samples. Given that students' behavior is often not representative of the general population, (see, e.g., Bellemare and Kröger, 2007; Anderson et al., 2013), and considering the importance of external validity in this context, evidence from a representative sample of the general population is key.

To close these research gaps, we test the effect of carbon pricing alone and in combination with two different revenue recycling schemes (symmetric and asymmetric carbon dividends respectively). Specifically, we develop a modified version of the Collective Risk Social Dilemma (CRSD) applied to a consumption context and run it on *Prolific*, inviting a large sample of 2,112 subjects of the U.S. general population. We examine how the incentive structures affect coordination in the CRSD and the ability to avoid simulated climate change. Participants are randomly assigned to groups of 4, and remain within the same assigned groups over the course of 10 rounds. In each round, in real time, participants are asked to make an individual consumption decision about a fictitious good or service from which they derive a utility, by gaining tokens (i.e. the experimental currency unit), but which also produces a negative externality: a contribution to simulated CO_2 emission. Practically, they can decide on a consumption level of 0, 2 or 4 units per round. Tokens accumulated via consumption can lead to a bonus payment at the end of the game. However, this bonus is only guaranteed if the group does not exceed a critical threshold of CO_2 emissions, leading to simulated catastrophic climate change. We measure success rates as the portion of groups who remain below the critical consumption threshold meaning the simulated CO_2 emission.

Study participants are randomly assigned to one of four conditions: *Baseline*, *Tax*, *Symmetric* and *Asymmetric*. The *Baseline* condition serves as a control, in which no carbon tax or dividend is applied. The *Tax* condition simulates a Pigouvian carbon tax, without any revenue recycling. The *Symmetric* and *Asymmetric* treatments simulate a carbon tax where the tax revenue is redistributed within the group via a carbon dividend. Specifically, in the *Symmetric* condition, the tax revenue is redistributed equally among all players in the group, whereas in the *Asymmetric* condition, the tax revenue is redistributed asymmetrically such that only below-average CO_2 emitters benefit from the dividend (polluter pays principle).

We find that the combination of a carbon tax with an asymmetric carbon dividend, rewarding the below-average emitters, worked best to reduce total consumption (CO_2 emissions). 94% of groups in the condition featuring the carbon tax accompanied by asymmetric dividends successfully remained below the tipping point. The failure rate (i.e. exceeding the threshold) tripled from 6% to 18% when the carbon dividend was symmetric, as this reduced the incentives to limit own consumption. In the presence of no tax or a carbon tax without any revenue recycling, the failure rate was four times as high (22% and 25%, respectively), compared to the carbon tax with asymmetric dividends (6%). We conclude that incentives work also with respect to coordinating groups without the possibility to communicate to remain below a critical threshold, the surpassing of which could lead to significant losses for the group. Preventing catastrophic climate change requires a reduction in CO_2 emissions, which necessitates individual behavior change. Our study provides compelling evidence that achieving cooperation is not only feasible but very likely when appropriate incentives are deployed. In particular, a strategy combining a carbon tax with an asymmetric carbon dividend, which reallocates tax revenue to those who pollute less than the average, appears most promising. We further report that, independent of treatment conditions, holding stronger pro-environmental attitudes is positively associated with group success rates (i.e. remaining below the critical consumption threshold). We also find that being more conservative is negatively associated with group success and self-reporting to be a Republican voter is associated with holding more negative attitudes towards carbon taxes and carbon dividends, independent of the treatment condition. Importantly, we find that individuals who experience the carbon tax measure with an asymmetric dividend hold more positive attitudes towards carbon taxes and dividends, than individuals in any other condition. This suggests the experience of the measures positively influenced the perception of these.

Our study adds to the existing body of literature in several key areas. In addition to practical, economic and competitive concerns (see, e.g., Marron and Maag, 2018; Timilsina, 2018), the literature on carbon pricing and revenue recycling in the form of carbon dividends to date has emphasized the importance of developing political acceptance and public support for these measures. For example, Cherry et al. (2012) have found a reluctance towards efficiency-enhancing market interventions, such as Pigouvian taxes, in a lab setting. Klenert et al., 2018 have argued that an adequate use of tax revenues can increase the acceptability of carbon taxes. Findings by Bourgeois et al., 2021 further support this, as they have demonstrated that revenue recycling methods such as lump-sum payments can counteract the regressive nature of a carbon tax. In a systematic review of public support for carbon taxes, Carattini et al. (2018) have recommended lump-sum payments as a way to recycle the carbon tax revenue (like carbon dividends), which may reduce public resistance to carbon taxes, provided that misconceptions about the tax are dispelled. This is further supported by empirical evidence by Kaplowitz and McCright (2015) and Beiser-McGrath and Bernauer (2019), who have found that such lump-sum payments (carbon dividends) can strongly increase public support for carbon taxes. Kallbekken et al. (2011) have further suggested that support could be improved by channeling revenues to specific groups and avoiding the "tax" label. However, experimentally testing the carbon tax and dividend in a CRSD context remains a novelty.

Furthermore, the issue of fairness has been pointed out as a focal point in the literature. Numerous scholars from different fields have emphasized the importance of distributing burdens in such a way that individuals perceive them to be fair, which can raise support levels (Ringius et al., 2002; Caney, 2014; Dannenberg et al., 2015; Jagers et al., 2018; Sommer et al., 2022). Notably, there is evidence that while people's worldview is very influential, experiencing of welfare enhancing policies has the potential to affect perceptions of these measures. On the one hand, Cherry et al. (2017) have found that people's worldviews affect the acceptance of efficiency-enhancing policies, leading to substantial variations in policy aversion. This is further echoed by Jagers et al. (2018), who found that self-identified right-leaning individuals typically respond favorably to compensatory measures, while left-leaning individuals tend to be less supportive of tax increases when paired with simultaneous income tax reductions. On the other hand, in their lab experiment examining congestion pricing, Janusch et al. (2021) have found that initial support for the policy was based on individual worldviews. However, once participants experienced the policy, the impact on personal financial gains or losses became the decisive factor for support.

Our study builds upon the discussed literature and addresses several research gaps. We offer a novel experimental investigation of whether introducing a carbon tax, coupled with two forms of carbon dividends, can improve coordination to avoid simulated climate change in a threshold public goods game of loss avoidance. Acknowledging the importance of public attitudes towards carbon taxes and dividends, we augment the literature by exploring the influence that experience of the measures in the game has on beliefs and attitudes towards them. Our findings provide empirical evidence that direct experience with these mechanisms can shift public perceptions. We further examine how these attitudes differ among participants with different political leanings and also examine the role that validated environmental attitudes and levels of conservatism play in cooperative behavior and group success rates.

Though the CRSD has previously been applied in several modified forms, a further novelty of our study is applying it to a consumption context and conducting the CRSD with participants from the United States general population. Tavoni et al. (2011) have investigated the effect of unequal endowments on coordination and allowed for communication in the CRSD and found that inequality reduces the likelihood of coordination, but this is mitigated by communication. Dannenberg et al. (2015) and McBride (2010) have investigated the influence of risk and ambiguity about the detrimental threshold in the game on coordination behavior. Dannenberg et al. (2015) have found that threshold uncertainty reduces group success in preventing the public bad, while McBride (2010) has found that this result is further influenced by the size of the benefits resulting from successful action. Fischbacher et al. (2011) have introduced a linear payoff function, instead of the typical "all-or-nothing" setting, and implemented signals regarding the location of the detrimental threshold. Brekke et al. (2017) have investigated the influence of framing and heterogeneous endowments on public good contributions and found that expressing contributions in absolute, rather than relative terms increases contributions in treatments with lower endowments. Applying the CRSD to the consumption context and simulating the different tax and revenue recycling mechanisms has, to our knowledge, not been done before, and allows a close examination of incentives and behavior in a controlled setting. Moreover, conducting the CRSD with subjects from the general United States population is particularly relevant, as the U.S. is a major global polluter in absolute and per capita terms, with heterogeneous attitudes towards climate change across the political spectrum (see, e.g., McCright and Dunlap, 2011; Baldwin and Lammers, 2016). It is, therefore, important for policymakers to understand behavior of U.S. consumers and voters with regards to climate change. It also provides a test case among a population that does not yet have a federal carbon tax in place, and using a general population, rather than student sample, provides greater external validity to the findings.

2. Study Design, Procedure, and Hypotheses

The present study constitutes a pre-registered online experiment programmed in oTree (Chen et al., 2016) that was conducted with a U.S. sample (representative sampling $N = 1{,}120$; general population sampling $N = 992$;[2] total sample size $N = 2{,}112$; for details regarding the representative sampling see Table B1 in

[2] Unfortunately, our study design prevented us from obtaining a fully representative U.S. sample regarding age, gender and ethnicity, as collecting data from individuals with specific characteristics took considerable time, disrupting our simultaneous group decision approach. This necessitated sourcing the remaining sample from the general U.S. population without explicit

the Appendix)[3] recruited via Prolific.[4] Participants were randomly assigned to one of four conditions (one baseline, and three stylized treatments): *Baseline*, *Tax*, *Symmetric* and *Asymmetric*. Within each condition, participants were randomly and anonymously assigned to groups of four. Group formation required all four members to be online simultaneously in real-time, and group assignment did not change throughout the experiment.

Each participant received a lump sum payment equivalent to GBP 2.50 for participating in the experiment and had the opportunity to earn additional bonus payments based on behavior throughout the game. Participants played a modified version of the Collective Risk Social Dilemma (CRSD), simulating climate change. The experiment was parameterized to yield an expected additional payment of GBP 3 for the task, with a maximum and minimum possible payout of GBP 8 and 0, respectively.

Participants were instructed to imagine that they could consume a good or service from which they derive a benefit, but which causes a negative externality (see the detailed instructions in Section A.1 in the Appendix). In each of 10 rounds, participants were asked to decide on the amount of consumption they wish to make. Each consumption unit corresponds to one experimental currency unit called token, which was converted to the monetary bonus payment at the end of the game. However, each consumption unit also produces one unit of simulated CO_2 emission. The bonus payment was only guaranteed if the group did not exceed a critical threshold of CO_2 emissions. Thus, consumption of tokens provided a monetary reward to individuals, but over-consumption at the group level could jeopardize everyone's monetary gains.

Ahead of the initiation of the CRSD, participants were provided with detailed instructions, specific to their assigned condition. In order to proceed to the group formation, participants were required to complete and correctly answer a comprehension check questionnaire, comprised of 9 questions. After playing 10 rounds of the CRSD, participants were asked to complete a survey, including their decision-making motivations throughout the game, the Resistance to Change Beliefs Scale (White et al., 2019), and the Revised New Environmental Paradigm (NEP) scale (Dunlap et al., 2002), to establish participants' levels of conservativism and environmental attitudes respectively. We also provided a debriefing and explanation of the carbon dividend, and asked three questions about attitudes towards the carbon tax and dividend. Finally, we collected demographic information, including political leaning.

In each round of the experiment, participants could decide on how many units $c \in [0, 2, 4]$ they want to consume, and thereby add as tokens to their personal account balance. Each unit of consumption also contributed linearly to the public bad (CO_2 emissions). The unconsumed units $(4 - c)$ were lost and could be thought of as a contribution to prevention of the public bad (since participants were foregoing the additional tokens that contribute to the bonus payment). If the group's cumulative consumption (and thus cumulative CO_2 emissions) after 10 rounds exceeded the threshold of 50% (80 units) of the maximum possible group consumption (160 units), simulated catastrophic climate change occured with a known

stratification based on U.S. census data on age, gender, and ethnicity, thus potentially limiting the distribution accuracy of these demographics in our data.

[3] The displayed relative frequencies in Table Table B1 correspond to a sub-sample of $N = 1{,}120$, which constitutes 53% of the total sample of $N = 2{,}112$ observations. A fraction of 1 indicates a bracket sampled precisely to its intended quantity. Differential ratios within each stratum denote a lack of fully balanced sampling.

[4] The pre-analyses plan and the experimental software can be found under https://osf.io/epm6n/.

probability of 60%. In the case that this happened, all (100%) of the accumulated tokens of all members of the group were lost.[5]

If the cumulative consumption did not exceed the threshold at the end of the ten rounds (i.e. participants prevented catastrophic climate change) or if catastrophic climate change did not occur (probability of 40%), each player of the group kept all their accumulated tokens. These tokens were then converted into GBP at a ratio of $5:1$ as a bonus payment. If all the tokens were lost due to catastrophic climate change, the bonus payment was zero.

Throughout the game, participants received multiple pieces of information to help them make their consumption decisions but could not communicate with each other. At the end of each round, participants could see the consumption of all members of the group (including their own) for that round. They also saw the aggregate group consumption for that round, as well as the combined group consumption for all rounds played up to that point (see e.g., Milinski et al., 2008; Tavoni et al., 2011). Participants also received visual information about the cumulative consumption of the group via a progress bar (see Figures A4, A8, A12, and A16). Participants had access to a quick reference guide, in which all relevant terms and instructions were explained, in order to ensure comprehension. The quick reference guide could be accessed at any point, and provided the instructions that participants already saw at the start of the experiment, in a summarized form.

In this setup, there is a collective benefit of cooperation within the group to avoid the aggregate consumption–that is, total externalities–from exceeding 80 units. However, at the individual level, group members have an incentive to consume the maximum amount and to act as free riders. For example, a constant consumption of 2 or 4 units by each group member over the 10 rounds would represent pure strategy Nash equilibria. Participants' rational strategy depends on the history of the game, i.e., past consumption patterns of the group members and beliefs regarding the remaining rounds. In any given round, and given a set of beliefs about the other group members, any of the consumption options $[0, 2, 4]$ can be rationalized. For example, if exceeding the threshold results in a lower expected payoff for a risk-neutral participant, it can be rational for her to consume zero in specific rounds, if she believes that by making such a choice, the threshold will not be exceeded. On the other hand, if this participant knows or believes that the threshold will be exceeded regardless of her own consumption, it is rational for her to consume the highest amount (4 units) and to speculate on luck.

Treatment Details

Baseline

The *Baseline* condition served as a control, in which the CRSD was played as described, without the implementation of any carbon pricing (taxation or dividend). In this condition, one unit of consumption translated to one token, and to one unit of CO_2 emission.

[5] This probability guarantees that the Nash equilibrium, in which all participants consume 2 tokens in each of the 10 rounds, Pareto dominates the Nash equilibrium, in which all participants consume 4 tokens in each of the 10 rounds.

Tax

In the *Tax* condition, participants had to pay a carbon tax of 50% on the tokens associated with their chosen consumption in each round.[6] This means that for every unit of consumption, participants received half the number of tokens. The CO_2 emissions remained the same (one unit of emissions per unit of consumption). In this condition, the tax revenue was not redistributed or used otherwise. This avoids confounders that could be due to the way in which tax revenue is used. In this setup, any observed effect of coordination becoming relatively more attractive compared to consumption can be more cleanly measured. This procedure is similar to, for example, Sausgruber and Tyran (2005).[7] At the end of each round, when participants received the summary information of the completed round and the previous rounds, they also saw the carbon tax deductions. Specifically, they were shown how much is deducted from each participant's consumption in tokens (displayed with a negative sign), as well as the number of tokens left for each participant after the deduction of the tax, both in the current round and for all previous rounds combined.

In our design, the tax may provide an incentive to coordinate on lower levels of group consumption. Importantly, in theory, the quantity consumed in an individually rational consumption optimum, where marginal cost (price) equals marginal utility, is reduced by an increase in marginal cost, for example, by imposing a carbon tax on a good or service. The last unit(s) of this good or service previously consumed would be expected not to be consumed after the price increase because its marginal cost would now exceed its corresponding marginal utility. This would lead to a situation where it would be individually rational to consume fewer units than before the introduction of the tax. The tax in our experiment does increase marginal cost approximately, as expressed by the reduction in tokens added to the account balance for a given consumption choice when the tax is introduced. However, by design, this never happens to a point where the marginal cost exceeds the marginal utility of an additional unit of consumption. Therefore, in our experiment, the tax in and of itself (without the coordination component) never makes a consumption reduction individually rational. The estimate of the tax effect on group success rates must be viewed as a lower bound estimate of the effect of a Pigouvian tax on coordination success. Thus, in the baseline condition, in any particular round and given a set of beliefs about the other group members (that might be influenced by the tax itself), any of the three consumption choices of the set $[0, 2, 4]$ can be rationalized.

When predictions are made about participants' rational decisions in this treatment, there are no differences compared to *Baseline*. For each case where a particular decision is rational for a participant in treatment *Baseline*, it is, *ceteris paribus*, also rational for a participant in treatment *Tax*. The implication of the carbon tax, therefore, is that the individual marginal cost of coordination decreases. Put differently, foregoing consumption becomes relatively less costly and coordination becomes more attractive in the *Tax* condition. This can be seen in Table 1. After the tax is implemented, a consumption reduction of, say, 2 units, equivalent to 2 units of simulated CO_2 emissions, can be achieved by effectively sacrificing only 1

[6] Unlike a classic Pigouvian tax, in our setup we did not internalize 100% of the simulated emissions. The reason for this was to keep the design as simple as possible and to establish a 1:1 relationship between a unit of consumption and a unit of pollution. In this case, a tax equal to 100% of the marginal damage caused by pollution would result in zero tokens remaining in the personal account for each unit of consumption chosen. We considered full internalization negligible in this context and focused on the change in the relative attractiveness of consumption versus coordination caused by the tax.

[7] To avoid confounding effects, for example, that exceeding the threshold is subjectively perceived as less problematic by losing on average smaller amounts (reduced by the tax), we set the conversion rate (token/currency) to $2.5 : 1$ to ensure the same expected payoff and decision consequences for each participant as in treatment *Baseline* to allow for an internally valid design.

token (post-tax) compared to 2 tokens in *Baseline*. In combination with the fear of the catastrophic loss, this mechanism may facilitate coordinating on lower consumption levels, ensuring the threshold is not exceeded. It is for this reason that the *Tax* treatment allows us to measure the impact of a relative reduction in consumption incentives, compared to the fixed incentive of avoiding surpassing the detrimental threshold. This could be considered as a substitution effect between consumption and coordination. The *Tax* treatment further allows us to cleanly isolate the effect of symmetrical and asymmetrical revenue refunding on coordination success. We predicted that introducing the carbon tax will improve coordination and thus, success rates, relative to the *Baseline* condition (H1).

Symmetric Dividend

In the *Symmetric* condition, everything was identical to the *Tax* condition, but in addition to paying the tax, participants in each group also received the tax revenue paid out as a dividend in each round. The tax revenue generated per round was redistributed equally among all four participants. As with tokens generated through consumption, dividends were credited as tokens to each group member's personal account each round.

Even with this mechanism, any of the three consumption choices of the set $[0, 2, 4]$ can be rationalized given the history of the game and the beliefs of the player. For a rational agent, *ceteris paribus*, no differences in behavior are expected in this condition compared to *Baseline* and *Tax*. Nevertheless, we predicted that this mechanism further improves coordination and increases the success rates compared to *Tax*, given that participants with low consumption benefit relatively the most from this setup. This can be explained by considering the scenario outlined in table 1 below.

Table 1: Example of the basic intuition behind the effects of a carbon tax and a carbon dividend.

Participant	a	b	c	d
Round Endowment	4	4	4	4
Consumption	0	2	2	4
Tax on consumption (50%)	0	1	1	2
Tokens post tax	0	1	1	2
Carbon Dividend (total = 4)	1	1	1	1
Tokens post dividend (total = 8)	1	2	2	3

While participant 4 only gets 50% of her tax refunded via the dividend, participants 2 and 3 get their full tax contribution refunded. With the carbon dividend, some of the group members consuming little end up paying no tax at all, but may still receive more tokens from the dividend, than they would based on their consumption choices (see e.g., participant 1 in Table 1). Because participants are expected to factor in the risk of exceeding the harmful threshold, which is constant across treatments, we expected this additional reduction in the marginal cost of cooperation to further improve the success rates (H2).

Asymmetric Dividend

Our fourth condition *Asymmetric*, captures a different revenue recycling scheme, which is motivated by the "polluters-pay" principle (see, e.g., Davidson, 2021). Kallbekken et al. (2011) have found that recycling revenues to more narrowly targeted groups increases support for taxation. We examined whether refunding only below-average (not median) polluters, can improve success rates in the CRSD by providing strong incentives to consume less. The incentives are especially strong when others consume higher amounts. In all other respects, this treatment was identical to *Symmetric*, but the collected tax revenue was redistributed asymmetrically, such that only the below-average consumers / polluters benefited. The tax revenue generated each round was equally distributed among those members of the group who consumed less than the total group average.Table 2 illustrates this mechanism.

This setup, in contrast with the other treatments, might also change individually rational behavior without taking into account the coordination incentives. If not for the need to cooperate to remain below the threshold, in the other treatments, higher consumption is always associated with a higher final or expected payoff. In the *Asymmetric* treatment, however, there are cases where those who do not consume anything at all can end up best in absolute terms. For example, participant 1, who has chosen 0 units to consume, receives 4 tokens via the asymmetric dividend, since he is the only participant with below-average consumption. Thus, he ends up better than all the other participants with positive consumption in this round. We expected the asymmetric dividend to further improve coordination and, thus, predicted it to yield the highest success rates (H3).

Finally, given evidence for learning effects in the acceptance of welfare-enhancing measures (Janusch et al., 2021), we expected that experiencing the measures will influence respondents' attitudes towards them. Specifically, we hypothesized that beliefs about the carbon tax' and dividends' respective efficacy and fairness in curbing climate change will be more optimistic in the treatments that experienced the dividend and tax respectively, compared to the baseline (H4).

Table 2: Example of the basic intuition behind the effects of a carbon tax and an asymmetric carbon dividend only to below-average consumers per round.

Participant	a	b	c	d
Round Endowment	4	4	4	4
Consumption	0	2	2	4
Tax on consumption (50%)	0	1	1	2
Tokens post tax	0	1	1	2
Carbon Dividend (total = 4)	4	0	0	0
Tokens post dividend (total = 8)	4	1	1	2

We implemented the between-subjects treatment design shown in Figure 1. See the detailed instructions for each stage of the study in Section A.1 in the Appendix.

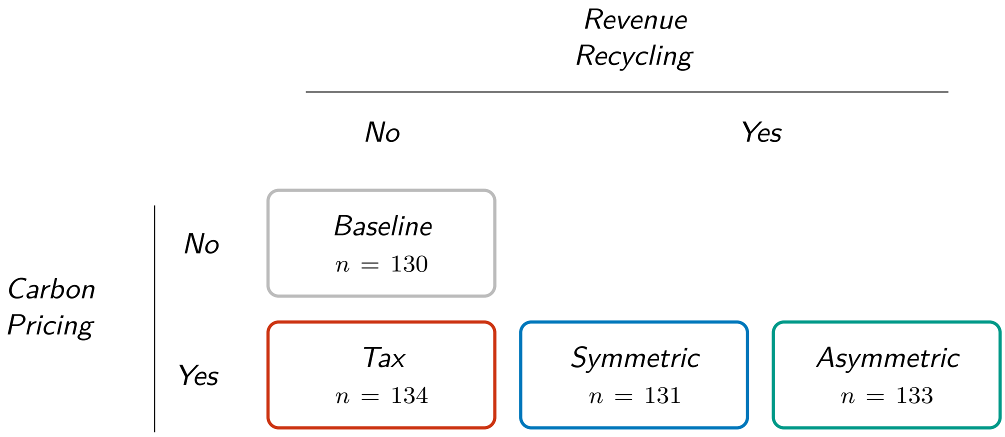

Figure 1: Treatment Design. The figure illustrates the between-subjects treatment design implemented in the experiment, including the treatment labeling, and the number of independent observations per treatment (four participants per group generate one independent observation). The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric).

3. Results

Statistical Power, Descriptives, and Sample Balancing Checks

In compliance with our publicly accessible and registered Pre-Analysis Plan on the Open Science Framework (OSF),[8] we will adhere to significance levels of 0.05, 0.01, and 0.001 for all statistical examinations within this manuscript. Prior to executing the registered primary analyses, we conducted sample balancing checks to ensure equal sample attributes across all conditions (refer to Table B2 for descriptive statistics) and to define relevant control variables. The outcomes of the sample balancing checks are exhibited in Table B3 in the Appendix. We discern statistically significant discrepancies in participants' self-reported political inclinations between conditions *Baseline* and *Symmetric*, as well as *Asymmetric*. Moreover, we identify systematic disparities in political orientation and educational level between conditions *Tax* and *Asymmetric*, revealing statistically significant sample differences across treatments. For our main analyses, we adopted a conservative approach and estimated supplementary econometric specifications, controlling for all self-reported participant attributes.

The primary outcome variable across all conditions are success rates, which we compared pairwise between conditions, utilizing equality of proportions z-tests. Success was defined as not surpassing the detrimental consumption threshold, thereby avoiding simulated catastrophic climate change. Accordingly, as a

[8] https://osf.io/epm6n/; unless otherwise specified, all analyses within this section have been pre-registered on OSF.

standardization of the distance between two proportions, we measured the effect sizes as Cohen's h.[9] Additionally, we compared the patterns of group consumption and resultant negative externality between treatments, by applying unpaired sample t-tests. Finally, we compared policy attitudes towards carbon taxes and carbon dividends across conditions.

We collected a sample of 2,112 participants, generating 528 independent observations (groups who completed 10 rounds), with around 130 independent observations per condition. With this we achieved a statistical power of at least 80% to reliably detect a standardized effect size equal to or larger than Cohen's $h = 0.35$, given a Type I error rate of $\alpha = 0.05$ in a two-sided equality of proportions z-test.[10] For example, given a success rate of 50% in one condition, an h of 0.35 corresponds to a relative difference of about 17 percentage points, that is, a change in success rates to about 33% or 67% in another condition.

Prior to evaluating our main results, we also analyzed indicators of comprehension to ensure our results are reliable. In addition to the comprehension checks required at the start of the game, we asked participants several follow-up questions about the instructions and their understanding (see table B23). We find that an average of 96% of participants across conditions considered the instructions well explained and stated that they made an informed decision in each round. On average, 97% of participants across conditions stated that they felt they understood the game overall. Dropout rates throughout the game were also very low, with an average of 1.20% across conditions. Figure 2 gives a descriptive overview of the average consumption and success rates across conditions and Table B6 in the Appendix shows the respective summary statistics.

[9] Cohen's h is defined as the absolute difference between the arcsine transformations of the success rates, that is, $h = |\phi_1 - \phi_2|$ with $\phi_i = 2 \cdot \arcsin\sqrt{p_i}\ \forall\ i = \{1, 2\}$. For a given percentage point difference between two proportions, Cohen's h depends on the base proportion on which the effect is calculated. Cohen's h is typically interpreted based on the same rule of thumb as Cohen's d, that is, $h = 0.2$ implies a "small" effect, $h = 0.5$ portrays a "medium" effect, and $h = 0.8$ indicates a "large" effect (Cohen, 1988).

[10] To achieve a statistical power of at least 80% to reliably detect a small standardized effect of $h = 0.2$, we would have needed at least 390 independent observations per condition. This corresponds to 1,560 participants in each condition and thus 6,240 participants in total.

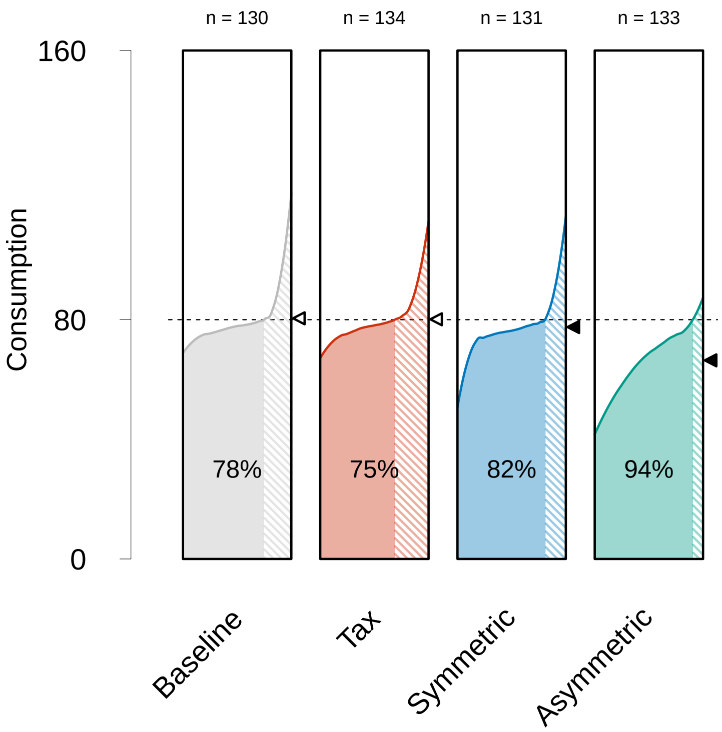

Figure 2: Overview of aggregate group consumption and success rates. Each treatment is represented by a column-bar with aggregate group consumption measured on the y-axis. The threshold consumption ($=80$) is indicated by the dotted horizontal line. Per treatment, the final aggregate consumption of all groups are shown in ascending order. The filled area represents all groups that did not surpass the threshold ($success = 1$), while the hatched area represents groups who did ($success = 0$). The value in percent corresponds to the proportion of the filled area, i.e., the success rate. Additionally, a marker (arrow) on the right side of each bar indicates the mean aggregate consumption level. A filled / empty arrow indicates a mean aggregate group consumption of ≤ 80 / > 80. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean.

Main Results

Result 1: *Compared to the Baseline condition, the group success rates are statistically significantly higher in the asymmetric dividend (Asymmetric) condition, but not in the tax only (Tax) or symmetric dividend (Symmetric) conditions.*

Support: We first examined the primary outcome variable, success rates, and compared these pairwise across all four conditions. Figure 3 depicts the success rates within all four conditions, ranging from 75% in *Tax* to 94% in *Asymmetric*. The whiskers in Figure 3 represent 95% confidence intervals, and the colored stars indicate statistical significance in one-sided unpaired sample z tests of proportion compared to the respective condition (gray = *Baseline*, red = *Tax*, blue = *Symmetric*, and green = *Asymmetric*). When compared to the *Baseline* condition, we do not find a statistically significant increase in success rates in the *Tax* or the *Symmetric* condition. However, with a success rate of 94%, the *Asymmetric* condition stands out and we find statistically significantly higher success rates compared to each of the other three conditions (see Table B4 in the Appendix for details).[11] We are therefore able to support our third hypothesis (H3), predicting that the carbon tax accompanied by the asymmetric dividend will improve cooperation and increase success rates, but find no statistical support for H1 and H2.

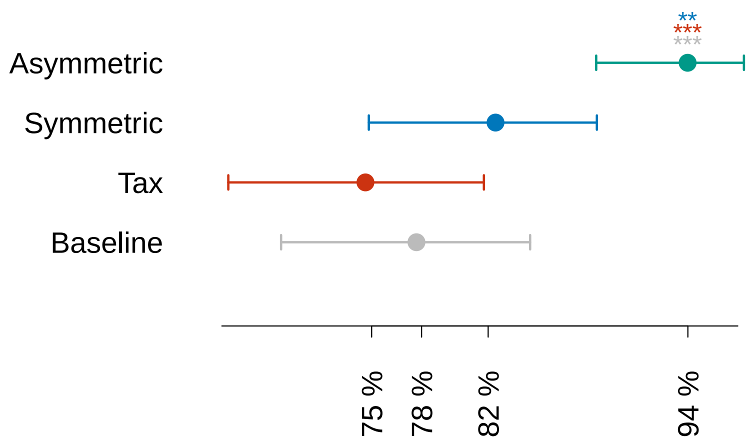

Figure 3: Success rate comparisons across treatments. Success rates for each treatment are indicated by the round marker and are based on the proportions of groups who did not surpass the threshold after all 10 rounds were played ($success = 1$). The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean. Error bars indicate 95% confidence intervals. Significance stars are based on p values of one-sided unpaired sample t-tests between conditions. Statistical details are provided in Table B4 * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

Next, we examined average aggregate group consumption across the conditions. Figure 2 indicates that average aggregate group consumption (y-axis) was lower in condition *Asymmetric* relative to all other conditions. This is statistically significant (one-sided unpaired sample t-tests shown in Figure 4; see

[11] See Table B12 in the Appendix for a robustness check applying a logistic regression model with a binary dummy for success as the dependent variable: yes = 1, no = 0 and the treatment dummies as independent variables. The model confirms our main results.

Table B5 in the Appendix for further details). Additionally, we observe statistical evidence for reduced average aggregate group consumption in condition *Symmetric* when compared to the baseline and the *Tax* condition. Therefore, the condition of symmetrically redistributing the tax revenue also proved effective in lowering the average group consumption compared to the baseline.

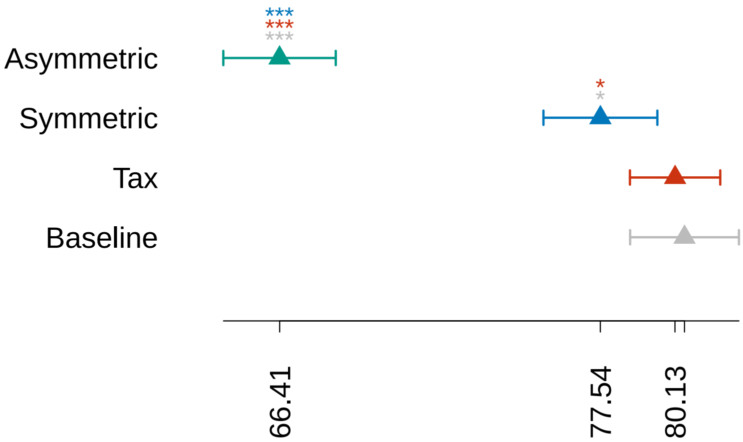

Figure 4: Aggregate average group consumption comparisons across treatments. Aggregate group consumption for each treatment are indicated by the triangle-marker. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean. Error bars indicate 95% confidence intervals. Significance stars are based on p values of one-sided unpaired sample t-tests between conditions. Statistical details are provided in Table B5 * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

We additionally assessed indicators of participants' decision-making considerations across the conditions. Specifically we measured the reported importance that the group not exceed the critical consumption threshold, and participants' willingness to sacrifice consumption only if other participants did so (both measured on Likert scales from 1 to 5). The results are documented in Table B7 in the Appendix. Compared with the *Baseline* condition, we find that individuals in the *Symmetric* and *Asymmetric* conditions report a stronger desire to prevent the group from surpassing the critical consumption threshold and a greater willingness to sacrifice consumption only when other players reciprocated. We do not observe any differences between the *Baseline* and *Tax* conditions.

> **Result 2:** *Individuals in condition Asymmetric express more favourable beliefs and attitudes towards a carbon tax and carbon dividends - specifically the asymmetric dividend - compared to individuals in Baseline.*

Support: In addressing our final primary research question, we investigated whether attitudes towards the implementation of carbon taxes and carbon dividends in society differ between conditions. We executed pairwise Mann-Whitney U tests to examine disparities, and report the results in Table B8 within the Appendix. Compared to individuals in the *Baseline* condition, those exposed to any carbon dividend treatment exhibited a stronger conviction that others in their community would support carbon emission pricing via a carbon tax. This partially supports our hypothesis H4, that beliefs about the carbon tax and dividend will be more favorable among groups who experienced the mechanism in the CRSD. Relative to the baseline, only individuals in the *Asymmetric* condition exhibited stronger beliefs that pricing carbon emissions through a carbon tax with a dividend (1) would help reduce carbon emissions, (2) is a fair method of reducing carbon emissions, and (3) more strongly expressed willingness to support pricing carbon emissions through a carbon tax and dividend. We do not find any such difference between *Baseline* and the *Tax* and *Symmetric* conditions. Finally, also reported in Table B8 in the Appendix, we detect heightened support for asymmetric dividends, but not symmetric dividends, among individuals in the respective condition *Asymmetric* when compared with the baseline, while for individuals in *Tax* and *Symmetric* we do not identify such an effect.

> **Result 3:** *Exhibiting lower conservatism and greater environmental concern is associated with an increased likelihood of group success. Self-reported Democrats, in particular, hold more positive attitudes towards carbon taxes and dividends upon experiencing the measures (Asymmetric).*

Support: We delved further into the analysis of attitudes towards the instruments by differentiating between different levels of revealed conservatism. Table B10 in the Appendix displays the results of an univariate logistic regression model (binary dummy for success as the dependent variable: yes = 1, no = 0), while Table B14 in the Appendix reports the results of ordered logistic regression models (attitudes on Likert scales between 1 and 5 as dependent variables). Both models are specified with the Resistance to Change-Beliefs Scale as the independent variable.[12] This scale represents a validated measure of conservatism (see, e.g., White et al., 2019). Utilizing this 10-item measure (employing Likert scales between 1 and 5), our objective was to ascertain participants' genuine levels of conservatism, as opposed to merely relying on their self-reported political inclinations. Our results indicate that groups tend to be more successful when their members exhibit lower levels of conservatism (see Table B10). Additionally, we find that more conservatism is positively associated with beliefs in the effectiveness and fairness of carbon taxes with dividends (see Table B14).[13]

We also examined whether coordination success in environmental framing and stances towards carbon pricing instruments are associated with environmental attitudes, as measured by the validated 15-item "New Environmental Paradigm" (NEP) belief scale (Dunlap et al., 2002).[14] We present the results of univariate logistic regression models (binary dummy for success as the dependent variable: yes = 1, no = 0) and ordered logistic regression models (attitudes on Likert scales between 1 and 5 as dependent variables) in Table B11 (success rate) and Table B15 (instruments) in the Appendix. We find that individuals with elevated levels on this scale, those who exhibit greater environmental concern, are associated with a higher likelihood of group success but not with more positive stances towards the instruments.

We further investigated whether variations in behavior and stances towards the instruments between treatments differ between self-reported Republicans and Democrats. Tables B20, B21 (exploratory extension), and B22 (exploratory extension) detail the policy instrument stances across conditions via two-sided Mann-Whitney U tests for self-reported Republicans, Democrats, and other party supporters. Notably, self-identified Democrats' attitudes towards carbon taxes with dividends are significantly influenced by their experience in the *Asymmetric* condition. However, we do not observe this for other treatment conditions

[12] The first row of Table B9 in the Appendix shows average scores across treatments.
[13] For a contextualization of the results, the reader is referred to Section 4.
[14] The second row of Table B9 in the Appendix shows average scores across treatments.

among Democrats, nor any effects among Republicans and supporters of other parties. Next, we evaluated the difference-in-difference (DiD) effects to scrutinize variations in consumption behavior and stances towards policy instruments between Republicans and Democrats across treatments. This DiD analysis provides insight into how the effects of the experimental conditions differ between these two political groups. We therefore configured ordered logistic regressions with individual consumption and attitudes on the 5-point Likert scales as dependent variables, a treatment dummy, a factor variable for political affiliation, and an interaction term between both as independent variables. As reported in tables B19 and B17 in the Appendix, we detect no statistically significant difference-in-difference effect between any of the conditions and self-reported political leaning on any of the policy items. Furthermore, we do not find any systematic interaction effects between the conditions and self-reported political leaning on individual consumption across the 10 rounds. However, in round 9 we find that the treatment effect of *Symmetric* and *Asymmetric* on individual consumption compared to *Baseline* is statistically significantly stronger for self-reported republicans. As we do not detect any such effect in other rounds, we remain cautious in interpreting these findings.

Lastly, in a non-preregistered exploratory extension, we also measured whether participants' demographic and socioeconomic characteristics are correlated with success rates, consumption and attitudes towards carbon taxes and carbon taxes accompanied by carbon dividends. In Table B13 in the Appendix, we present the relationships between success rates and participant characteristics by estimating multivariate logistic regression models with a binary dummy for success as the dependent variable: yes = 1, no = 0. We observe that women are linked with a higher likelihood of group success relative to men. Finally, we find that individuals who self-reported that they did not make informed decisions throughout the game are associated with a diminished likelihood of group success (which make up less than 5% of the sample). Next, Table B18 in the Appendix presents the outcomes from multivariate ordered logistic regressions investigating the link between participants' average consumption in each of the ten rounds (the dependent variables) and their respective demographic and socioeconomic attributes (the independent variables). We find that younger individuals and women are less likely to exhibit high consumption levels, while self-identified Republicans are more prone to higher consumption across the ten rounds. Additionally, Table B16, also located in the Appendix, delineates the correlations between policy attitudes (the dependent variables) and participants' demographic and socioeconomic traits (the independent variables). The data indicates that older individuals and women have a tendency to hold less favorable attitudes and beliefs towards the proposed measures. Similarly, self-identified Republicans and other party adherents are less likely to possess positive attitudes and beliefs towards the policy measures when compared to self-identified Democrats.

4. Discussion and Conclusion

Social sciences have demonstrated time and again that incentives shape behavior. Anthropogenic climate change, one of the biggest global challenges we face today, is fundamentally a behavioral challenge. In order to prevent crossing irreversible environmental tipping points, appropriate incentives in the form of financial costs and rewards are powerful tools to shift behavior and mitigate climate change. In this paper we tested the effects of carbon pricing alone and in combination with two different revenue recycling schemes (carbon dividends distributed symmetrically or asymmetrically). Specifically, we examined the impact of the tax and the dividends on cooperation and group success to remain below a critical consumption threshold. We ran a modified version of the Collective Risk Social Dilemma (CRSD) with a large U.S. sample of 2,112 subjects over 10 non-independent rounds. We measured the share of groups who successfully remained below a critical threshold of simulated CO_2 emissions (success rate).

We found that a carbon tax coupled with an asymmetric carbon dividend, in which tax revenue was redistributed to below-average emitters, was most effective at reducing total consumption (CO_2 emissions). Relative to the baseline, a carbon tax combined with a symmetric dividend also significantly reduced average group consumption, but to a lesser extent. The success rate of the asymmetric dividend condition was 94%, meaning that nearly all groups in this treatment successfully remained below the critical consumption threshold (tipping point). This success rate was significantly higher than that of each of the three other conditions. Though we also observe directional evidence that success rates, relative to the *Baseline* condition, were higher in the symmetric dividend condition – where the carbon tax revenue was equally paid out to all members of the group – this difference (82% vs 78%) was not significant.

Especially when we consider the implications of failure rates – exceeding a critical tipping point and causing irreversible environmental damage – a clear picture emerges. Failure rates in the no tax and tax only conditions were four times as high (22% and 25%, respectively) and three times as high in the symmetric carbon dividend condition (18%), compared to the asymmetric dividend condition (6%). Thus, the strong incentives in the asymmetric condition worked well in coordinating within-group behavior. Our study offers robust evidence that achieving the necessary level of coordination is not just possible, but highly likely, given the right incentives. We found that combining a carbon tax with an asymmetric carbon dividend is a suitable incentive structure. Following the polluters pay principle, this incentive structure provides not only a monetary disincentive to over-consumption, it also supplies a strong monetary incentive for reducing harmful consumption and thus, CO_2 emissions.

Our findings regarding the effect of carbon pricing and carbon dividends on consumption and success rates relative to baseline are conservative, providing a lower-bound estimate of their potential impacts. In our experimental setting, participants remained individually incentivized to maximize consumption, even when a carbon tax and symmetric dividend were in play. In real-world scenarios, however, the interplay of the tax's effects, including both substitution and income effects, makes consumption less appealing on an individual level, regardless of coordination efforts. Thus, in addition to the influences these measures have on consumption through coordination, we would also expect an individually rational reduction in the use of environmentally harmful goods and services in real-world contexts. This expected behavior is not captured in our experimental design but would contribute to a further decrease in consumption and an increase in success rates.

There is also evidence that compensation measures like a carbon dividend can be a useful tool to increase fairness perceptions among those who were previously skeptical of a policy, thereby increasing support (Jagers et al., 2018). This is in line with our findings, as beliefs about the ability of the tax, along with dividends, to help curb climate change were more optimistic in the treatments that experienced these measures compared to the baseline condition. Learning effects in the acceptance of welfare-enhancing measures may also have played a role (Janusch et al., 2021). Our data suggest that this may be mainly driven by self-reported Democrats, who appear most likely to hold more positive attitudes after experiencing the tax and dividend measures, relative to the baseline.

We also found that across all treatments, holding stronger pro-environmental attitudes correlated positively with group success rates (i.e. remaining below the critical consumption threshold). Moreover, greater conservatism (scoring higher on the "Resistance to Change-Beliefs Scale") was negatively associated with group success rate. Notably, scoring higher in the "Resistance to Change Beliefs Scale" (RCBS), and thus revealing higher conservatism, was positively linked with more approval of the carbon tax with dividend. This seems to be at odds with our findings of self-reported Republicans being more critical of carbon pricing measures and dividends. Table B24 shows an OLS regression with the RCBS as dependent variable and self-reported political leaning as independent variable. We did not find any association between those two variables. This suggests that people's resistance to change does not necessarily align with their political identity. Our findings illustrate the complexities within the notion of "conservatism". Political conservatism, associated with the Republican Party in the United States, often implies limited government intervention, which could suggest resistance to a carbon tax. Yet psychological conservatism, as measured by the RCBS, captures a preference for stability, which might align with carbon tax support, if seen as preserving an environmental status quo. This seeming discrepancy suggests that self-reported political leaning may not provide an accurate reflection of an individual's conservatism, as measured by the RCBS (see, e.g., Ellis and Stimson, 2009; Everett, 2013; Zell and Bernstein, 2014). This complexity underscores the need for caution in drawing conclusions based on political affiliation alone.

Although our conclusions derive from stylized experimental data, the substantial sample size drawn from the general population bolsters our confidence in extrapolating these results to real-world contexts. We found evidence not only that the mechanism alters behavior due to changing incentive structures, but also that the experience of the mechanism influences the decision-making process. Both groups experiencing the carbon dividend were significantly more likely to agree that over the 10 rounds remaining below the threshold was important to them, and that they were willing to sacrifice consumption only when other players did so. This suggests the possibility of a virtuous cycle whereby responding to incentives alters the motivation to act a certain way.

To further improve on the generalizability of outcomes and enhance ecological validity of the study, future research could explore the use of actual green and brown goods and services, e.g., via vouchers, rather than abstract units of consumption. Trade-offs between more and less environmentally harmful goods and services more closely captures people's preferences that affect their real-world environmental decisions. One key hurdle in climate change mitigation, not captured in this design, is the relatively long time horizon and disconnect between action and consequence. It would be important to understand how the measures introduced in this study (carbon tax and dividends) affect behavior when the averse outcome (surpassing the tipping point) is ambiguous or known only later. Further research on improving the ex-ante acceptance of carbon taxes and carbon dividends, which our study did not address, would also be of importance.

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Appendices

for Online Publication

Carbon Pricing in a CRSD Context:
Experimental Evidence

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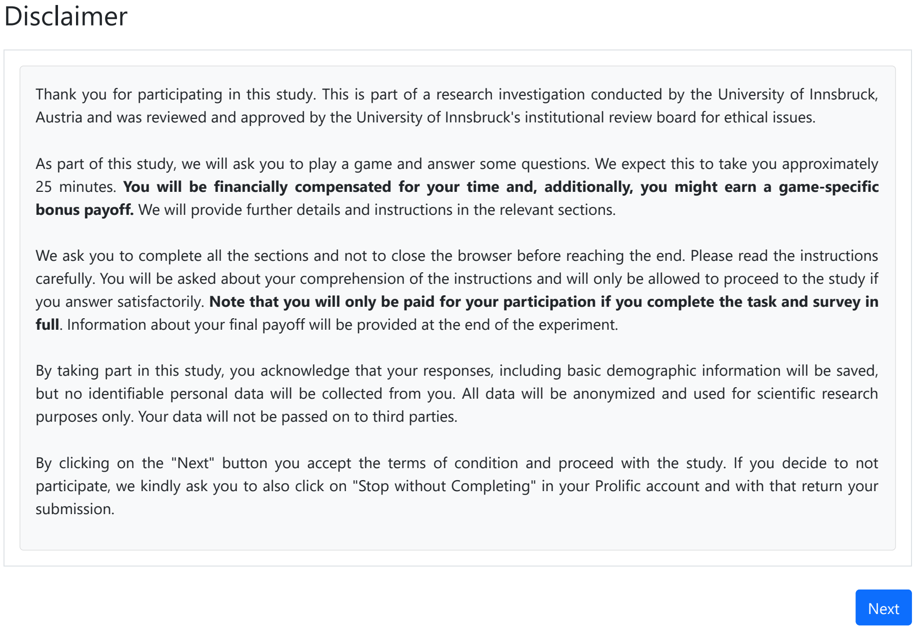
Contents

A. Experimental Software

A.1. Instructions

Figures A1–A18 show the disclaimer, experimental instructions, mentioned examples, quick guides (available during control questions and the game) for each treatment, and control questions. The full experimental software is available at https://osf.io/epm6n.



Disclaimer

Thank you for participating in this study. This is part of a research investigation conducted by the University of Innsbruck, Austria and was reviewed and approved by the University of Innsbruck's institutional review board for ethical issues.

As part of this study, we will ask you to play a game and answer some questions. We expect this to take you approximately 25 minutes. **You will be financially compensated for your time and, additionally, you might earn a game-specific bonus payoff.** We will provide further details and instructions in the relevant sections.

We ask you to complete all the sections and not to close the browser before reaching the end. Please read the instructions carefully. You will be asked about your comprehension of the instructions and will only be allowed to proceed to the study if you answer satisfactorily. **Note that you will only be paid for your participation if you complete the task and survey in full**. Information about your final payoff will be provided at the end of the experiment.

By taking part in this study, you acknowledge that your responses, including basic demographic information will be saved, but no identifiable personal data will be collected from you. All data will be anonymized and used for scientific research purposes only. Your data will not be passed on to third parties.

By clicking on the "Next" button you accept the terms of condition and proceed with the study. If you decide to not participate, we kindly ask you to also click on "Stop without Completing" in your Prolific account and with that return your submission.

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Figure A1: Disclaimer.

Instructions Game (Part 1/2)

General:

You will be playing a game with other people, in which your individual decisions and the decisions of others influence the group, which in turn has implications for simulated climate change. You will be able to earn money as a bonus payoff during this game, in addition to receiving a fixed payment of GBP 2.50 for your participation.

Players:

You will be assigned to a group of 4 with 3 other players participating in real-time. Each player in your group faces the same decision-making problem as you.

Premise:

The game has multiple rounds. In each round you will be asked to decide on consumption. You can imagine this being the consumption of a good or service, which you derive benefits from, but which produces some CO2 output. Thus, by consuming, you gain a financial reward: you accumulate tokens in your account balance, which can later be converted to GBP. But there is a trade-off: through consumption you contribute to the simulated emission of the greenhouse gas, CO2. Too much consumption can lead to catastrophic climate change, which causes significant economic losses to you and the others in the group.

Anonymity:

You will remain anonymous throughout the game. A single letter "nickname" (A, B, C, D) will be assigned to everyone in your group. The nickname assigned to you will be highlighted in blue throughout the game.

Rounds:

You will play for 10 rounds. In each round, all players will be asked simultaneously, "How many units do you want to consume in this round?". You can choose to consume 0 (nothing), 2 or 4 units, to be added as tokens to your account balance.

The game can only proceed to the next round if all players have submitted their consumption choice. You have a maximum of 2 minutes to make your decision in each round. If you do not select your desired consumption for a given round in time, the computer will automatically carry over whatever decision you made in the previous round (in the first round a random decision will be made in such a case). You will be able to make a choice again in the next round. If you select the desired consumption but do not confirm your decision by clicking „Next", the selected consumption will be submitted after the 2 minutes.

After each player has submitted their consumption choice, the computer will sum up the total amount consumed by the group. Consumption of the group is accumulated over the course of the 10 rounds.

There is a critical group consumption threshold of 80 units. If this amount is surpassed, simulated catastrophic climate change can occur, which would cause significant economic losses to all players. That means, if the total amount consumed by all players of the group at any point in the game surpasses 80 units, you and the others in the group are exposed to the risk of losing all tokens accumulated over the 10 rounds from consumption.

Next

Figure A2: Instructions *Baseline* Page 1 of 2.

Instructions Game (Part 2/2)

Consumption & Tokens:

Each round you make decisions about your consumption, which is then translated to tokens in your account balance.

For example, suppose in one round three players in the group select a consumption of 2 units and one player selects a consumption of 4 units. The three players who consumed 2 units would receive 2 tokens for their consumption added to their account balance in this round. The player who consumed 4 units would receive 4 tokens for their consumption added to their account balance.

As with group consumption, the tokens are accumulated in your account each round until the end of the game, where the tokens are converted to GBP to determine your bonus payoff.

Consumption-Page:

To help your decision-making, each round you will be able to view two tables: one showing the information of the previous round, and one showing the combined information for all rounds. Each table contains the consumption of each player in tokens and the total consumption of the group in tokens.

In addition, the accumulated consumption is visualized as a progress bar. Each player's aggregate consumption is marked on the bar. Your own consumption is highlighted in blue. An orange warning symbol indicates the consumption threshold, after which catastrophic climate change can occur.

Click to show example

Bonus Payoff & Catastrophic Climate Change:

You may receive a bonus payoff at the end of the game. This is determined as follows:

- If simulated catastrophic climate change occurs, you will lose all your tokens and, therefore, your bonus payoff. Catastrophic climate change occurs with a likelihood of 60% once your group surpassed the consumption threshold. The computer draws the outcome of this randomly for your group.
- If your group manages to evade simulated catastrophic climate change, your bonus is certain.
- All your accumulated and remaining tokens after this determination are converted 5:1 to GBP.

For example, if you finally accumulated 20 tokens over the course of the game, and your group managed to evade simulated catastrophic climate change, you will receive a bonus of GBP 4.

However, if your group surpassed the consumption threshold of 80 units, you have a 60% chance of simulated catastrophic climate change occurring and, therefore, receiving no bonus, and a 40% chance of simulated catastrophic climate change not occurring and, therefore, receiving your bonus of GBP 4.

Ending the Game:

The game ends after 10 rounds. After that, you will be sent to the results page indicating the final outcome of the game.

Quick Guide:

Throughout the game you can always click on "Click to show quick guide" if you want to refresh your memory of any of the terms and key parts of the game. Just remember that your timer is still running, and you have to make a decision in every round.

Next

Figure A3: Instructions *Baseline* Page 2 of 2. See Figure A4 for the example.

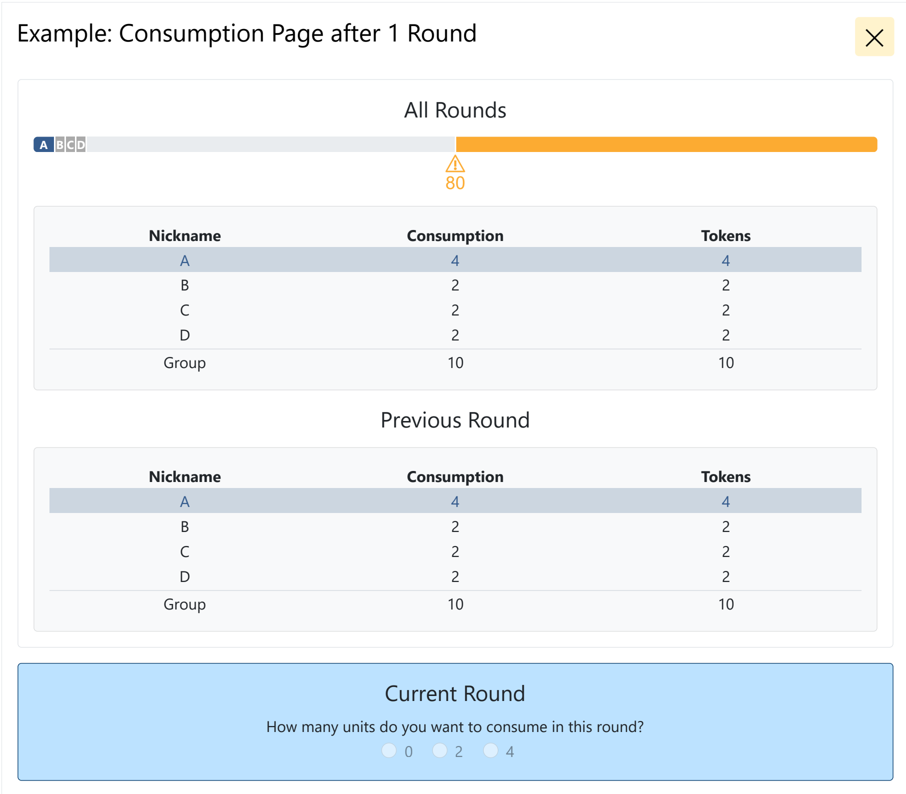


Figure A4: Example *Baseline*.

Quick Guide / Reference Key

Tokens:
Unit of monetary gain, which might be converted 5:1 to GBP at the end of the game.

Account balance:
Aggregate number of tokens personally accumulated over the course of the game.

Consumption:
Contributes to both simulated catastrophic climate change and your personal token account balance in each round.

Group consumption:
Consumption is accumulated by all 4 players over the course of the game.

Consumption threshold:
Total amount of group consumption, which, if exceeded, can cause simulated catastrophic climate change. This threshold is set to 80 units.

Catastrophic climate change:
Can occur at the end of the game with a likelihood of 60% if your group's aggregate consumption surpasses the consumption threshold of 80 units. If this happens, all your tokens will be lost.

Rounds:
The game ends after 10 rounds have been played.

Nickname:
Letters are randomly assigned as nicknames to players in the group. Your assigned nickname is indicated in blue.

Figure A5: Quick Guide *Baseline*.

Instructions Game (Part 1/2)

General:

You will be playing a game with other people, in which your individual decisions and the decisions of others influence the group, which in turn has implications for simulated climate change. You will be able to earn money as a bonus payoff during this game, in addition to receiving a fixed payment of GBP 2.50 for your participation.

Players:

You will be assigned to a group of 4 with 3 other players participating in real-time. Each player in your group faces the same decision-making problem as you.

Premise:

The game has multiple rounds. In each round you will be asked to decide on consumption. You can imagine this being the consumption of a good or service, which you derive benefits from, but which produces some CO2 output. Thus, by consuming, you gain a financial reward: you accumulate tokens in your account balance, which can later be converted to GBP. But there is a trade-off: through consumption you contribute to the simulated emission of the greenhouse gas, CO2. Too much consumption can lead to catastrophic climate change, which causes significant economic losses to you and the others in the group. Because of the environmental damage of consumption, your consumption is taxed, providing you fewer tokens per unit consumed. Your pre-tax consumption contributes to catastrophic climate change.

Anonymity:

You will remain anonymous throughout the game. A single letter "nickname" (A, B, C, D) will be assigned to everyone in your group. The nickname assigned to you will be highlighted in blue throughout the game.

Rounds:

You will play for 10 rounds. In each round, all players will be asked simultaneously, "How many units do you want to consume in this round?". You can choose to consume 0 (nothing), 2 or 4 units, to be added as tokens to your account balance.

The game can only proceed to the next round if all players have submitted their consumption choice. You have a maximum of 2 minutes to make your decision in each round. If you do not select your desired consumption for a given round in time, the computer will automatically carry over whatever decision you made in the previous round (in the first round a random decision will be made in such a case). You will be able to make a choice again in the next round. If you select the desired consumption but do not confirm your decision by clicking „Next", the selected consumption will be submitted after the 2 minutes.

After each player has submitted their consumption choice, the computer will sum up the total amount consumed by the group. Consumption of the group is accumulated over the course of the 10 rounds.

There is a critical group consumption threshold of 80 units. If this amount is surpassed, simulated catastrophic climate change can occur, which would cause significant economic losses to all players. That means, if the total amount consumed by all players of the group at any point in the game surpasses 80 units, you and the others in the group are exposed to the risk of losing all tokens accumulated over the 10 rounds from consumption.

Next

Figure A6: Instructions *Tax* Page 1 of 2.

Instructions Game (Part 2/2)

Consumption & Tokens:

Each round you make decisions about your consumption, which is then translated to tokens in your account balance. However, each unit you consume will be subject to a carbon tax of 50%. The amount of consumption remaining after tax will be added to your account balance as tokens in each round.

For example, suppose in one round three players in the group select a consumption of 2 units and one player selects a consumption of 4 units. Given the tax rate of 50%, half the consumption gets deducted as taxes from each player, while the other half gets added as tokens to the account balance. The three players who consumed 2 units would lose 1 token in taxes and receive 1 token for their consumption added to their account balance in this round. The player who consumed 4 units would lose 2 tokens in taxes and would receive 2 tokens for their consumption added to their account balance.

As with group consumption, the tokens are accumulated in your account each round until the end of the game, where the tokens are converted to GBP to determine your bonus payoff.

Consumption-Page:

To help your decision-making, each round you will be able to view two tables: one showing the information of the previous round, and one showing the combined information for all rounds. Each table contains the consumption of each player, the carbon tax deducted from each player's consumption in tokens (negative sign), and the number of tokens left for each player after the deduction of the tax. You will be able to see the individual player's amounts and the totals for the group.

In addition, the accumulated consumption is visualized as a progress bar. Each player's aggregate consumption is marked on the bar. Your own consumption is highlighted in blue. An orange warning symbol indicates the consumption threshold, after which catastrophic climate change can occur.

Click to show example

Bonus Payoff & Catastrophic Climate Change:

You may receive a bonus payoff at the end of the game. This is determined as follows:

- If simulated catastrophic climate change occurs, you will lose all your tokens and, therefore, your bonus payoff. Catastrophic climate change occurs with a likelihood of 60% once your group surpassed the consumption threshold. The computer draws the outcome of this randomly for your group.
- If your group manages to evade simulated catastrophic climate change, your bonus is certain.
- All your accumulated and remaining tokens after this determination are converted 2.5:1 to GBP.

For example, if you finally accumulated 10 tokens over the course of the game, and your group managed to evade simulated catastrophic climate change, you will receive a bonus of GBP 4.

However, if your group surpassed the consumption threshold of 80 units, you have a 60% chance of simulated catastrophic climate change occurring and, therefore, receiving no bonus, and a 40% chance of simulated catastrophic climate change not occurring and, therefore, receiving your bonus of GBP 4.

Ending the Game:

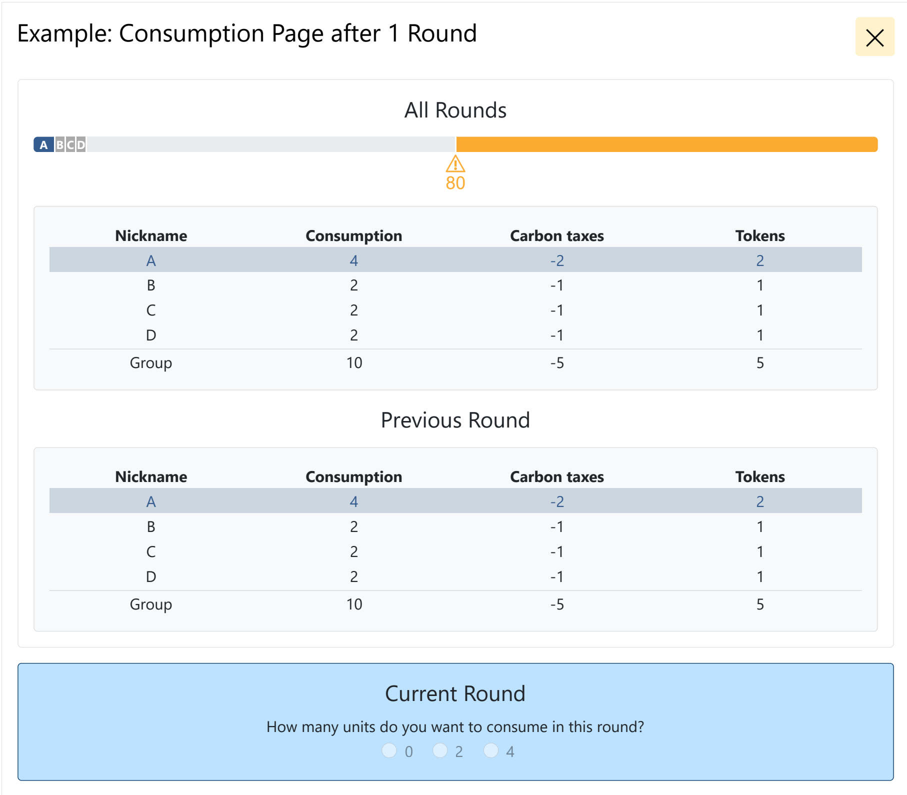
The game ends after 10 rounds. After that, you will be sent to the results page indicating the final outcome of the game.

Quick Guide:

Throughout the game you can always click on "Click to show quick guide" if you want to refresh your memory of any of the terms and key parts of the game. Just remember that your timer is still running, and you have to make a decision in every round.

Next

Figure A7: Instructions *Tax* Page 2 of 2. See Figure A8 for the example.



Example: Consumption Page after 1 Round

All Rounds

A B C D

80

Nickname	Consumption	Carbon taxes	Tokens
A	4	-2	2
B	2	-1	1
C	2	-1	1
D	2	-1	1
Group	10	-5	5

Previous Round

Nickname	Consumption	Carbon taxes	Tokens
A	4	-2	2
B	2	-1	1
C	2	-1	1
D	2	-1	1
Group	10	-5	5

Current Round

How many units do you want to consume in this round?

0 2 4

Figure A8: Example *Tax*.

Quick Guide / Reference Key

Tokens:

Unit of monetary gain, which might be converted 2.5:1 to GBP at the end of the game.

Account balance:

Aggregate number of tokens personally accumulated over the course of the game.

Consumption:

Contributes to both simulated catastrophic climate change and your personal token account balance in each round.

Group consumption:

Consumption is accumulated by all 4 players over the course of the game.

Carbon Tax:

Is set at 50%. Therefore, half of your selected consumption in tokens will be deducted as tax in each round.

Consumption threshold:

Total amount of group consumption, which, if exceeded, can cause simulated catastrophic climate change. This threshold is set to 80 units.

Catastrophic climate change:

Can occur at the end of the game with a likelihood of 60% if your group's aggregate consumption surpasses the consumption threshold of 80 units. If this happens, all your tokens will be lost.

Rounds:

The game ends after 10 rounds have been played.

Nickname:

Letters are randomly assigned as nicknames to players in the group. Your assigned nickname is indicated in blue.

Figure A9: Quick Guide *Baseline*.

Instructions Game (Part 1/2)

General:

You will be playing a game with other people, in which your individual decisions and the decisions of others influence the group, which in turn has implications for simulated climate change. You will be able to earn money as a bonus payoff during this game, in addition to receiving a fixed payment of GBP 2.50 for your participation.

Players:

You will be assigned to a group of 4 with 3 other players participating in real-time. Each player in your group faces the same decision-making problem as you.

Premise:

The game has multiple rounds. In each round you will be asked to decide on consumption. You can imagine this being the consumption of a good or service, which you derive benefits from, but which produces some CO2 output. Thus, by consuming, you gain a financial reward: you accumulate tokens in your account balance, which can later be converted to GBP. But there is a trade-off: through consumption you contribute to the simulated emission of the greenhouse gas, CO2. Too much consumption can lead to catastrophic climate change, which causes significant economic losses to you and the others in the group. Because of the environmental damage of consumption, your consumption will be subject to a carbon tax, providing you fewer tokens per unit consumed. Your pre-tax consumption contributes to catastrophic climate change. The taxes collected are distributed equally to each player. This is known as a carbon dividend.

Anonymity:

You will remain anonymous throughout the game. A single letter "nickname" (A, B, C, D) will be assigned to everyone in your group. The nickname assigned to you will be highlighted in blue throughout the game.

Rounds:

You will play for 10 rounds. In each round, all players will be asked simultaneously, "How many units do you want to consume in this round?". You can choose to consume 0 (nothing), 2 or 4 units, to be added as tokens to your account balance.

The game can only proceed to the next round if all players have submitted their consumption choice. You have a maximum of 2 minutes to make your decision in each round. If you do not select your desired consumption for a given round in time, the computer will automatically carry over whatever decision you made in the previous round (in the first round a random decision will be made in such a case). You will be able to make a choice again in the next round. If you select the desired consumption but do not confirm your decision by clicking „Next", the selected consumption will be submitted after the 2 minutes.

After each player has submitted their consumption choice, the computer will sum up the total amount consumed by the group. Consumption of the group is accumulated over the course of the 10 rounds.

There is a critical group consumption threshold of 80 units. If this amount is surpassed, simulated catastrophic climate change can occur, which would cause significant economic losses to all players. That means, if the total amount consumed by all players of the group at any point in the game surpasses 80 units, you and the others in the group are exposed to the risk of losing all tokens accumulated over the 10 rounds from consumption.

Next

Figure A10: Instructions *Symmetric* Page 1 of 2.

Instructions Game (Part 2/2)

Consumption & Tokens:

Each round you make decisions about your consumption, which is then translated to tokens in your account balance. However, each unit you consume will be subject to a carbon tax of 50%. The amount of consumption remaining after tax will be added to your account balance as tokens in each round. Additionally, in each round, the carbon taxes collected from everyone in the group will be summed up and equally redistributed to each player as a so-called carbon dividend.

For example, suppose in one round three players in the group select a consumption of 2 units and one player selects a consumption of 4 units. Given the tax rate of 50%, half the consumption gets deducted as taxes from each player, while the other half gets added as tokens to the account balance. In this case, 1 token in taxes is collected from those who consumed 2 units, and 2 tokens in taxes from the player who consumed 4 units. Because of the carbon dividend, the total amount of taxes collected (1 + 1 + 1 + 2 = 5 tokens) then gets redistributed equally among all the four players: 5 tokens / 4 = 1.25 tokens each. The three players who consumed 2 units receive 1 token for their consumption and an additional 1.25 tokens from the dividend, totalling 2.25 tokens added to their account balance for this round. The player who consumed 4 units receives 2 tokens for consumption and an additional 1.25 from the dividend, totalling 3.25 tokens added to their account balance for this round.

As with group consumption, the tokens are accumulated in your account each round until the end of the game, where the tokens are converted to GBP to determine your bonus payoff.

Consumption-Page:

To help your decision-making, each round you will be able to view two tables: one showing the information of the previous round, and one showing the combined information for all rounds. Each table contains the consumption of each player, the carbon tax deducted from each player's consumption in tokens (negative sign), the amount of redistributed carbon dividends in tokens, and the number of tokens left for each player after the deduction and redistribution of the tax. You will be able to see the individual player's amounts and the totals for the group.

In addition, the accumulated consumption is visualized as a progress bar. Each player's aggregate consumption is marked on the bar. Your own consumption is highlighted in blue. An orange warning symbol indicates the consumption threshold, after which catastrophic climate change can occur.

Click to show example

Bonus Payoff & Catastrophic Climate Change:

You may receive a bonus payoff at the end of the game. This is determined as follows:

- If simulated catastrophic climate change occurs, you will lose all your tokens and, therefore, your bonus payoff. Catastrophic climate change occurs with a likelihood of 60% once your group surpassed the consumption threshold. The computer draws the outcome of this randomly for your group.
- If your group manages to evade simulated catastrophic climate change, your bonus is certain.
- All your accumulated and remaining tokens after this determination are converted 5:1 to GBP.

For example, if you finally accumulated 20 tokens over the course of the game, and your group managed to evade simulated catastrophic climate change, you will receive a bonus of GBP 4.

However, if your group surpassed the consumption threshold of 80 units, you have a 60% chance of simulated catastrophic climate change occurring and, therefore, receiving no bonus, and a 40% chance of simulated catastrophic climate change not occurring and, therefore, receiving your bonus of GBP 4.

Ending the Game:

The game ends after 10 rounds. After that, you will be sent to the results page indicating the final outcome of the game.

Quick Guide:

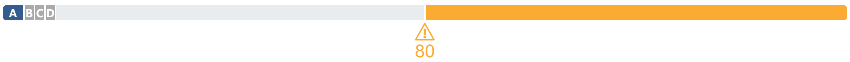
Throughout the game you can always click on "Click to show quick guide" if you want to refresh your memory of any of the terms and key parts of the game. Just remember that your timer is still running, and you have to make a decision in every round.

Next

Figure A11: Instructions *Symmetric* Page 2 of 2. See Figure A12 for the example.

Example: Consumption Page after 1 Round

All Rounds



Nickname	Consumption	Carbon taxes	Carbon Dividends	Tokens
A	4	-2	1.25	3.25
B	2	-1	1.25	2.25
C	2	-1	1.25	2.25
D	2	-1	1.25	2.25
Group	10	-5	5	10

Previous Round

Nickname	Consumption	Carbon taxes	Carbon Dividends	Tokens
A	4	-2	1.25	3.25
B	2	-1	1.25	2.25
C	2	-1	1.25	2.25
D	2	-1	1.25	2.25
Group	10	-5	5	10

Current Round

How many units do you want to consume in this round?

○ 0 ○ 2 ○ 4

Figure A12: Example *Symmetric*.

Quick Guide / Reference Key

Tokens:

Unit of monetary gain, which might be converted 5:1 to GBP at the end of the game.

Account balance:

Aggregate number of tokens personally accumulated over the course of the game.

Consumption:

Contributes to both simulated catastrophic climate change and your personal token account balance in each round.

Group consumption:

Consumption is accumulated by all 4 players over the course of the game.

Carbon Tax:

Is set at 50%. Therefore, half of your selected consumption in tokens will be deducted as tax in each round

Carbon Dividend:

The total amount of taxes collected from all players are added up in each round and redistributed equally in tokens amongst all players of the group.

Consumption threshold:

Total amount of group consumption, which, if exceeded, can cause simulated catastrophic climate change. This threshold is set to 80 units.

Catastrophic climate change:

Can occur at the end of the game with a likelihood of 60% if your group's aggregate consumption surpasses the consumption threshold of 80 units. If this happens, all your tokens will be lost.

Rounds:

The game ends after 10 rounds have been played.

Nickname:

Letters are randomly assigned as nicknames to players in the group. Your assigned nickname is indicated in blue.

Figure A13: Quick Guide *Symmetric*.

Instructions Game (Part 1/2)

General:

You will be playing a game with other people, in which your individual decisions and the decisions of others influence the group, which in turn has implications for simulated climate change. You will be able to earn money as a bonus payoff during this game, in addition to receiving a fixed payment of GBP 2.50 for your participation.

Players:

You will be assigned to a group of 4 with 3 other players participating in real-time. Each player in your group faces the same decision-making problem as you.

Premise:

The game has multiple rounds. In each round you will be asked to decide on consumption. You can imagine this being the consumption of a good or service, which you derive benefits from, but which produces some CO2 output. Thus, by consuming, you gain a financial reward: you accumulate tokens in your account balance, which can later be converted to GBP. But there is a trade-off: through consumption you contribute to the simulated emission of the greenhouse gas, CO2. Too much consumption can lead to catastrophic climate change, which causes significant economic losses to you and the others in the group. Because of the environmental damage of consumption, your consumption will be subject to a carbon tax, providing you fewer tokens per unit consumed. Your pre-tax consumption contributes to catastrophic climate change. The taxes collected are distributed equally to players who have consumed a lower or equal number of units compared to the group average. This is known as a carbon dividend.

Anonymity:

You will remain anonymous throughout the game. A single letter "nickname" (A, B, C, D) will be assigned to everyone in your group. The nickname assigned to you will be highlighted in blue throughout the game.

Rounds:

You will play for 10 rounds. In each round, all players will be asked simultaneously, "How many units do you want to consume in this round?". You can choose to consume 0 (nothing), 2 or 4 units, to be added as tokens to your account balance.

The game can only proceed to the next round if all players have submitted their consumption choice. You have a maximum of 2 minutes to make your decision in each round. If you do not select your desired consumption for a given round in time, the computer will automatically carry over whatever decision you made in the previous round (in the first round a random decision will be made in such a case). You will be able to make a choice again in the next round. If you select the desired consumption but do not confirm your decision by clicking „Next", the selected consumption will be submitted after the 2 minutes.

After each player has submitted their consumption choice, the computer will sum up the total amount consumed by the group. Consumption of the group is accumulated over the course of the 10 rounds.

There is a critical group consumption threshold of 80 units. If this amount is surpassed, simulated catastrophic climate change can occur, which would cause significant economic losses to all players. That means, if the total amount consumed by all players of the group at any point in the game surpasses 80 units, you and the others in the group are exposed to the risk of losing all tokens accumulated over the 10 rounds from consumption.

Next

Figure A14: Instructions *Asymmetric* Page 1 of 2.

Instructions Game (Part 2/2)

Consumption & Tokens:

Each round you make decisions about your consumption, which is then translated to tokens in your account balance. However, each unit you consume will be subject to a carbon tax of 50%. The amount of consumption remaining after tax will be added to your account balance as tokens in each round. Additionally, in each round, the carbon taxes collected by everyone in the group will be summed up and equally redistributed among players who consumed a lower or equal number of units compared to the group average, as a so-called carbon dividend.

For example, suppose in one round three players in the group select a consumption of 2 units and one player selects a consumption of 4 units. Given the tax rate of 50%, half the consumption gets deducted as taxes from each player, while the other half gets added as tokens to the account balance. In this case, 1 token in taxes is collected from those who consumed 2 units, and 2 tokens in taxes from the player who consumed 4 units. Because of the carbon dividend, the total amount of taxes collected (1 + 1 + 1 + 2 = 5 tokens) then gets redistributed among those who consumed a lower or equal number of units compared to the group average. Here, the average group consumption (total consumption divided by 4 players) was (2 + 2 + 2 + 4) / 4 = 2.5 units. Since three players are below the group average consumption of 2.5 units, the total tax collected of 5 will be split among these 3 players: 5 tokens / 3 = 1.67 tokens each. The three players who consumed 2 units receive 1 token for their consumption and 1.67 tokens from the dividend, totalling 2.67 tokens added to their account balance for this round. The player who consumed 4 units receives 2 tokens for consumption and nothing from the dividend, so 2 tokens get added to their account balance for this round.

As with group consumption, the tokens are accumulated in your account each round until the end of the game, where the tokens are converted to GBP to determine your bonus payoff.

Consumption-Page:

To help your decision-making, each round you will be able to view two tables: one showing the information of the previous round, and one showing the combined information for all rounds. Each table contains the consumption of each player, the carbon tax deducted from each player's consumption in tokens (negative sign), the amount of redistributed carbon dividends in tokens, and the number of tokens left for each player after the deduction and redistribution of the tax. You will be able to see the individual player's amounts and the totals for the group.

In addition, the accumulated consumption is visualized as a progress bar. Each player's aggregate consumption is marked on the bar. Your own consumption is highlighted in blue. An orange warning symbol indicates the consumption threshold, after which catastrophic climate change can occur.

Click to show example

Bonus Payoff & Catastrophic Climate Change:

You may receive a bonus payoff at the end of the game. This is determined as follows:

- If simulated catastrophic climate change occurs, you will lose all your tokens and, therefore, your bonus payoff. Catastrophic climate change occurs with a likelihood of 60% once your group surpassed the consumption threshold. The computer draws the outcome of this randomly for your group.
- If your group manages to evade simulated catastrophic climate change, your bonus is certain.
- All your accumulated and remaining tokens after this determination are converted 5:1 to GBP.

For example, if you finally accumulated 20 tokens over the course of the game, and your group managed to evade simulated catastrophic climate change, you will receive a bonus of GBP 4.

However, if your group surpassed the consumption threshold of 80 units, you have a 60% chance of simulated catastrophic climate change occurring and, therefore, receiving no bonus, and a 40% chance of simulated catastrophic climate change not occurring and, therefore, receiving your bonus of GBP 4.

Ending the Game:

The game ends after 10 rounds. After that, you will be sent to the results page indicating the final outcome of the game.

Quick Guide:

Throughout the game you can always click on "Click to show quick guide" if you want to refresh your memory of any of the terms and key parts of the game. Just remember that your timer is still running, and you have to make a decision in every round.

Next

Figure A15: Instructions *Asymmetric* Page 2 of 2. See Figure A16 for the example.

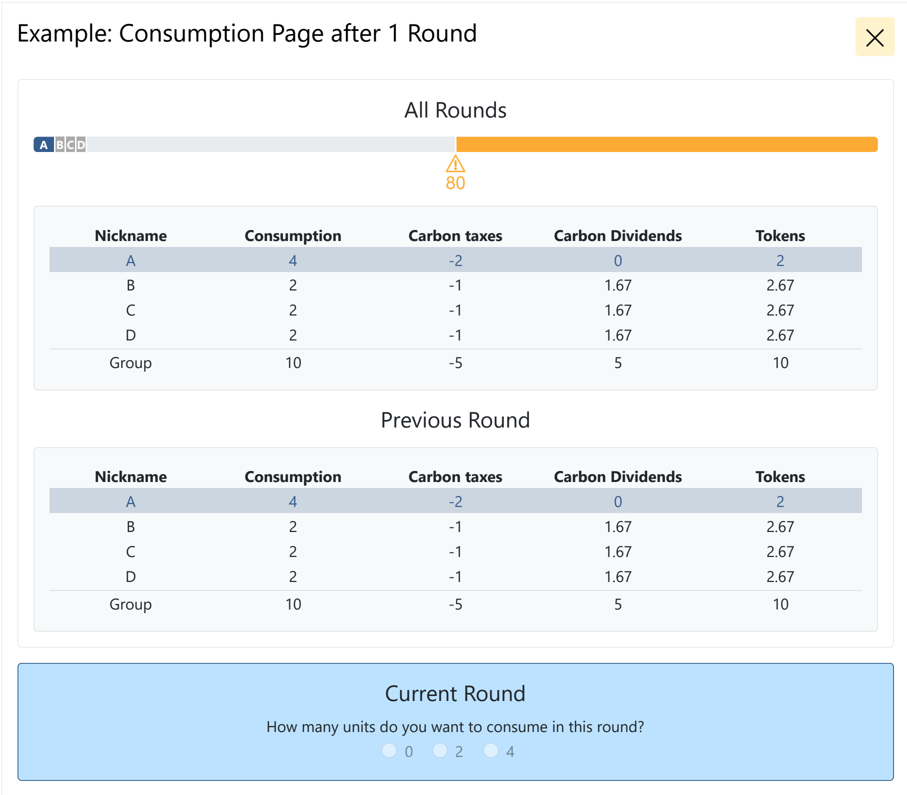


Figure A16: Example *Asymmetric*.

Quick Guide / Reference Key

Tokens:

Unit of monetary gain, which might be converted 5:1 to GBP at the end of the game.

Account balance:

Aggregate number of tokens personally accumulated over the course of the game.

Consumption:

Contributes to both simulated catastrophic climate change and your personal token account balance in each round.

Group consumption:

Consumption is accumulated by all 4 players over the course of the game.

Carbon Tax:

Is set at 50%. Therefore, half of your selected consumption in tokens will be deducted as tax in each round

Carbon Dividend:

The total amount of taxes collected from all players are added up in each round and redistributed equally in tokens amongst all players of the group who consumed less than or equal to the group average in this round.

Consumption threshold:

Total amount of group consumption, which, if exceeded, can cause simulated catastrophic climate change. This threshold is set to 80 units.

Catastrophic climate change:

Can occur at the end of the game with a likelihood of 60% if your group's aggregate consumption surpasses the consumption threshold of 80 units. If this happens, all your tokens will be lost.

Rounds:

The game ends after 10 rounds have been played.

Nickname:

Letters are randomly assigned as nicknames to players in the group. Your assigned nickname is indicated in blue.

Figure A17: Quick Guide *Asymmetric*.

Control Questions - Attempt 1 / 2

In order to proceed, you have to correctly answer the following questions. You may check the quick guide if needed.

To prevent catastrophic climate change, which total amount of consumption must not be surpassed by the group over the course of the game?

- ◯ 0
- ◯ 80
- ◯ 160

At the end of the game, all tokens in your account will be converted to cash. Which of the following conversions is correct?

- ◯ The conversion rate is 5:1. Therefore, 100 tokens would be converted to GBP 20 in cash.
- ◯ Tokens are not converted to cash. Everyone receives a fixed payment.
- ◯ The conversion rate is 1:1. Therefore, 100 tokens would be converted to GBP 100 in cash.

How does the consumption of previous rounds carry over to future rounds?

- ◯ Each round is independent. In every round everything is reset
- ◯ Consumption is accumulated over all the rounds. I.e., each round, the consumption is added to the consumption of previous rounds.

Which conditions cause the game to end?

- ◯ The game continues infinitely until the threshold is surpassed.
- ◯ The game ends after exactly 10 rounds.

What information about past consumption is shown to everyone in each round?

- ◯ Each individual player's consumption, as well as the total group consumption for the previous round and for all rounds combined.
- ◯ No information is shown.
- ◯ Only information about of one's own past decisions is shown.

Please select "22" as the correct answer for this item.

- ◯ 71
- ◯ 22
- ◯ 19

How does your consumption translate to tokens in your account

- ◯ Consumption does not affect tokens in your account.
- ◯ More consumption leads to fewer tokens being added to your account.
- ◯ Every unit of consumption adds one token to your account.

What happens if the group surpasses the consumption threshold?

- ◯ Nothing
- ◯ The game ends
- ◯ Catastrophic climate change can occur

How likely is it that catastrophic climate change will occur once your group surpasses the consumption threshold?

- ◯ 0%
- ◯ 60%
- ◯ 100%

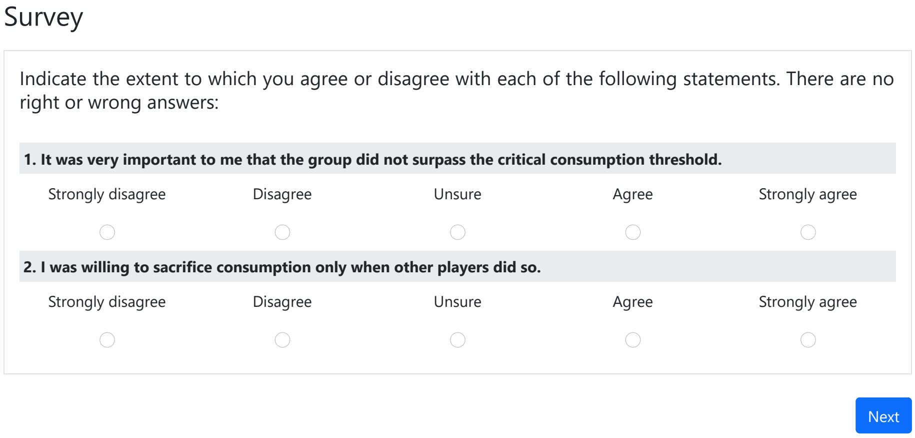
Click to show quick guide

Next

Figure A18: Control Questions.

A.2. Survey

Figures A19–A25 show the content of the post-experimental survey including demographics and feedback that was collected.



Survey

Indicate the extent to which you agree or disagree with each of the following statements. There are no right or wrong answers:

1. It was very important to me that the group did not surpass the critical consumption threshold.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

2. I was willing to sacrifice consumption only when other players did so.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

Next

Figure A19: Survey items on decision making.

Survey

Click to show Explanations on Carbon Taxes and Carbon Dividends

If a **carbon tax** were implemented in the United States, please indicate the extent to which you agree or disagree with the following statements:

Remember that a carbon tax is a tax on goods and services that produce high carbon emissions.

1. I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

2. I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

3. I would support pricing carbon emissions via a carbon tax.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

4. I believe other people in my community would support pricing carbon emissions via a carbon tax.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

If a **carbon tax and dividend** were implemented in the United States, please indicate the extent to which you agree or disagree with the following statements:

Remember that a carbon tax with dividend means that the tax revenue gets redistributed by being paid out in cash to the taxpayers.

1. I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

2. I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

3. I would support pricing carbon emissions via a carbon tax and dividend.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

4. I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

5. Which type of carbon dividend, if any, would you be more likely to support?

○ Symmetric dividend (equal distribution of carbon taxes)

○ Asymmetric dividend (distribution of carbon taxes only among below-average carbon emitters)

○ Neither

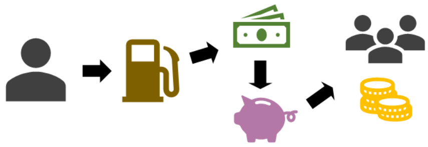
Next

Figure A20: Survey items on carbon taxes and carbon dividends. See Figure A21 for the explanations.

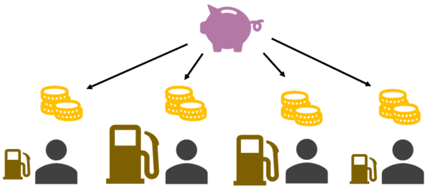
Explanations on Carbon Taxes and Carbon Dividends:

Policymakers have long grappled with the question of how to encourage the reduction of CO2 emissions. One possible approach is by pricing carbon emissions. This could be done by introducing a carbon tax with a so-called carbon dividend. This works in the following way:

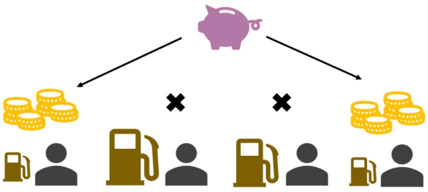
A carbon tax means that carbon-heavy goods and services are taxed, making them more costly. By comparison, greener alternatives are relatively cheaper and become more attractive. Combined with a carbon dividend, periodically (i.e. at the end of each year), all the money collected via the carbon tax is redistributed across the population, paid out in cash (the dividend).



The dividend can be paid out symmetrically, such that the total amount of carbon tax revenue is equally distributed among all those who paid taxes, regardless of how much carbon they emitted (and therefore regardless of how much carbon taxes they paid).



The dividend can also be paid out asymmetrically, such that the total amount of carbon tax revenue is distributed to those who consumed less carbon than the average person (and therefore also paid less carbon tax than the average).



In either case, most households would benefit from a carbon dividend, because the dividend received would exceed people's share of carbon tax, and only those with above-average CO2 footprints would pay more tax than they would receive as a dividend.

Figure A21: Explanation of carbon taxes and carbon dividends.


Survey

Indicate the extent to which you agree or disagree with each of the following statements. There are no right or wrong answers:

1. Approaches used by people in the past are generally the most effective.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

2. If society is going to change, it should occur slowly and naturally.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

3. The established way of doing things should be protected and preserved.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

4. Fast or radical changes are unwise and dangerous.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

5. Traditions reflect wisdom and knowledge.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

6. Making sudden changes tends to create more problems than solutions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

7. Slow, gradual change helps prevent catastrophes and mistakes.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

8. Quick changes are acceptable if they restore things to how they were before.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

9. Following traditions tends to create a closed-minded society.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

10. Established traditions are the best way to run society.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
○	○	○	○	○

Next

Figure A22: *Resistance to Change-Beliefs Scale* (see, e.g., White et al., 2019) survey items. Item 9 is evaluated in reverse.

Survey

Indicate the extent to which you agree or disagree with each of the following statements. There are no right or wrong answers:

1. We are approaching the limit of the number of people the Earth can support.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

2. Humans have the right to modify the natural environment to suit their needs.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

3. When humans interfere with nature it often produces disastrous consequences.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

4. Human ingenuity will ensure that we do not make the Earth unliveable.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

5. Humans are seriously abusing the environment.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

6. The Earth has plenty of natural resources if we just learn how to develop them.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

7. Plants and animals have as much right as humans to exist.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

9. Despite our special abilities, humans are still subject to the laws of nature.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

10. The so-called "ecological crisis" facing humankind has been greatly exaggerated.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

11. The Earth is like a spaceship with very limited room and resources.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

12. Humans were meant to rule over the rest of nature.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

13. The balance of nature is very delicate and easily upset.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

14. Humans will eventually learn enough about how nature works to be able to control it.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

15. If things continue on their present course, we will soon experience a major ecological catastrophe.

Strongly disagree | Disagree | Unsure | Agree | Strongly agree

Next

Figure A23: *New Environmental Paradigm* (Dunlap et al., 2002) survey items. Even numbered items are evaluated in reverse.

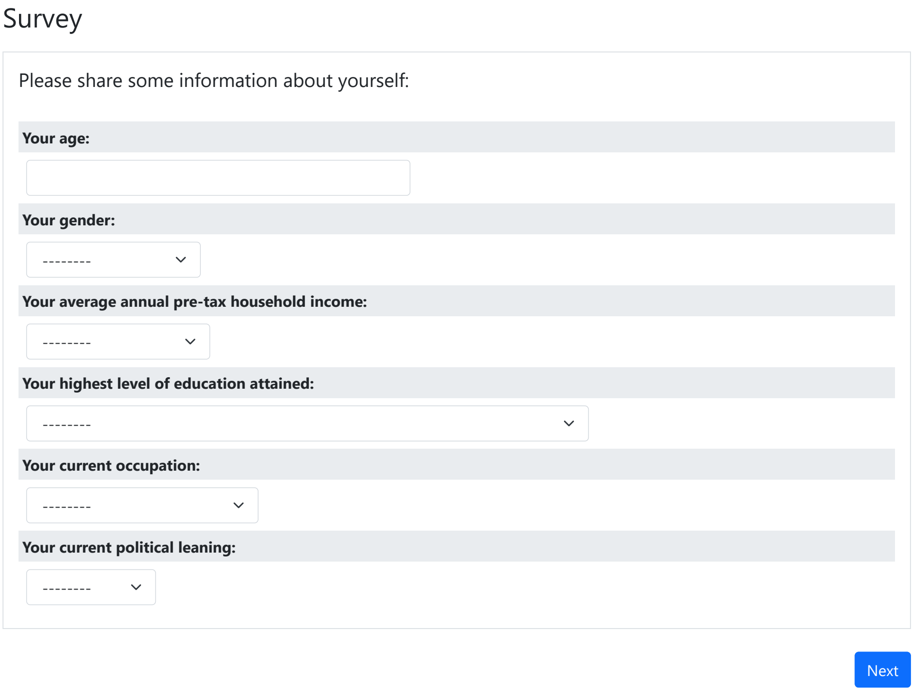


Figure A24: Demographics.

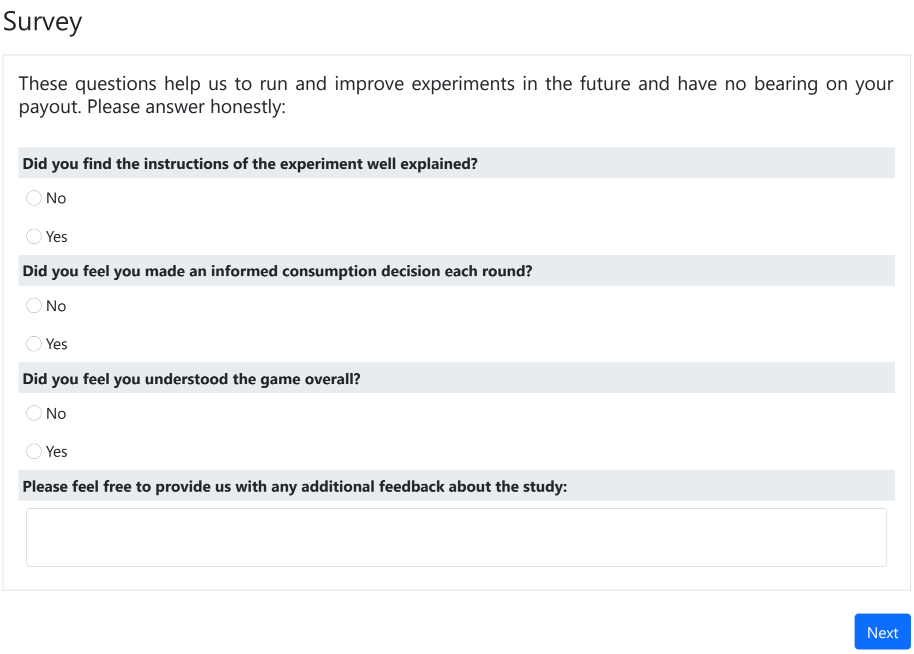


Figure A25: Feedback.

B. Supplementary Tables

Table B1: Representative data sampling statistics. The exhibited relative frequencies refer to a sub-sample of $N = 1120$, equating to 53% of the full sample of $N = 2112$ observations. A value of 1 implies that the corresponding bracket has achieved its exact target sampling size. Nonetheless, varied fractions within each stratum suggest that the sampling across brackets was not entirely balanced.

Age:	
18 - 17	0.983
28 - 37	1.004
38 - 47	0.943
48 - 57	0.810
58 - 150	0.373
Sex:	
female	0.764
male	0.753
Ethnicity:	
asian	0.701
black	0.620
mixed	0.853
other	0.741
white	0.783

Table B2: Descriptive statistics of demographic characteristics per treatment: age in years, gender, education, occupation, income and political leaning in percent. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). Note that some categories have few to no observations. We do not omit any of these in proceeding analyses, but interpretation of these should be taken with caution. n indicates the number of observations.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 520$	$n = 536$	$n = 524$	$n = 532$
Age	37.905	39.432	39.380	37.953
Gender:				
Male	53.6%	54.6%	56.8%	54.1%
Female	43.5%	43.2%	41.9%	43.5%
Non-Binary	2.3%	1.5%	0.8%	2.3%
Other	0.2%	0.4%	0.2%	0.2%
I prefer not to tell	0.4%	0.4%	0.4%	0.0%
Education:				
None	0.0%	0.2%	0.2%	0.0%
Primary	0.2%	0.4%	0.8%	1.1%
Secondary	0.0%	0.0%	0.0%	0.0%
Associates degree	28.0%	30.2%	29.1%	22.5%
Bachelor's degree	11.8%	13.1%	12.0%	11.7%
Professional degree	41.9%	40.3%	39.4%	45.4%
Master's degree	2.9%	1.9%	2.1%	1.3%
Doctorate degree	13.4%	12.0%	13.6%	16.6%
I prefer not to tell	1.7%	1.9%	2.9%	1.3%
Occupation:				
Employed	62.1%	62.9%	60.0%	60.7%
Self employed / Freelance	13.0%	14.1%	14.5%	13.8%
Unemployed	12.0%	10.9%	12.0%	11.9%
Retired	3.3%	5.1%	6.7%	5.1%
Student	6.2%	4.9%	4.4%	6.4%
I prefer not to tell	3.3%	2.3%	2.3%	2.1%
Income USD:				
less than 50.000	38.1%	40.2%	38.8%	35.5%
50.000 to 59.999	11.5%	11.6%	10.9%	11.2%
60.000 to 69.999	10.1%	8.1%	9.9%	9.5%
70.000 or more	37.9%	37.1%	38.8%	42.2%
I prefer not to tell	2.5%	3.0%	1.5%	1.7%
Political Leaning:				
Republican	23.1%	22.9%	20.5%	17.2%
Democrat	57.9%	57.2%	54.1%	55.6%
Other	19.0%	19.9%	25.4%	27.2%

Table B3: Pairwise comparisons of differences in demographics across treatments. The first (upper) part shows comparisons relative to *Baseline*. The second (middle) part shows comparisons relative to *Tax*. The third (lower) part shows comparisons relative to *Symmetric*. Additionally, reference conditions are marked as "ref.". Age is compared using two-sided unpaired sample t-tests. All other demographics are compared using two-sided Mann-Whitney U tests. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Age	ref.	0.990	0.940	0.930
Gender:	ref.	0.680	0.220	0.830
Income USD:	ref.	0.670	0.800	0.340
Education:	ref.	0.190	0.670	0.140
Occupation:	ref.	0.650	0.650	0.710
Political Leaning:	ref.	0.790	0.030*	0.000***
Age		ref.	0.950	0.910
Gender:		ref.	0.410	0.850
Income USD:		ref.	0.860	0.170
Education:		ref.	0.400	0.000**
Occupation:		ref.	0.350	0.390
Political Leaning:		ref.	0.050	0.000**
Age			ref.	0.870
Gender:			ref.	0.310
Income USD:			ref.	0.230
Education:			ref.	0.060
Occupation:			ref.	0.940
Political Leaning:			ref.	0.230

Table B4: Pairwise comparisons of success rates (one-sided unpaired sample proportion tests) across treatments. Values not in parentheses or brackets correspond to success rates of the respective row. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). Values in parentheses indicate p-values. Values in brackets indicate non-directional Cohen's h values. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 130$	$n = 134$	$n = 131$	$n = 133$
Baseline		0.777 [0.072]	0.777 [0.119]	0.777 [0.488]
Tax	0.746 (0.670)		0.746 [0.191]	0.746 [0.560]
Symmetric	0.824 (0.210)	0.824 (0.081)		0.824 [0.369]
Asymmetric	0.940*** (0.000)	0.940*** (0.000)	0.940** (0.003)	

Table B5: Pairwise comparisons of aggregate group consumption (one-sided unpaired sample t-tests) across treatments. Values not in parentheses or brackets correspond to aggregate group consumption of the respective row. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). Values in parentheses indicate p-values. Values in brackets indicate Cohen's d values. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 130$	$n = 134$	$n = 131$	$n = 133$
Baseline		80.462 [0.033]	80.462 [0.262]	80.462 [1.263]
Tax	80.134 (0.396)		80.134 [0.250]	80.134 [1.329]
Symmetric	77.542* (0.018)	77.542* (0.022)		77.542 [0.976]
Asymmetric	66.406*** (0.000)	66.406*** (0.000)	66.406*** (0.000)	

Table B6: Group level averages (mean) of success rates, aggregate group consumption, and payoffs for each treatment. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). The variable "Time" indicates the average time participants spent in the experiment in minutes and "Payoff" denotes the average payoff participants received GBP. n indicates the number of observations.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 130$	$n = 134$	$n = 131$	$n = 133$
Success Rate	0.777	0.746	0.824	0.940
Consumption	80.462	80.134	77.542	66.406
Time	18.644	20.814	20.187	20.970
Payoff	5.873	5.846	5.797	5.611

Table B7: Two-sided Mann-Whitney U tests of participant responses to survey items on their decision making process (see Figure A19 for details) pairwise compared across treatments. For the individual survey items values are given in scores. For the additional questions values are given in proportions. Reference values are in parentheses. Scores are based on the weighted averages values of the responses. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 520$	$n = 536$	$n = 524$	$n = 532$
Individual Survey Items:				
Item 1	(4.455)	4.524	4.562*	4.618**
Item 2	(2.789)	2.642	2.612*	2.597*
Item 1		(4.524)	4.562	4.618**
Item 2		(2.642)	2.612	2.597
Item 1			(4.562)	4.618
Item 2			(2.612)	2.597

Item 1: It was very important to me that the group did not surpass the critical consumption threshold.
Item 2: I was willing to sacrifice consumption only when other players did so.

Table B8: Two-sided Mann-Whitney U tests of policy attitude survey items (see Figure A20 for details) pairwise compared across treatments. For the individual survey items values are given in scores. For the additional questions values are given in proportions. Reference values are in parentheses. Scores are based on the weighted averages values of the responses. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Individual Survey Items:				
Item Taxes 1	(3.634)	3.743	3.675	3.754
Item Taxes 2	(3.539)	3.644	3.549	3.677
Item Taxes 3	(3.591)	3.627	3.610	3.660
Item Taxes 4	(3.072)	3.180	3.203*	3.197*
Item Dividends 1	(3.636)	3.699	3.681	3.849**
Item Dividends 2	(3.616)	3.654	3.610	3.749*
Item Dividends 3	(3.655)	3.663	3.656	3.790*
Item Dividends 4	(3.312)	3.384	3.358	3.374
Item Taxes 1		(3.743)	3.675	3.754
Item Taxes 2		(3.644)	3.549	3.677
Item Taxes 3		(3.627)	3.610	3.660
Item Taxes 4		(3.180)	3.203	3.197
Item Dividends 1		(3.699)	3.681	3.849*
Item Dividends 2		(3.654)	3.610	3.749
Item Dividends 3		(3.663)	3.656	3.790
Item Dividends 4		(3.384)	3.358	3.374
Item Taxes 1			(3.743)	3.754
Item Taxes 2			(3.644)	3.677
Item Taxes 3			(3.627)	3.660
Item Taxes 4			(3.180)	3.197
Item Dividends 1			(3.699)	3.849*
Item Dividends 2			(3.654)	3.749*
Item Dividends 3			(3.663)	3.790
Item Dividends 4			(3.384)	3.374

To be continued on next page.

Continued from Table B8.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Additional Question:				
Response Symmetric	(0.380)	0.380	0.375	0.325
Response Asymmetric	(0.432)	0.453	0.447	0.541***
Response Neither	(0.188)	0.167	0.178	0.134*
Response Symmetric		(0.380)	0.375	0.325
Response Asymmetric		(0.453)	0.447	0.541**
Response Neither		(0.167)	0.178	0.134
Response Symmetric			(0.375)	0.325
Response Asymmetric			(0.447)	0.541**
Response Neither			(0.178)	0.134

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.
Additional Question: Which type of carbon dividend, if any, would you be more likely to support?
Response Symmetric: Symmetric dividend (equal distribution of carbon taxes)
Response Asymmetric: Asymmetric dividend (distribution of carbon taxes only among below-average carbon emitters)
Response Neither: Neither

Table B9: Validated *Resistance to Change-Beliefs Scale* and *New Environmental Paradigm* scores (see Figures A22 and A23 for details) for each treatment. Scores are based on the weighted averages values of the responses (items coded in reverse are considered accordingly). n indicates the number of observations.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Resistance to Change-Beliefs Scale	3.344	3.365	3.336	3.347
New Environmental Paradigm	3.000	3.018	3.017	2.919

Table B10: Univariate logistic regression of participant success rates on RC-B scores. Success rates are based on the proportions of groups who did not surpass the threshold after all 10 rounds were played ($success = 1$). Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Success Rate $n = 2102$
Resistance to Change-Beliefs Scale	0.864* (0.071)
Constant	7.206*** (0.243)

Table B11: Univariate logistic regression of participant success rates on *New Environmental Paradigm* scores. Success rates are based on the proportions of groups who did not surpass the threshold after all 10 rounds were played ($success = 1$). Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Success Rate $n = 2100$
New Environmental Paradigm	1.277** (0.085)
Constant	1.707 (0.365)

Table B12: Logistic regression of group success rates on treatment dummies. Success rates are based on the proportions of groups who did not surpass the threshold after all 10 rounds were played ($success = 1$). Values not in parentheses are reported as odds ratios. Standard errors are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Success Rate $n = 528$
Tax	0.844
	(0.290)
Symmetric	1.348
	(0.312)
Asymmetric	4.486***
	(0.421)
Constant	3.483***
	(0.211)

Table B13: Multivariate logistic regression of participant success rates on demographics. Categories with the majority of responses are chosen to be covered in the constant: *Education:* 6 ("Professional degree"), *Gender:* 1 ("Male"), *Income:* 4 ("70,000 or more"), *Occupation:* 1 ("Employed"), *Policies:* 2 ("Asymmetric dividend"), *Policital Leaning:* 2 ("Democrat"), *Binary Makers:* 2 ("Yes"). Success rates are based on the proportions of groups who did not surpass the threshold after all 10 rounds were played ($success = 1$). Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Success Rate $n = 2100$
Age	0.997 (0.006)
Education:	
None	>99.999*** (0.878)
Primary	2.393 (1.088)
Associates degree	0.776 (0.147)
Bachelor's degree	1.022 (0.203)
Master's degree	0.850 (0.415)
Doctorate degree	0.992 (0.189)
I prefer not to tell	0.790 (0.417)
Gender:	
Female	1.385** (0.127)
Non-binary	2.109 (0.528)
Other	0.321 (0.969)
I prefer not to tell	>99.999*** (0.569)
Constant	5.759*** (0.331)

To be continued on next page.

Continued from Table B13.

	Success Rate $n = 2100$
Income USD:	
less than 50,000	0.813 (0.152)
50,000 to 59,999	0.737 (0.204)
60,000 to 69,999	0.943 (0.231)
I prefer not to tell	0.693 (0.422)
Occupation:	
Self-employed / Freelance	1.243 (0.193)
Unemployed	0.893 (0.187)
Retired	1.194 (0.273)
Student	1.102 (0.286)
I prefer not to tell	0.995 (0.363)
Policies:	
Symmetric dividend	1.002 (0.130)
Neither	0.774 (0.170)
Political Leaning:	
Republican	0.979 (0.157)
Other	0.970 (0.147)
Good Explanation: No	0.735 (0.266)
Informed Decision: No	0.510* (0.291)
Understood Game: No	0.778 (0.352)
Time Control	*Yes*

Table B14: Univariate ordered logistic regression of policy attitude survey items (see Figure A20 for item descriptions) on *Resistance to Change-Beliefs Scale* scores. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Item Taxes 1 $n = 2102$	*Item Taxes 2* $n = 2102$	*Item Taxes 3* $n = 2102$	*Item Taxes 4* $n = 2102$	*Item Dividends 1* $n = 2102$	*Item Dividends 2* $n = 2102$	*Item Taxes Dividends 3* $n = 2102$	*Item Dividends 4* $n = 2102$
Resistance to Change-Beliefs Scale	1.062	1.052	1.073	1.014	1.119*	1.134*	1.077	1.051
	(0.051)	(0.051)	(0.052)	(0.050)	(0.052)	(0.050)	(0.050)	(0.051)

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.

Table B15: Univariate ordered logistic regression of policy attitude survey items (see Figure A20 for item descriptions) on *New Environmental Paradigm* scores. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Item Taxes 1 $n = 2100$	*Item Taxes 2* $n = 2100$	*Item Taxes 3* $n = 2100$	*Item Taxes 4* $n = 2100$	*Item Dividends 1* $n = 2100$	*Item Dividends 2* $n = 2100$	*Item Taxes Dividends 3* $n = 2100$	*Item Dividends 4* $n = 2100$
New Environmental Paradigm	0.998	0.977	0.979	1.076	0.996	0.929	0.957	0.985
	(0.059)	(0.057)	(0.059)	(0.057)	(0.060)	(0.062)	(0.059)	(0.056)

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.

Table B16: Multivariate ordered logistic regression of policy attitude survey items (see Figure A20 for item descriptions) on demographics. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Item Taxes 1 $n = 2102$	*Item Taxes 2* $n = 2102$	*Item Taxes 3* $n = 2102$	*Item Taxes 4* $n = 2102$	*Item Dividends 1* $n = 2102$	*Item Dividends 2* $n = 2102$	*Item Dividends 3* $n = 2102$	*Item Dividends 4* $n = 2102$
Age	0.983***	0.985***	0.985***	0.988***	0.985***	0.986***	0.987***	0.988***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Education:								
None	>99.999***	2.961	2.553	0.141***	>99.999***	>99.999***	2.066	2.494
	(0.000)	(1.189)	(1.240)	(0.125)	(0.000)	(0.000)	(1.257)	(2.297)
Primary / elementary school	1.084	0.807	0.741	0.215***	3.477*	1.736	1.597	0.389*
	(0.654)	(0.514)	(0.504)	(0.393)	(0.549)	(0.670)	(0.602)	(0.458)
Associates degree	0.942	0.837	0.855	0.968	1.015	0.924	0.956	0.949
	(0.105)	(0.106)	(0.104)	(0.103)	(0.108)	(0.105)	(0.108)	(0.108)
Bachelor's degree	0.944	0.809	0.853	0.862	0.798	0.793	0.793	0.886
	(0.140)	(0.129)	(0.142)	(0.138)	(0.136)	(0.133)	(0.139)	(0.138)
Master's degree	1.205	0.917	0.938	0.808	1.467	1.283	1.117	0.742
	(0.247)	(0.280)	(0.265)	(0.268)	(0.256)	(0.245)	(0.263)	(0.239)
Doctorate degree	1.139	0.995	0.955	1.066	1.113	1.043	1.055	0.995
	(0.118)	(0.130)	(0.123)	(0.122)	(0.122)	(0.123)	(0.120)	(0.122)
I prefer not to tell	1.551	1.230	1.414	1.197	1.218	0.878	1.325	1.224
	(0.323)	(0.271)	(0.262)	(0.295)	(0.276)	(0.229)	(0.265)	(0.276)
Gender:								
Female	0.855	0.965	0.948	0.763**	0.824*	0.871	0.850*	0.686***
	(0.083)	(0.081)	(0.083)	(0.084)	(0.084)	(0.083)	(0.082)	(0.081)
Non-binary	1.619	1.963	2.420*	1.123	1.231	1.565	1.220	1.080
	(0.307)	(0.424)	(0.389)	(0.259)	(0.325)	(0.351)	(0.352)	(0.261)
Other	3.372	3.689	3.422	6.556	1.121	2.369	2.358	4.568***
	(1.024)	(0.956)	(0.977)	(1.024)	(0.907)	(0.478)	(0.513)	(0.449)
I prefer not to tell	1.410	0.736	0.734	0.746	0.359	0.377	0.303*	0.412
	(1.086)	(0.833)	(0.770)	(0.778)	(0.603)	(0.773)	(0.514)	(0.546)
Income:								
less than USD 50,000	0.816*	0.906	0.868	0.877	0.861	0.907	0.943	0.845
	(0.103)	(0.098)	(0.100)	(0.102)	(0.095)	(0.096)	(0.095)	(0.096)
USD 50,000 to USD 59,999	0.899	0.984	0.860	1.119	0.952	0.940	0.952	1.064
	(0.141)	(0.141)	(0.139)	(0.140)	(0.143)	(0.142)	(0.144)	(0.135)
USD 60,000 to USD 69,999	0.721*	0.772	0.732	0.727*	0.820	0.888	0.866	0.714*
	(0.153)	(0.156)	(0.170)	(0.147)	(0.157)	(0.149)	(0.154)	(0.145)
I prefer not to tell	0.473**	0.503*	0.411**	0.464**	0.478**	0.570	0.398***	0.390***
	(0.254)	(0.280)	(0.290)	(0.293)	(0.264)	(0.289)	(0.279)	(0.281)

To be continued on next page.

Continued from Table B16.

	Item Taxes 1 $n = 2102$	*Item Taxes 2* $n = 2102$	*Item Taxes 3* $n = 2102$	*Item Taxes 4* $n = 2102$	*Item Dividends 1* $n = 2102$	*Item Dividends 2* $n = 2102$	*Item Dividends 3* $n = 2102$	*Item Dividends 4* $n = 2102$
Occupation:								
Self-employed / Freelance	0.792	0.816	0.770	0.826	0.998	0.950	1.003	1.028
	(0.139)	(0.143)	(0.134)	(0.126)	(0.139)	(0.146)	(0.140)	(0.131)
Unemployed	0.913	0.827	0.888	0.692**	1.116	0.992	1.058	0.799
	(0.129)	(0.123)	(0.126)	(0.131)	(0.130)	(0.119)	(0.126)	(0.127)
Retired	1.220	1.120	0.964	1.086	1.348	1.042	0.989	1.320
	(0.219)	(0.213)	(0.222)	(0.213)	(0.220)	(0.218)	(0.227)	(0.204)
Student	1.037	1.047	1.113	0.947	0.912	1.005	0.882	0.775
	(0.175)	(0.172)	(0.173)	(0.179)	(0.176)	(0.161)	(0.160)	(0.174)
I prefer not to tell	0.758	0.689	0.769	0.879	0.732	0.631	0.669	0.649
	(0.243)	(0.242)	(0.261)	(0.241)	(0.273)	(0.273)	(0.267)	(0.233)
Political Leaning:								
Republican	0.285***	0.245***	0.183***	0.509***	0.315***	0.266***	0.217***	0.516***
	(0.117)	(0.117)	(0.118)	(0.112)	(0.110)	(0.116)	(0.121)	(0.109)
Other	0.375***	0.345***	0.319***	0.681***	0.404***	0.372***	0.331***	0.605***
	(0.104)	(0.106)	(0.103)	(0.102)	(0.107)	(0.102)	(0.105)	(0.102)

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.

Table B17: Multivariate ordered logistic regression of policy attitude survey items (see Figure A20 for item descriptions) on treatments, political leaning, and their interactions. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Item Taxes 1 $n = 2102$	*Item Taxes 2* $n = 2102$	*Item Taxes 3* $n = 2102$	*Item Taxes 4* $n = 2102$	*Item Dividends 1* $n = 2102$	*Item Dividends 2* $n = 2102$	*Item Taxes Dividends 3* $n = 2102$	*Item Dividends 4* $n = 2102$
Treatment:								
Tax	1.068	1.090	1.055	1.081	0.995	1.042	0.927	0.999
	(0.147)	(0.144)	(0.150)	(0.153)	(0.142)	(0.149)	(0.141)	(0.143)
Symmetric	1.019	0.999	1.100	1.260	1.068	0.905	0.948	1.080
	(0.152)	(0.142)	(0.147)	(0.140)	(0.151)	(0.148)	(0.148)	(0.140)
Asymmetric	1.060	1.170	1.097	1.303	1.413*	1.313*	1.364*	1.215
	(0.143)	(0.141)	(0.141)	(0.146)	(0.142)	(0.138)	(0.140)	(0.146)
Political Leaning:								
Republican	0.221***	0.204***	0.187***	0.508***	0.251***	0.231***	0.194***	0.483***
	(0.210)	(0.216)	(0.221)	(0.191)	(0.208)	(0.202)	(0.207)	(0.185)
Other	0.300***	0.304***	0.298***	0.640	0.367***	0.338***	0.297***	0.643
	(0.238)	(0.215)	(0.222)	(0.244)	(0.236)	(0.206)	(0.229)	(0.238)
Interactions:								
Tax:Republican	1.607	1.427	1.147	1.271	1.469	1.196	1.499	1.377
	(0.288)	(0.298)	(0.302)	(0.301)	(0.270)	(0.281)	(0.283)	(0.273)
Asymmetric:Republican	1.379	1.125	0.786	0.915	1.279	0.875	0.684	0.766
	(0.330)	(0.314)	(0.314)	(0.294)	(0.339)	(0.314)	(0.322)	(0.296)
Symmetric:Republican	1.137	1.129	0.881	0.926	1.239	1.378	1.302	1.276
	(0.320)	(0.322)	(0.321)	(0.303)	(0.303)	(0.321)	(0.319)	(0.307)
Tax:Other	1.233	1.231	1.019	1.365	1.234	1.119	1.200	1.286
	(0.325)	(0.335)	(0.328)	(0.318)	(0.343)	(0.325)	(0.334)	(0.319)
Asymmetric:Other	1.455	1.178	1.227	0.931	0.986	0.993	1.009	0.842
	(0.293)	(0.279)	(0.279)	(0.302)	(0.290)	(0.260)	(0.283)	(0.303)
Symmetric:Other	1.260	1.090	1.012	1.078	1.114	1.240	1.222	0.863
	(0.313)	(0.294)	(0.300)	(0.314)	(0.315)	(0.292)	(0.311)	(0.306)

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.

Table B18: Multivariate ordered logistic regression of individual consumption across all 10 rounds on demographics. Available consumption choices in all rounds were 0, 2, or 4 units. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Round 1 $n = 2100$	*Round 2* $n = 2100$	*Round 3* $n = 2100$	*Round 4* $n = 2100$	*Round 5* $n = 2100$	*Round 6* $n = 2100$	*Round 7* $n = 2100$	*Round 8* $n = 2100$	*Round 9* $n = 2100$	*Round 10* $n = 2100$
Age	0.981***	0.993	0.987***	0.992*	0.992*	0.992*	0.996	0.995	0.996	1.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Education:										
None	0.187	0.272	0.248	0.300	0.273	0.302	0.305	0.377	0.532	1.031
	(1.390)	(1.360)	(1.346)	(1.344)	(1.338)	(1.333)	(1.323)	(1.316)	(1.291)	(1.276)
Primary / elementary school	0.393	0.917	0.991	2.498	1.157	0.670	0.690	1.937	0.975	0.371
	(0.607)	(0.543)	(0.585)	(0.560)	(0.534)	(0.538)	(0.529)	(0.576)	(0.525)	(0.667)
Associates degree	1.303*	0.985	0.995	1.207	1.159	1.010	1.111	0.996	1.000	0.951
	(0.125)	(0.115)	(0.111)	(0.111)	(0.111)	(0.110)	(0.109)	(0.108)	(0.106)	(0.110)
Bachelor's degree	1.276	0.872	0.941	1.201	0.819	0.854	1.015	0.943	0.867	0.921
	(0.157)	(0.144)	(0.141)	(0.140)	(0.141)	(0.138)	(0.137)	(0.134)	(0.135)	(0.139)
Master's degree	1.519	1.166	1.237	1.325	1.388	1.430	0.977	1.064	1.155	1.011
	(0.341)	(0.303)	(0.295)	(0.295)	(0.301)	(0.295)	(0.296)	(0.291)	(0.284)	(0.310)
Doctorate degree	1.258	1.229	1.148	1.022	0.955	1.027	1.033	1.015	1.049	0.996
	(0.149)	(0.136)	(0.133)	(0.132)	(0.131)	(0.132)	(0.129)	(0.129)	(0.127)	(0.130)
I prefer not to tell	1.200	1.159	1.826	1.832	1.338	1.341	1.232	0.874	0.786	0.598
	(0.364)	(0.315)	(0.321)	(0.326)	(0.311)	(0.311)	(0.304)	(0.305)	(0.309)	(0.334)
Gender:										
Female	0.682***	0.591***	0.697***	0.705***	0.624***	0.691***	0.786**	0.809*	0.951	0.909
	(0.100)	(0.092)	(0.089)	(0.089)	(0.088)	(0.088)	(0.086)	(0.086)	(0.085)	(0.087)
Non-binary	0.597	0.505*	0.476*	0.435*	0.504*	0.754	0.519*	0.920	1.259	0.948
	(0.372)	(0.340)	(0.330)	(0.331)	(0.326)	(0.327)	(0.323)	(0.323)	(0.313)	(0.331)
Other	0.139*	0.892	1.819	1.522	0.693	0.438	0.957	1.115	0.655	0.633
	(0.984)	(0.930)	(0.908)	(0.811)	(0.849)	(0.790)	(0.833)	(0.905)	(0.784)	(0.870)
I prefer not to tell	0.164*	0.702	0.350	1.784	0.256	0.726	1.090	1.073	1.758	1.044
	(0.844)	(0.840)	(0.762)	(0.783)	(0.858)	(0.786)	(0.739)	(0.781)	(0.805)	(0.717)
Income:										
less than USD 50,000	1.073	0.891	1.290*	1.069	1.008	1.044	0.960	1.068	1.057	1.103
	(0.117)	(0.108)	(0.105)	(0.104)	(0.104)	(0.103)	(0.102)	(0.102)	(0.100)	(0.104)
USD 50,000 to USD 59,999	1.455*	1.135	1.135	0.966	0.908	0.837	1.191	0.928	1.039	1.334*
	(0.163)	(0.149)	(0.147)	(0.146)	(0.145)	(0.144)	(0.142)	(0.142)	(0.139)	(0.144)
USD 60,000 to USD 69,999	1.198	0.989	1.165	0.989	0.890	0.800	1.041	0.907	1.230	1.406*
	(0.175)	(0.161)	(0.157)	(0.154)	(0.154)	(0.156)	(0.151)	(0.149)	(0.150)	(0.149)
I prefer not to tell	1.955*	1.680	2.024*	1.466	1.201	1.572	1.353	0.681	0.894	1.682
	(0.335)	(0.328)	(0.304)	(0.317)	(0.310)	(0.296)	(0.299)	(0.297)	(0.295)	(0.299)

To be continued on next page.

Continued from Table B18.

	Round 1 $n = 2100$	*Round 2* $n = 2100$	*Round 3* $n = 2100$	*Round 4* $n = 2100$	*Round 5* $n = 2100$	*Round 6* $n = 2100$	*Round 7* $n = 2100$	*Round 8* $n = 2100$	*Round 9* $n = 2100$	*Round 10* $n = 2100$
Occupation:										
Self-employed / Freelance	0.964	0.815	0.974	0.788	0.749*	0.784	0.799	0.876	0.847	0.911
	(0.147)	(0.135)	(0.132)	(0.131)	(0.131)	(0.131)	(0.129)	(0.127)	(0.127)	(0.131)
Unemployed	0.696*	0.784	0.697*	0.783	0.717*	0.612***	0.910	0.750*	0.838	0.745*
	(0.161)	(0.148)	(0.143)	(0.144)	(0.143)	(0.142)	(0.138)	(0.140)	(0.137)	(0.146)
Retired	1.085	0.688	0.884	0.735	0.592*	0.708	0.959	0.796	0.789	1.043
	(0.244)	(0.219)	(0.220)	(0.218)	(0.214)	(0.213)	(0.214)	(0.208)	(0.208)	(0.212)
Student	0.941	1.026	0.496***	0.770	0.654*	0.888	0.616*	0.911	1.100	1.223
	(0.228)	(0.207)	(0.202)	(0.198)	(0.199)	(0.196)	(0.193)	(0.192)	(0.189)	(0.192)
I prefer not to tell	0.709	0.977	0.670	0.638	0.847	0.648	0.774	0.716	0.873	0.560
	(0.314)	(0.305)	(0.288)	(0.285)	(0.282)	(0.276)	(0.279)	(0.275)	(0.270)	(0.304)
Political Leaning:										
Republican	1.097	1.145	1.221	1.483***	1.287*	1.218	1.337**	1.274*	1.185	1.020
	(0.125)	(0.115)	(0.112)	(0.111)	(0.111)	(0.110)	(0.109)	(0.108)	(0.106)	(0.110)
Other	0.834	0.817	0.843	1.031	1.149	1.123	1.056	1.135	0.911	1.039
	(0.121)	(0.110)	(0.108)	(0.107)	(0.107)	(0.106)	(0.105)	(0.104)	(0.102)	(0.105)

Table B19: Multivariate ordered logistic regression of individual consumption across all 10 rounds on treatments, political leaning, and their interactions. Available consumption choices in all rounds were 0, 2, or 4 units. Values not in parentheses are reported as odds ratios. Standard errors, clustered on group level, are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Round 1 $n = 2100$	*Round 2* $n = 2100$	*Round 3* $n = 2100$	*Round 4* $n = 2100$	*Round 5* $n = 2100$	*Round 6* $n = 2100$	*Round 7* $n = 2100$	*Round 8* $n = 2100$	*Round 9* $n = 2100$	*Round 10* $n = 2100$
Treatment:										
Tax	0.776	0.788	1.022	0.935	1.100	0.978	1.076	0.854	1.100	0.855
	(0.175)	(0.163)	(0.157)	(0.157)	(0.155)	(0.153)	(0.153)	(0.152)	(0.151)	(0.158)
Asymmetric	0.349***	0.274***	0.365***	0.423***	0.405***	0.437***	0.570***	0.659**	1.011	1.120
	(0.179)	(0.167)	(0.161)	(0.161)	(0.158)	(0.158)	(0.157)	(0.153)	(0.152)	(0.157)
Symmetric	0.449***	0.633**	0.728*	0.694*	1.089	0.808	0.881	1.060	1.019	0.946
	(0.180)	(0.166)	(0.160)	(0.160)	(0.157)	(0.155)	(0.155)	(0.154)	(0.153)	(0.159)
Political Leaning:										
Republican	0.973	0.939	1.188	1.229	1.404	1.226	1.397	0.989	0.825	1.200
	(0.235)	(0.215)	(0.209)	(0.206)	(0.207)	(0.206)	(0.207)	(0.202)	(0.200)	(0.207)
Other	0.913	0.801	0.758	0.912	1.319	0.926	1.005	0.913	0.713	0.699
	(0.253)	(0.233)	(0.225)	(0.230)	(0.222)	(0.222)	(0.221)	(0.221)	(0.215)	(0.232)
Interactions:										
Tax:Republican	0.803	1.422	0.831	1.163	0.643	0.760	0.753	1.278	1.177	0.901
	(0.333)	(0.305)	(0.298)	(0.293)	(0.291)	(0.289)	(0.288)	(0.288)	(0.282)	(0.295)
Asymmetric:Republican	1.212	1.050	0.993	1.337	1.398	1.049	1.097	1.706	1.950*	0.779
	(0.351)	(0.326)	(0.318)	(0.320)	(0.319)	(0.319)	(0.314)	(0.305)	(0.303)	(0.306)
Symmetric:Republican	1.520	1.106	1.076	1.259	0.775	1.018	1.130	1.284	1.855*	0.797
	(0.344)	(0.315)	(0.307)	(0.299)	(0.302)	(0.297)	(0.298)	(0.294)	(0.286)	(0.300)
Tax:Other	0.800	1.292	1.308	1.078	0.968	1.157	0.990	1.486	1.184	1.386
	(0.358)	(0.325)	(0.315)	(0.317)	(0.312)	(0.310)	(0.306)	(0.305)	(0.300)	(0.321)
Asymmetric:Other	0.963	1.049	1.309	1.197	1.304	1.558	1.272	1.546	1.437	1.611
	(0.334)	(0.308)	(0.302)	(0.305)	(0.298)	(0.299)	(0.297)	(0.293)	(0.286)	(0.300)
Symmetric:Other	1.475	1.144	1.333	1.679	0.627	1.423	1.091	1.072	1.386	1.734
	(0.344)	(0.317)	(0.307)	(0.307)	(0.301)	(0.302)	(0.296)	(0.296)	(0.292)	(0.306)

Table B20: Two-sided Mann-Whitney U tests of policy attitude survey items (see Figure A20 for details) pairwise compared across treatments only for participants with *"Republican"* political leaning. For the individual survey items values are given in scores. For the additional question values are given in proportions. Reference values are in parentheses. Scores are based on the weighted averages values of the responses. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 119$	$n = 122$	$n = 107$	$n = 91$
Individual Survey Items:				
Item Taxes 1	(3.084)	3.393*	3.187	3.297
Item Taxes 2	(2.882)	3.148	2.963	3.077
Item Taxes 3	(2.882)	3.016	2.879	2.802
Item Taxes 4	(2.798)	2.975	2.897	2.901
Item Dividends 1	(3.109)	3.352	3.280	3.429*
Item Dividends 2	(3.017)	3.139	3.150	3.088
Item Dividends 3	(3.000)	3.189	3.103	2.934
Item Dividends 4	(3.000)	3.205	3.206	2.989
Item Taxes 1		(3.393)	3.187	3.297
Item Taxes 2		(3.148)	2.963	3.077
Item Taxes 3		(3.016)	2.879	2.802
Item Taxes 4		(2.975)	2.897	2.901
Item Dividends 1		(3.352)	3.280	3.429
Item Dividends 2		(3.139)	3.150	3.088
Item Dividends 3		(3.189)	3.103	2.934
Item Dividends 4		(3.205)	3.206	2.989
Item Taxes 1			(3.187)	3.297
Item Taxes 2			(2.963)	3.077
Item Taxes 3			(2.879)	2.802
Item Taxes 4			(2.897)	2.901
Item Dividends 1			(3.280)	3.429
Item Dividends 2			(3.150)	3.088
Item Dividends 3			(3.103)	2.934
Item Dividends 4			(3.206)	2.989

To be continued on next page.

Continued from Table B20.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Additional Question:				
Response Symmetric	(0.361)	0.393	0.308	0.275
Response Asymmetric	(0.319)	0.344	0.336	0.407
Response Neither	(0.319)	0.262	0.355	0.319
Response Symmetric		(0.393)	0.308	0.275
Response Asymmetric		(0.344)	0.336	0.407
Response Neither		(0.262)	0.355	0.319
Response Symmetric			(0.308)	0.275
Response Asymmetric			(0.336)	0.407
Response Neither			(0.355)	0.319

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.
Additional Question: Which type of carbon dividend, if any, would you be more likely to support?
Response Symmetric: Symmetric dividend (equal distribution of carbon taxes)
Response Asymmetric: Asymmetric dividend (distribution of carbon taxes only among below-average carbon emitters)
Response Neither: Neither

Table B21: Two-sided Mann-Whitney U tests of policy attitude survey items (see Figure A20 for details) pairwise compared across treatments only for participants with *"Democrat"* political leaning. For the individual survey items values are given in scores. For the additional question values are given in proportions. Reference values are in parentheses. Scores are based on the weighted averages values of the responses. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 298$	$n = 305$	$n = 283$	$n = 294$
Individual Survey Items:				
Item Taxes 1	(3.973)	3.990	3.972	3.997
Item Taxes 2	(3.926)	3.948	3.926	4.017
Item Taxes 3	(4.000)	4.000	4.042	4.044
Item Taxes 4	(3.225)	3.256	3.360	3.364
Item Dividends 1	(3.950)	3.931	3.943	4.116*
Item Dividends 2	(3.963)	3.967	3.912	4.102*
Item Dividends 3	(4.050)	3.977	4.004	4.201*
Item Dividends 4	(3.487)	3.469	3.505	3.578
Item Taxes 1		(3.990)	3.972	3.997
Item Taxes 2		(3.948)	3.926	4.017
Item Taxes 3		(4.000)	4.042	4.044
Item Taxes 4		(3.256)	3.360	3.364
Item Dividends 1		(3.931)	3.943	4.116*
Item Dividends 2		(3.967)	3.912	4.102
Item Dividends 3		(3.977)	4.004	4.201**
Item Dividends 4		(3.469)	3.505	3.578
Item Taxes 1			(3.972)	3.997
Item Taxes 2			(3.926)	4.017
Item Taxes 3			(4.042)	4.044
Item Taxes 4			(3.360)	3.364
Item Dividends 1			(3.943)	4.116
Item Dividends 2			(3.912)	4.102**
Item Dividends 3			(4.004)	4.201**
Item Dividends 4			(3.505)	3.578

To be continued on next page.

Continued from Table B21.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Additional Question:				
Response Symmetric	(0.396)	0.384	0.410	0.354
Response Asymmetric	(0.513)	0.531	0.519	0.588
Response Neither	(0.091)	0.085	0.071	0.058
Response Symmetric		(0.384)	0.410	0.354
Response Asymmetric		(0.531)	0.519	0.588
Response Neither		(0.085)	0.071	0.058
Response Symmetric			(0.410)	0.354
Response Asymmetric			(0.519)	0.588
Response Neither			(0.071)	0.058

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.
Additional Question: Which type of carbon dividend, if any, would you be more likely to support?
Response Symmetric: Symmetric dividend (equal distribution of carbon taxes)
Response Asymmetric: Asymmetric dividend (distribution of carbon taxes only among below-average carbon emitters)
Response Neither: Neither

Table B22: Two-sided Mann-Whitney U tests of policy attitude survey items (see Figure A20 for details) pairwise compared across treatments only for participants with *"Other"* political leaning. For the individual survey items values are given in scores. For the additional question values are given in proportions. Reference values are in parentheses. Scores are based on the weighted averages values of the responses. Responses to all items were given as values from from 1 to 5 corresponding to *Strongly disagree*, *Disagree*, *Unsure*, *Agree*, and *Strongly agree*. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Baseline	*Tax*	*Symmetric*	*Asymmetric*
	$n = 98$	$n = 106$	$n = 133$	$n = 144$
Individual Survey Items:				
Item Taxes 1	(0.351)	0.351	0.350	0.087
Item Taxes 2	(0.304)	0.304	0.736	0.183
Item Taxes 3	(0.797)	0.797	0.689	0.231
Item Taxes 4	(0.141)	0.141	0.249	0.446
Item Dividends 1	(0.526)	0.526	0.540	0.193
Item Dividends 2	(0.618)	0.618	0.692	0.271
Item Dividends 3	(0.723)	0.723	0.586	0.208
Item Dividends 4	(0.359)	0.359	0.822	0.944
Item Taxes 1		(0.946)	0.946	0.536
Item Taxes 2		(0.445)	0.445	0.944
Item Taxes 3		(0.904)	0.904	0.409
Item Taxes 4		(0.732)	0.732	0.395
Item Dividends 1		(0.944)	0.944	0.625
Item Dividends 2		(0.903)	0.903	0.685
Item Dividends 3		(0.847)	0.847	0.411
Item Dividends 4		(0.203)	0.203	0.321
Item Taxes 1			(0.399)	0.399
Item Taxes 2			(0.311)	0.311
Item Taxes 3			(0.423)	0.423
Item Taxes 4			(0.606)	0.606
Item Dividends 1			(0.490)	0.490
Item Dividends 2			(0.536)	0.536
Item Dividends 3			(0.452)	0.452
Item Dividends 4			(0.690)	0.690

To be continued on next page.

Continued from Table B22.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Additional Question:				
Response Symmetric	(0.357)	0.358	0.353	0.299
Response Asymmetric	(0.316)	0.349	0.383	0.528**
Response Neither	(0.327)	0.292	0.263	0.174**
Response Symmetric		(0.358)	0.353	0.299
Response Asymmetric		(0.349)	0.383	0.528**
Response Neither		(0.292)	0.263	0.174*
Response Symmetric			(0.353)	0.299
Response Asymmetric			(0.383)	0.528*
Response Neither			(0.263)	0.174

Item Taxes 1: I believe pricing carbon emissions through a carbon tax would help reduce carbon emissions.
Item Taxes 2: I consider pricing carbon emissions via a carbon tax to be a fair method of reducing carbon emissions.
Item Taxes 3: I would support pricing carbon emissions via a carbon tax.
Item Taxes 4: I believe other people in my community would support pricing carbon emissions via a carbon tax.
Item Dividends 1: I believe pricing carbon emissions through a carbon tax with a carbon dividend would help reduce carbon emissions.
Item Dividends 2: I consider pricing carbon emissions via a carbon tax and dividend to be a fair method of reducing carbon emissions.
Item Dividends 3: I would support pricing carbon emissions via a carbon tax and dividend.
Item Dividends 4: I believe other people in my community would support pricing carbon emissions via a carbon tax and dividend.
Additional Question: Which type of carbon dividend, if any, would you be more likely to support?
Response Symmetric: Symmetric dividend (equal distribution of carbon taxes)
Response Asymmetric: Asymmetric dividend (distribution of carbon taxes only among below-average carbon emitters)
Response Neither: Neither

Table B23: Relative frequencies of passive (automatically filled) decisions and positive responses to feedback questions (see Figure A25 for details) for each treatment. The *Baseline* condition implements neither carbon pricing nor revenue recycling. The *Tax* treatment introduces carbon pricing without revenue recycling. *Symmetric* applies both carbon pricing and symmetric revenue recycling within the group. *Asymmetric* also employs carbon pricing and revenue recycling, but distribution is equal only for consumers below the mean (asymmetric). n indicates the number of observations.

	Baseline $n = 520$	*Tax* $n = 536$	*Symmetric* $n = 524$	*Asymmetric* $n = 532$
Autofill	1.3%	1.2%	0.8%	1.4%
Good Explanation	98.1%	95.4%	95.8%	94.5%
Informed Decision	98.3%	95.3%	95.6%	94.5%
Understood Game	98.3%	96.6%	97.3%	96.0%

Table B24: Linear regression of *Resistance to Change-Beliefs Scale* scores on self-stated political leaning dummies. The category with the majority of responses ("Democrat") is chosen to be covered in the constant. Standard errors are provided in parentheses. n indicates the number of observations. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

	Resistance to Change-Beliefs Scale
	$n = 2100$
Republican	-0.036
	(0.044)
Other	-0.017
	(0.044)
Constant	2.988***
	(0.023)

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Sebastian Bachler, Sarah Lynn Flecke, Jürgen Huber, Michael Kirchler, Rene Schwaiger

Carbon Pricing, Carbon Dividends and Cooperation: Experimental Evidence

Abstract
Anthropogenic climate change is one of the most pressing global issues today and finding means of mitigation is of utmost importance. To this end, we investigate whether carbon taxes on their own and coupled with revenue recycling schemes (symmetric or asymmetric carbon dividends) improve cooperative behavior in a modified threshold public goods game of loss avoidance. We implement a randomized controlled trial on a large sample of the U.S. population and measure the portion of groups who successfully remain below a critical consumption threshold. We find that a carbon tax with symmetric dividends reduces harmful consumption levels, but coupling the tax with asymmetric dividends not only enhances consumption reduction but also significantly improves group cooperation in avoiding simulated climate change. Our results show that the application of a carbon tax and asymmetric carbon dividends reduces the failure rate to about one-fourth (6 %), compared to the 22 % observed in a baseline condition. We find that environmental attitudes, conservatism, education, and gender are significantly associated with success rates in staying below the threshold.

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