



Grant Agreement number: 101132559

Project acronym: ST4TE

Project title: Strategies for just and equitable transitions in Europe

Type of action: RIA

D3.2: Report on (i) the association between the consumption carbon footprint and income; ii) linking consumption carbon footprint and inequality

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Due date	30.6.2026
Actual submission date	30.9.2026
Dissemination Level	Public

Abstract: This document reports on Task 3.2 of the ST4TE project. This task is situated in WP3, which explores how existing inequalities interact with the drivers of the Twin Transition, leading to new cycles of inequality. Task 3.2 dissects the relation between income inequality and consumption carbon footprints (T3.2). This report (deliverable) consists of two parts, presented as individual papers. The first part analyses whether and through which mechanisms inequality shapes preferences for climate policies and climate behavior, which ultimately provides insights into the role of inequality in influencing household consumption decisions, and therefore their environmental impact. The second part explores the intricate relationship between consumption carbon footprints and income at the household level, leading to EU-wide quantitative evidence on how income inequality is related to emission footprint inequality, and the reduction of emissions over time, providing valuable insights into potential pathways for sustainable and equitable development.



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This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101132559.

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This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

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Overall Introduction

This deliverable consists of two separate parts:

The first part (“Say One Thing, Do Another? Inequality and the (Climate) Preference–Behavior Gap”) investigates whether and through which mechanisms inequality shapes preferences for climate policies and climate behavior. We address this question using observational data of Eurostat and the European Social Survey and by designing and implementing a large-scale online experiment (nearly 5,000 participants) across five European countries (France, Germany, Italy, Spain, and the United Kingdom). We show that the exposure to inequality increases support for green climate policies but decreases the willingness to take actions against climate change. Specifically, participants exposed to inequality are more in favour of introducing a flying tax and a green climate fund to finance clean energy in low-income countries, but they are less willing contribute individual time and effort toward the collective goal of environmental protection. This puzzle seems to be explained by the fact that inequality shapes these outcomes through different trajectories. For climate policy preferences, our findings show that participants exposed to inequality clearly identify the wealthy individuals and the government as responsible for environmental problems while also showing an increase in moral universalism. In contrast, for climate-related behaviour, mediators play a limited role, while inequality has a direct negative effect on the willingness to take action against climate change. Overall, these results have important policy implications, as rising disparities may influence the social foundations necessary for the design and implementation of effective climate action.

The second part (“Inequality and the emissions footprint: a European empirical perspective”) estimates the greenhouse gas emissions footprint of households in 17 countries in the European Union, for a selection of years 2010, 2015 and 2020. We find that households with higher income have higher per capita footprints, but lower per euro footprints. This means that the effect of per capita consumption expenditures dominate over the impact of the structure of spending on emissions. This results from the fact that low income households spend a larger part of their consumption budget on high emission goods and services, such as electricity. We also look at the changes of emission footprints, and find that for most of the cases (countries, years, income classes), footprints are reduced over the period 2010 – 2020. The largest reductions tend to be found for high income households. When we decompose the changes of emission footprints into three effects (changes of per capita consumption, changes in consumption structure, and changes in emission coefficients, i.e., emissions per euro spent on goods and services for a specific type), we find that the effect of emission coefficients dominates by far.



Part 1. Say One Thing, Do Another?**Inequality and the (Climate) Preference–Behavior Gap****Authors**

Bruno Martorano, Laura Metzger, Conrad Nunnenmacher and Chiara Proietti

Abstract: This paper investigates whether and through which mechanisms inequality shapes preferences for climate policies and climate behavior. We address this question using observational data of Eurostat and the European Social Survey and by designing and implementing a large-scale online experiment (nearly 5,000 participants) across five European countries (France, Germany, Italy, Spain, and the United Kingdom). We show that the exposure to inequality increases support for green climate policies but decreases the willingness to take actions against climate change. Specifically, participants exposed to inequality are more in favour of introducing a flying tax and a green climate fund to finance clean energy in low-income countries, but they are less willing contribute individual time and effort toward the collective goal of environmental protection. This puzzle seems to be explained by the fact that inequality shapes these outcomes through different trajectories. For climate policy preferences, our findings show that participants exposed to inequality clearly identify the wealthy individuals and the government as responsible for environmental problems while also showing an increase in moral universalism. In contrast, for climate-related behaviour, mediators play a limited role, while inequality has a direct negative effect on the willingness to take action against climate change. Overall, these results have important policy implications, as rising disparities may influence the social foundations necessary for the design and implementation of effective climate action.

Document Revision History

Date	Version	Author/Editor/Contributor	Summary of main changes / Status
30/07/2026	0.1	B. Martorano, L. Metzger, C. Nunnenmacher, C. Proietti	Draft



Part 1. Say One Thing, Do Another? Inequality and the (Climate) Preference–Behavior Gap

Executive summary

This paper investigates whether and through which mechanisms inequality shapes preferences for climate policies and climate behavior. We address this question using observational data of Eurostat and the European Social Survey and by designing and implementing a large-scale online experiment (nearly 5,000 participants) across five European countries (France, Germany, Italy, Spain, and the United Kingdom). We show that the exposure to inequality increases support for green climate policies but decreases the willingness to take actions against climate change. Specifically, participants exposed to inequality are more in favour of introducing a flying tax and a green climate fund to finance clean energy in low-income countries, but they are less willing contribute individual time and effort toward the collective goal of environmental protection. This puzzle seems to be explained by the fact that inequality shapes these outcomes through different trajectories. For climate policy preferences, our findings show that participants exposed to inequality clearly identify the wealthy individuals and the government as responsible for environmental problems while also showing an increase in moral universalism. In contrast, for climate-related behaviour, mediators play a limited role, while inequality has a direct negative effect on the willingness to take action against climate change. Overall, these results have important policy implications, as rising disparities may influence the social foundations necessary for the design and implementation of effective climate action.

1 Introduction

Inequality and the climate crisis stand out as two of the most urgent global challenges of our time (Chancel et al., 2025). Public narratives increasingly connect these challenges by framing the discussion in terms of the disproportionate responsibility of wealthy individuals and governments for environmental degradation. Such inequality-based narratives may influence the way in which people form and develop their preferences by altering perceptions of fairness and by shifting responsibility toward these specific groups. However, an important question remains: do these narratives also affect behavior and translate into a willingness to incur costly individual actions?

This paper investigates whether and how inequality shapes the preference–action gap and identifies the mechanisms through which it operates. Climate change provides a particularly useful context to examine this tension between preferences and behaviours because addressing it requires both collective policy responses and costly individual actions. Citizens may feel they are not responsible for climate change, believing that wealthier groups, whose lifestyles have a greater environmental impact, or the government, which should protect their citizens, should bear the primary responsibility. Recent evidence indeed confirms that progressive climate framing increases policy support. Douenne and Fabre (2022) and Sommer



et al. (2022) for example, use information treatments to expose participants to the distributional effects of climate policies and show that framing climate measures as progressive positively influences preferences for pro-environmental policies. Similarly, Dechezleprêtre et al. (2025) inform survey respondents across twenty countries about climate policies and their potential redistributive outcomes, reporting that policy support increases depending on the perceived impact on low-income households, the effectiveness of the policies in reducing emissions, and their effect on respondents' own households. D'Acunto et al. (2022) show that informing survey respondents about the unequal contributions of different groups to climate change affects policy support, particularly with respect to CO₂ taxation.

However, whether such mechanisms influence costly personal behavior in the same way they shape policy preferences remains unclear. The main issue is that addressing climate change constitutes a global public good that still involves individual costs. This implies that there might be other mechanisms explaining how inequality operates on individual behaviour. One prominent hypothesis, for instance, is that exposure to inequality makes coordinated efforts and the willingness to pursue shared objectives less likely. More generally, inequality may increase competitiveness, which can foster individualism, lower effort and undermine cooperation (Peters & Jetten, 2023; Sommet et al., 2024; Sommet & Elliot, 2023; Willis et al., 2022). An alternative hypothesis is that exposure to inequality shapes moral universalism, referring to the extent to which individuals apply the same moral concern to strangers as they do to members of their own group. Specifically, different social groups may also evaluate the costs of addressing the climate crisis through the lens of group identity. Some groups may perceive the relative costs of adopting green technologies, using environmentally friendly transport, or consuming climate-friendly food as disproportionately higher for their own group compared to others. Such perceptions can reinforce in-group favoritism, whereby individuals prioritize the interests of their own group over broader collective objectives.

Therefore, we set out to understand this connection by two means. First, we set the scene with observational data from EU-SILC and the European Social Survey, showcasing how inequality and climate preferences as well as personal attitudes toward climate change are correlated in the European Union. We demonstrate that that higher levels of inequality are connected with higher awareness of climate change and its consequences. It also lowers support for specific policies that can be perceived as burdening the broader population like taxes on fossil fuels. Even more importantly, we demonstrate that inequality seems strongly negatively correlated with a perceived personal responsibility for climate change. These findings point toward a gap between general attitude toward climate change and personal willingness to act.

To better understand whether and how inequality shapes this green preference–action gap, we design and implement a large-scale online experiment across five European countries (France, Germany, Italy, Spain, and the United Kingdom), using a representative sample of nearly 5,000 participants. The experiment exposes half of the participants to information treatments through a video highlighting societal inequality. The video presents key facts and showcase the different lifestyles patterns of the rich and working citizens illustrating the extent and consequences of inequality in our society. The purpose is to expose participants to the types of experiences, information, and public discussions that they and other citizens



encounter in their daily lives and have been exposed to in recent years. The remaining participants, serving as the control group, watch a video of similar length that explains the rules of playing checkers.

After watching the video, participants are asked to perform a number of tasks or to respond to a number of questions related to the mechanisms under consideration. In particular, we use survey questions to measure responsibility attribution for environmental degradation and moral universalism, and a traditional effort task to assess both effort and competitiveness among participants. After that, we measure how information on inequality shapes participants' preferences for green policies. Next, we elicit participants' willingness to sign a real petition asking government to take stronger measures against climate change, which we submitted to governments of the country involved in the study after the experiment. Lastly, respondents participate to a volunteering exercise, where they can spend additional time (without any remuneration) to perform an effort task with the purpose of gaining additional money to support the activity of an NGO working on climate change.

We find that exposure to inequality increases support for pro-environmental policies, but it decreases the willingness to take actions against climate change. Specifically, we show that the exposure to inequality increases support for very specific green climate policies, in particular for the introduction of a flying tax and a green climate fund to finance clean energy in low-income countries, two policies that can be considered progressive. On the other hand, participants in our treatment are less willing contribute time and effort toward the collective goal of environmental protection (in our case, by supporting an environmental NGO). This puzzle seems to be explained by the fact that inequality shapes these outcomes through different trajectories. Instead of observing a linear path from inequality to preferences to behaviour, we observe a more complex pattern. For climate policy preferences, our findings show that the impact of inequality is fully mediated by a number of factors. Participants exposed to inequality clearly identified the wealthy individuals and the government as responsible for environmental problems. The impact of inequality on green policy preferences is also mediated by changes in moral universalism. For climate-related behaviour, mediators play a limited role as inequality has a direct effect on the willingness to take action against climate change.

Our results make two main contributions. First, we contribute to the political economy literature examining the divergence between stated preferences and actual behavior. Much of the existing literature focuses on the intention–behavior gap and shows that intentions explain only a limited share of the variation in behavior across a wide range of contexts (Ajzen, 1991; Sheeran, 2002). In the context of climate change, existing studies similarly document that even strong concern about climate change often fails to translate into environmentally friendly actions (Kollmuss & Agyeman, 2002). This divergence is often attributed to factors such as perceived consumer effectiveness, trust as well as structural barriers such as higher prices, limited availability of green alternatives, or lack of information (Conner & Norman, 2022; Gifford, 2011). While these studies mainly examine the intention–behavior gap, which focuses on the relationship between individual intentions and subsequent actions, we focus on the preferences–behavior gap, which captures situations in which individuals express support for collective policies but remain reluctant to incur personal costs to support them. Making this distinction is particularly important in political economy because support for



green policies does not necessarily imply a willingness to bear the private costs associated with their implementation. Our study shows that exposure to inequality-based narratives shifts both climate policy preferences and climate behavior, but in opposite directions, which is mainly explained by the underlying factors linking inequality to these outcomes.

Our second contribution refers to the mechanisms through which inequality affect these alternative outcomes. While prior literature has mainly examined how perception of fairness or distributional consequences influence public support (see for example Dechezleprêtre et al. (2025)), our study emphasizes the role of responsibility attributions in mediating the causal effect of inequality on preferences for climate policies and the willingness to take actions against climate change. We also show that moral universalism functions as a mediating mechanism linking distributive narratives to policy demand. To our knowledge, the only study linking moral universalism and inequality is Cappelen et al. (2025), who report that universalist moral values are associated with stronger preferences for reducing inequality. In our study, inequality increases moral universalism. This response might be driven by the fact that inequality is problematized in our informational treatment, which breaks participants' identification with their in-group and force them to expand, rather than contract, moral concern toward strangers.

2 Correlating inequality and climate attitudes

Before turning to our experiment, we set the scene against which inequality may shape climate attitudes in Europe and provide observational evidence on how the two are related. Two parts of this background are central to our argument.

First, inequality has become an increasingly visible theme of European debate, often framed as contrast between a small group of wealthy individuals versus the rest of the population. In fact, wealth has grown on the top of the distribution, and this concentration has become more visible through discourse led by organisations such as Oxfam and a general increase in media coverage (Khalfan et al., 2023). A growing body of literature attempts to connect this concentration of wealth directly to the climate problem. The global top 1% is estimated to account for 15% of consumption-based emissions and 41% of emissions linked to their ownership of polluting assets (Chancel et al., 2025). At the same time, climate policy itself may further widen this gap, if returns of low carbon investments accrue with asset owners while the cost burden is shared by everyone.

Second, climate policy in Europe relies on measures, whose costs can be perceived as distributed unevenly. Broad measures such as carbon and fuel taxes have to be carried by a large segment of the population irrespective of their income. This regressivity can cause backlash as the French yellow vest movement has recently prominently shown (Douenne & Fabre, 2022). Other policies like taxes on air travel are specifically designed to target high emitters, which generally tends to increase their support in the broader population (D'Acunto et al., 2022). The distinction between those different types of policies is crucial to the understanding of the outcomes presented in the following.



To examine the relationship between income inequality and climate attitudes, we first use individual-level survey data from the 2016 European Social Survey (ESS), combined with sub-country-level income inequality data from Eurostat. The ESS is a cross-national survey that provides representative data on attitudes and policy preferences across Europe. The 2016 wave (round 8) includes 44,387 respondents across 23 European countries¹, and contains a dedicated section on welfare attitudes and attitudes to climate change. Individual responses are matched to sub-country-level inequality measures using the survey's geographical identifiers.

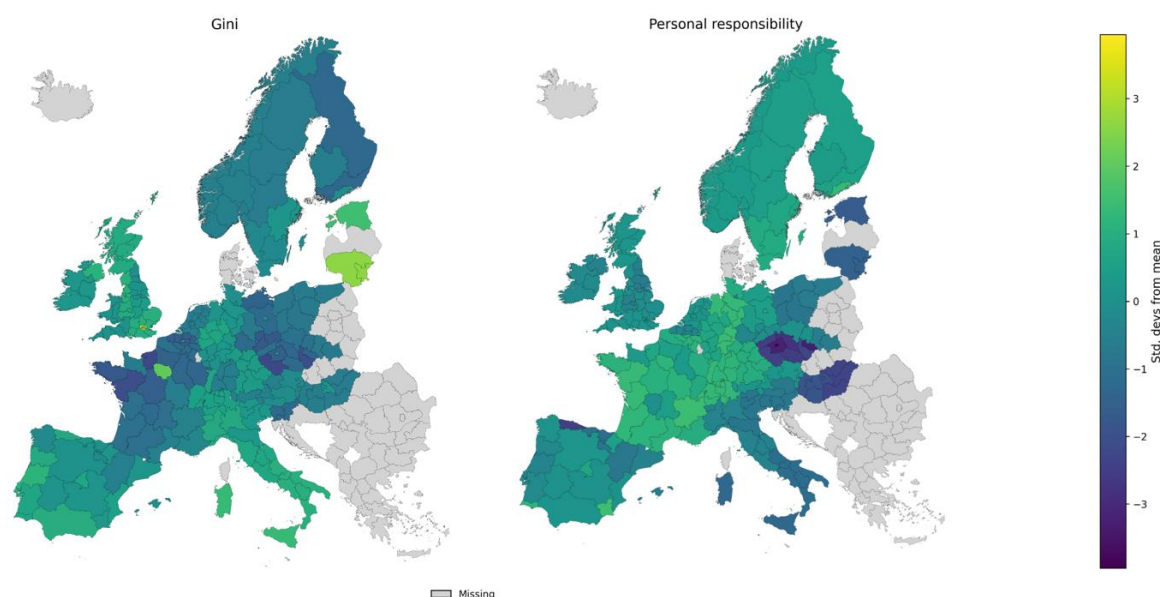
Income inequality is measured using the Gini coefficient, obtained from Eurostat data for the year 2022, that is based on harmonised microdata from the European Union Statistics on Income and Living Conditions (EU-SILC). The Gini coefficient is defined as “the relationship of cumulative shares of the population arranged according to the level of equivalised disposable income, to the cumulative share of the equivalised total disposable income received by them” (Eurostat, 2024). The indicator ranges from 0, perfect equality, to 1, perfect inequality, so that higher values indicate greater income inequality. To facilitate comparability across outcomes and easier interpretation of coefficients, the Gini index is standardised to have mean zero and unit standard deviation.

Figure 1 shows our first finding. Higher inequality levels in the EU are on average strongly negatively correlated with stated perceived responsibility for climate action. This means that the higher the inequality level is in a given state, the less the individuals feel personally responsible to act against climate change. There are also some significant regional patterns to highlight. Italy and the UK, for example, show a high level of inequality while indicating a comparably low level of perceived responsibility. Especially clear is the contrast in subregions like the London metropolitan region with stark levels of Gini and comparably low levels in perceived responsibility. France, in contrast, shows the opposite pattern. Lower levels of inequality and higher levels of perceived responsibility. The only region in light green, Île-de-France, is the most economic powerful region in France and an outlier to this pattern. In Spain, the overall pattern is less discernible, but hints at a slightly negative relationship, especially in the northern regions with higher responsibility and lower inequality. In Germany, the contrast is starkest in the former GDR, with high levels of inequality and comparably low levels of perceived responsibility. Taken together, this suggests a negative connection between inequality and personal perceived responsibility to tackle climate change in EU countries.

¹ Austria, Belgium, Czechia, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Russian Federation, Slovenia, Spain, Sweden, Switzerland, United Kingdom



Figure 1: Inequality level (Gini) and stated perceived responsibility for climate action



Notes: The figure shows two outcomes across the EU: the Gini coefficient on the left and the feeling of personal responsibility on the right. Both variables are standardised to have mean zero and unit standard deviation for comparability. Higher values are marked in brighter colours and indicate higher levels of inequality on the left map and higher levels of personal responsibility for fighting climate change on the right side. Lower levels, in contrast, are marked by darker colours. The personal responsibility information is drawn from the 2016 European Social Survey (ESS), measured at the individual level, and aggregated to the lowest possible NUTS-level up to NUTS-2. Income inequality is measured using the Gini coefficient based European Union Statistics on Income and Living Conditions (EU-SILC) data from the year 2022 (with two exceptions: For the UK, the most recent available data is from 2018. For Switzerland and France, the most recent data is from 2021) and aggregated to the lowest possible NUTS-level up to NUTS-2. Both variables are mapped on a NUTS2-level map from Eurostat, using NUTS2-granularity where available and alternatively NUTS1-level. For the Netherlands, only NUTS0-level data is available.

Besides personal responsibility, we have additional five additional indicators that can inform on the relationship of inequality and climate attitudes. We thus consider total of six measures from the ESS questionnaire that capture different dimensions of climate-related attitudes. These variables reflect individuals' perceptions of climate risk, attribution of responsibility for climate change, institutional expectations, and support for policy interventions.

Climate change worry is measured using the answer to the question "How worried are you about climate change?", with responses ranging from "not at all worried" to "extremely worried". Higher values indicate higher concern. The category climate change (natural causes) captures the beliefs about the causes of climate change by asking whether climate change is caused by natural processes, human activity, or both. Responses range from "entirely by natural processes" to "entirely by human activity", with higher values reflecting stronger attribution to human causes. Respondents who stated that they do not believe climate change is happening are reported as missing values and excluded from the analysis. The third variable, personal responsibility, measures to what extent individuals feel personally responsible for trying to reduce climate change. Responses are recorded on a 11-point scale



ranging from 0, “not at all”, to 10, “a great deal”, with higher values indicating stronger perceived personal responsibility. The variable of government taking action measures the perceived government effectiveness by asking whether individuals think that governments in enough countries will take action to address climate change. Responses range from “not likely at all” to “extremely likely”, with higher values indicating greater confidence in collective cross-country government action. The fifth variable measures the support for taxing fossil fuels and is measured using respondents’ level of support for increasing taxes on fossil fuels such as oil, gas, and coal. Responses range from “strongly in favour” to “strongly against” and is reverse-coded so that higher values indicate stronger support for taxation. Finally, support for subsidising renewable energy is measured by eliciting attitudes towards using public money to subsidise renewable energy sources such as wind and solar power. Responses follow the same scale and coding as the fossil fuel taxation variable, with higher values indicating greater support. All the variables from the ESS are standardised to have mean zero and unit standard deviation.

To assess the association between income inequality and climate attitudes, we estimate a series of linear regressions of the following form:

$$Y_{ic} = \beta_0 + \beta_1 \text{Gini}_c + \varepsilon_{ic}$$

Where Y_{ic} represents the standardised climate attitude outcome for individual i in country c , and Gini_c is the standardised coefficient measured at the country level. The coefficient β_1 captures the association between one standard deviation increase in income inequality and the corresponding change in climate attitude outcomes, expressed in standard deviation units. All regressions are estimated using survey probability weights.

Figure 2 summarises the estimated coefficients from the regressions. Results suggest that higher income inequality is positively associated with climate change concern and attribution to human cause. Specifically, a one standard deviation increase in the Gini coefficient is associated with a 0.033 standard deviation increase in climate change worry and a 0.023 standard deviation increase in the belief that climate change is driven by human activity rather than natural processes. This indicates that individuals living in more unequal states tend to express higher awareness of and concern about climate change as a human-induced phenomenon.

In contrast, higher income inequality is associated with less responsibility attribution and support for collective action. A one standard deviation increase in inequality is associated with a 0.013 standard deviation decrease in perceived personal responsibility for reducing climate change and a 0.006 standard deviation decrease in the perceived likelihood that governments will take sufficient action. While smaller in magnitude, these results remain statistically significant and may indicate systematically lower confidence in institutional capacity to address climate change in more unequal contexts.

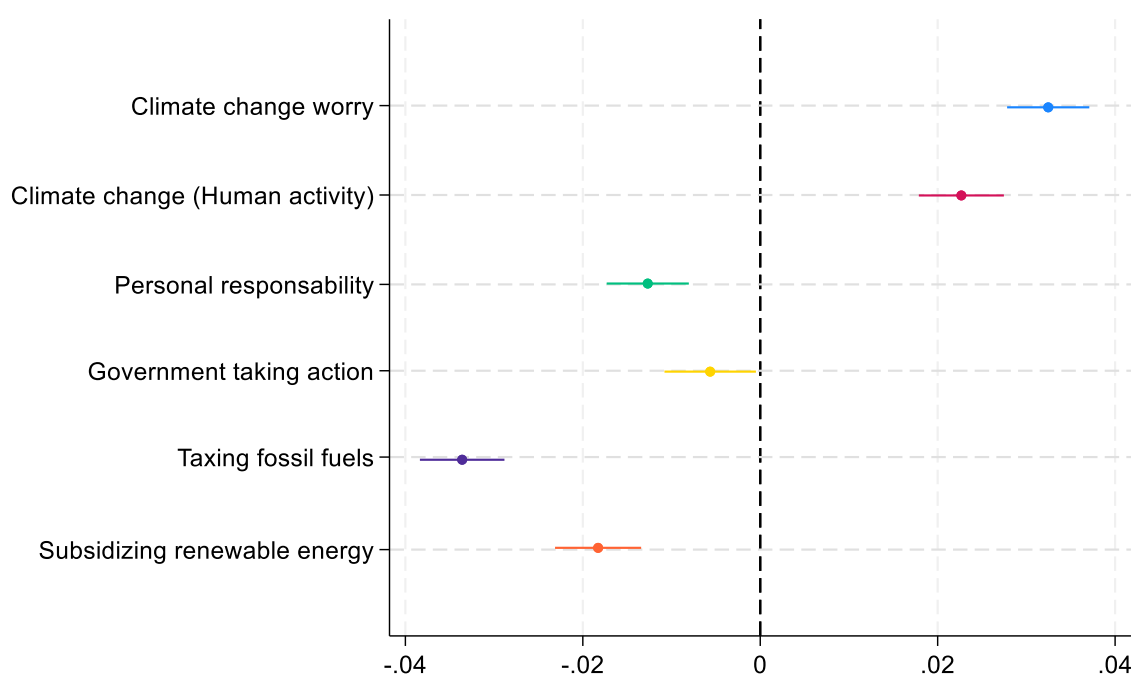
Similarly, income inequality is negatively associated with support for climate policy instruments. A one standard deviation increase in the Gini index is associated with a 0.034 standard deviation decrease in support for taxing fossil fuels and a 0.018 standard deviation



decrease in support for subsidising renewable energy. These results may suggest that higher inequality is linked not only to weaker personal and institutional responsibility perceptions, but also to lower acceptance of both regulatory and fiscal climate policy measures.

These results show that higher levels of income inequality are associated with greater concern about climate change and a stronger tendency to view climate change as driven by human activity. At the same time, higher inequality is associated with lower perceived personal responsibility, lower confidence in governments' ability to act, and weaker support for policy measures such as fossil fuel taxation and subsidies for renewable energy. This suggests that inequality may increase awareness, while simultaneously undermining social and institutional conditions required for collective responses to climate change.

Figure 2: Correlating inequality and climate attitudes



Notes: The graph shows coefficients from separate linear regressions of standardised climate attitude outcomes on the standardised Gini coefficient. Outcomes include climate change worry, beliefs about natural versus human causes of climate change, perceived personal responsibility for reducing climate change, perceived likelihood of government action, support for taxing fossil fuels, and support for subsidising renewable energy. All outcomes are drawn from the 2016 European Social Survey (ESS) and measured at the individual level. Income inequality is measured using the sub-country-level Gini coefficient from Eurostat (2022). Both the dependent variables and the Gini coefficient are standardised to have mean zero and unit standard deviation. Each point represents the estimated coefficient on the Gini index, with horizontal bars indicating 95% confidence intervals. Regressions are estimated using ESS probability weights and robust standard errors. All outcomes are standardised using the mean and standard deviation; coefficients representing effects in standard deviation units



3 Causal effect of inequality on green preferences and climate action

The observational data reveals an interesting puzzle suggesting a divergent impact of inequality on climate awareness and perceived personal responsibility that may signal a green preferences-action gap. To provide causal evidence on this potential divide, we implemented a large-scale online experiment in which exposure to inequality was randomly varied across individuals. We have recruited a total of 5,087 individual participants. The participants were drawn from five countries: France (1,018), Germany (1,013), Italy (1,022), Spain (1,010), and the UK (1,024). We used the services of the European sample provider Bilendi, and we set national quotas for age, gender, and education to ensure a representative sample. The description of the study gave an estimation of 15 minutes for completion – the actual median completion time was 16.6 minutes. The participants were paid in an internal currency via a point system according to Bilendi's payment policies, and the cost per interview was 9.84 Euros. Below, we provide a description of the questionnaire and the experimental design as well as a description of our sample.

3.1 Questionnaire and experimental design

Figure 3 gives an overview of the complete experiment design. The English questionnaire can be found in Appendix C. We start the experiment by asking participants demographic and other social questions, such as educational background, household income class, marital status, gender, religion, trust, and employment status. After this first part of the survey, we randomize participants into two groups, the treatment group (the information treatment) and the control group. Participants in the treatment group are shown a professionally produced video about inequality in our society which presents facts and showcasing the different lifestyles patterns of the rich and working citizens. Participants in the control group are asked to watch a video on rules of playing checkers.

After watching the video, participants are asked to perform a number of tasks or to respond to a number of questions related to the candidate mechanisms. The first candidate mechanism is effort. To measure individual effort, participants are shown 10 lines per round containing 0's and 1's. For each line, they have to count the amount of 0's and write it in the text box. The task has 3 rounds. Each round is associated to a different method of payment. The payment associated to round 1 is remunerating participants €0.1 per line in which they correctly count the number of zeros. Participants are given 40 seconds to complete as many of the 10 lines as possible. The payment associated to round 2 depends on the participant's performance relative to that of the other participants in the study. The top 10% of participants who correctly count the most lines within 40 seconds receive €0.40 per correct line, while all other participants receive no payment. In the last round, participants can choose which of the two previous payment schemes they prefer to apply to their performance. Responses to this question are also used to examine our second proposed mechanism, namely competition. We classify participants as more competitive if they chose the second payment structure.



The third mechanism is moral universalism. We measure universalism taking inspiration from Cappelen et al. (2025) and Enke et al. (2024). We ask participants a hypothetical question. "Suppose you have earned €1,000, but you have to give away the money in the form of taxes to finance a new green scheme that will benefit two different individuals. You can't keep any of the money for yourself. Assume that these two individuals have the same standard of living. How much of your €1,000 would you give to [ingroup-member], if the rest goes to a random stranger from [country name]?" We repeat the same question for several ingroup-member: (i) their family, (ii) a friend, (iii) a neighbour, (iv) someone who shares their religious beliefs, or (v) ethnic background, and (vi) a random stranger from their country.

Concerning the last mechanism, we investigate how participants attribute responsibility for climate change. Specifically, we ask the participants to what extent they think that the following groups are responsible for climate change in their country: each of us; the high-income earners; the government; companies; previous generations. Answers to each statement could range on a 1-5 Likert scale (not at all; a little; moderately; a lot; a great deal).

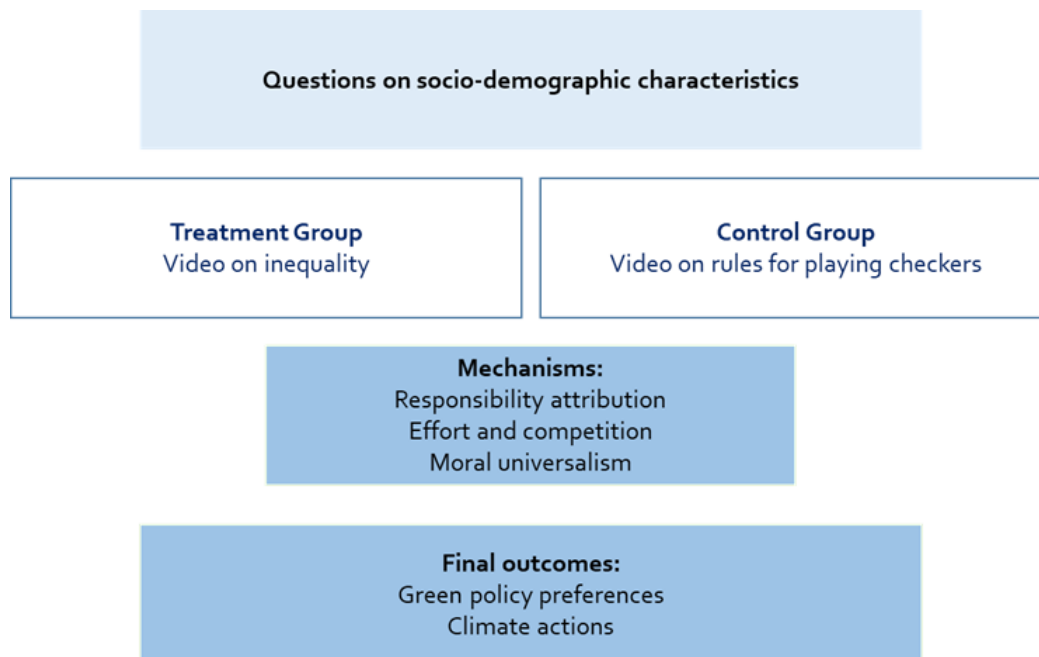
In the final part of the survey, we focus on the final outcomes by asking participants about their policy preferences and their willingness to engage in two real activities. First, we ask participants questions about their preferences concerning policies to address climate change using the same set of questions of Dechezleprêtre et al. (2025). Specifically, we ask for a tax on flying (that increases ticket prices by 20%); a carbon tax, increasing gasoline prices by €0.40 per litre; a ban of polluting vehicles in dense areas, like city centers; stricter energy standards for buildings, including renovation targets and a phase-out of fossil fuel heating; subsidies for low-carbon technologies (renewable energy, capture and storage of carbon); a contribution to a global climate fund to finance clean energy in low-income countries. These climate policy support outcomes are then measured on a Likert scale of 1 to 5 (1 signalling strong opposition, 5 signalling strong support).

Second, we use a petition to enhance credibility compared to self-reported preferences that have no real consequences (see Stantcheva (2023)). In particular, participants are informed that they can take action by signing a petition, which will be submitted to urge the government to take stronger measures against climate change. They are then presented with two options:

- Yes, I want to sign the following petition for stronger government action against climate change: "Climate change is an urgent crisis that requires bold government action. We need stronger policies to reduce emissions, invest in renewable energy, and protect people and ecosystems. I support the implementation of more ambitious climate and environmental policies.";
- No, I do not want to sign this petition.

Lastly, participants are invited to a volunteering exercise, where they could spend additional time (not be remunerated), to perform an effort task with the purpose of gaining additional money to support the activity of an NGO working on climate change. Specifically, they are presented with a series of small tasks. In each task, they are asked to select a specific number using a slider. For each page they completed accurately, they donate €0.1 to an NGO working on climate change and environmental protection. They can complete up to 3 tasks in total, and they are asked before each one whether they would like to continue. Participation is completely voluntary, and they can stop at any time by clicking "No".



Figure 3: Experimental design

3.2 Data quality and descriptive statistics

We take several measures to ensure the quality of our data. Of the total of 5,087 participants in the experiments, we exclude 18 participants who did not complete the full questionnaire. We also included an attention check and exclude the 53 participants who did not pass it. This leads us to a total of 71 participants that are excluded, which results in a total sample of 5,016 (Table 1). Importantly, the exclusion of these observations does not affect the balance of our experiment, as shown in Figure A1 in Appendix A.

Table 1. Observations excluded from the original sample

<i>Exclusion reason</i>	<i>Number</i>
Participants did not complete the full questionnaire	18
Participants did not pass the attention check	53
Total participants excluded	71

Descriptive statistics for the final sample are presented in Table 2. Our sample is broadly gender-balanced, with approximately 40% of participants aged 25–49. Notably, only 12% of the sample have a university degree, and they have, on average, a lower- to mid-tier household income. The political orientation seems to be balanced overall between the left and right spectrum while only 45% of participants report that they never or rarely trust in the government.



Table 2. Summary statistics (control variables)

<i>Variable</i>	Mean	SD	Min	Max
	(1)	(2)	(3)	(4)
Female	0.492	0.500	0	1
<i>Age</i>				
18-24	0.118	0.322	0	1
25-49	0.388	0.487	0	1
50-64	0.248	0.432	0	1
65 or older	0.246	0.431	0	1
University	0.124	0.330	0	1
<i>Household Income:</i>				
Low income	0.324	0.468	0	1
Lower-middle income	0.338	0.473	0	1
Upper-middle income	0.190	0.392	0	1
High income	0.074	0.262	0	1
Prefer not to say	0.074	0.262	0	1
<i>Trust in the government</i>	3.369	1.041	1	5
All the time	0.031	0.172	0	1
Most of the time	0.181	0.385	0	1
Only some of the time	0.332	0.471	0	1
Rarely	0.303	0.460	0	1
Never	0.153	0.360	0	1
<i>Political affiliation</i>				
Left-wing	0.161	0.367	0	1
Left of center	0.192	0.394	0	1
Center	0.334	0.472	0	1
Right of center	0.181	0.385	0	1
Right-wing	0.132	0.339	0	1
Duration in seconds (log)	7.072	0.780	5.802	13.154



3.3 Treatment and Experimenter Demand Effects

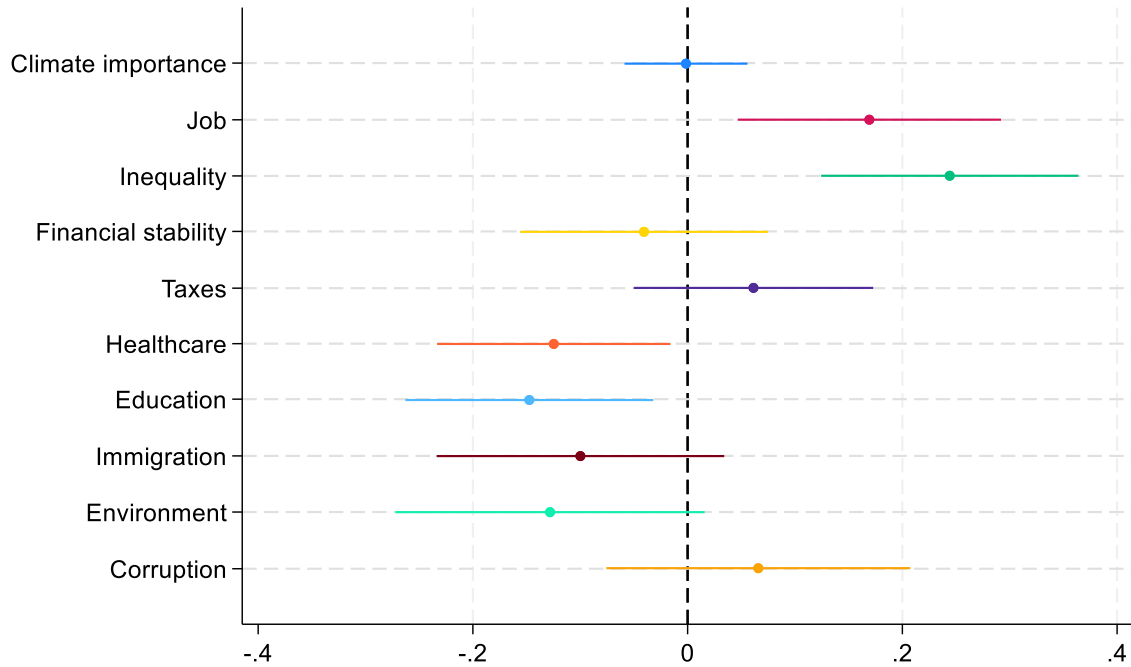
The video describes inequality in our society by presenting statistics and facts and showcasing the different lifestyles patterns of the rich and working citizens. The video makes no reference to climate change. It begins by presenting some basic numbers on billionaires, highlighting the growing number of them and the increasing concentration of wealth among a small group of individuals. We then personalized the information by presenting three real stories of citizens struggling in their daily lives. The goal is to encourage participants to think about inequality by contrasting the rich life with their own, thereby increasing their attention and sense of ownership while exposing them to the kinds of experiences, information, and public discussions that they and their families and friends encounter in their daily lives. All the information used to create the video is real, accurate, and sourced from verified sources such as Oxfam and reputable journalistic outlets.

To verify the effectiveness of our intervention, we use a ranking exercise asking participants to rank a set of issues from the one that concerns them most to the one that concerns them least: jobs; income equality; financial stability; taxes; health care; education; immigration; environment/climate change; government corruption. Figure 4 shows that, compared to the control group, treated participants in the treatment group give higher priority to inequality with differences between the two groups are statistically different. They also give higher priority to job and lower priority to healthcare and education. By contrast, treated participants appear to assign relatively less importance to the environmental topic, although the results are statistically significant only at the 10% level. This latter result seems to suggest the absence of any experimenter demand effect - i.e., the participants' perception that the experimenter expects them to respond in a certain way - a common concern in experimental studies (Orne, 2002; Zizzo, 2010).

We further test for any experimenter demand effect asking participants whether they agree or disagree with the statement that climate change is an important problem. Their answers can range from 1 (strongly disagree) to 5 (strongly agree). Figure A2 in Appendix A shows that around 8 out of 10 participants agree that climate change is an important problem. Specifically, the majority of participants in the control group agree (30%) or strongly agree (47%) that climate change is an important issue (Figure A2 in Appendix A). If any bias were present, we would expect treated respondents to report that climate is an important problem relatively more than the control group. Figure 4 shows that exposing people on inequality does not affect how they perceive the importance of climate change: the differences between the two groups are very close to zero and not statistically significant.



Figure 4: Climate importance and ranking theme comparison between treatment and control group



Note: For the ranking outcomes, we invert the scale so that higher values correspond to higher priority, and then standardize outcomes using the control-group distribution

3.4 Empirical strategy

Our general empirical framework is the following:

$$y_{ij} = \alpha_0 + \beta_1 \tau_{ij} + \beta_2 \gamma_{ij} + \delta_j + \varepsilon_{ij} \quad (1)$$

Where i refers to the individual, while j signals the geographical region (mainly admin 1). y represents the outcome of interest i.e. policy preferences, behavioural outcomes, and the different mediators. To facilitate comparability across outcomes, we standardize continuous variables by subtracting the control-group mean and dividing by the control-group standard deviation.

τ is representative of the treatment variable, which takes on the values 0 (control group) and 1 (treatment group). The γ is a vector of control variables. In our case, that includes the gender of the participant, a categorical variable indicating age, a dummy indicator showing whether participants have a university education or higher, as well as a separate categorical variable indicating household income class. We also control for trust in government measured with a categorical variable reporting how often participants can trust the government to do what is right (all the time; most of the time; only some of the time; rarely; and never), and political orientation, measured with a categorical variable (left-wing, left of centre, centre, right of centre, right-wing). Lastly, we include the log of the time spent to complete the survey



and region fixed effects (δ) to capture institutional and structural factors which are time invariant and should contribute to further reduce possibility of omitted variable bias.

In the main text, we report the estimates derived from an Ordinary Least Squares (OLS) estimation including the control variables. Results for the outcomes without controls are with some exceptions generally similar and reported in Table 7-11 in Online Appendix A.

4 Results

This section presents the findings of our experiment. We begin by analysing the effects of the informational treatment on the primary outcomes. We then broaden the analysis to examine their impact on a set of secondary outcomes.²

4.1 Impact of Inequality on Policy Preferences, Petition Signing, and Volunteering

We first investigate the effect of our informational treatment on participants' preferences regarding environmental policies.

To measure policy preferences, we create an index representing support for green policies by averaging responses to the following 6 policy items: (i) a tax on flying (that increases ticket prices by 20%); (ii) a carbon tax, increasing gasoline prices by €0.40 per litre; (iii) a ban of polluting vehicles in dense areas, like city centres; (iv) stricter energy standards for buildings, including renovation targets and a phase-out of fossil fuel heating; (v) subsidies for low-carbon technologies (renewable energy, capture and storage of carbon); (vi) and lastly, a contribution to a global climate fund to finance clean energy in low-income countries. The overall index ranges from 1 to 5, where 1 indicates low support for green climate policies and 5 indicates high support. Like the other outcome variables, this index and the six individual policy items are standardized. The reason for creating an index is that the six policy variables are correlated with one another; treating them as independent hypotheses would overstate the effective number of tests, as they capture closely related dimensions of a common policy orientation i.e. pro-climate policy support. Using the policy index not only help captures the latent pro-policy dimension but it also helps to increase precision and reduce noise by reducing the risk of spurious inference due to multiple testing.

Figure 5 shows that our treatment is effective in shaping policy preferences. Exposing participants to inequality increases support for green policies by 0.053 standard deviations

² We further ask the respondents about possible behaviours that experts say would help reduce greenhouse gas emissions, and to what extent they would be willing to adopt them: limit flying; limit driving; have an electric vehicle; limit beef consumption; limit heating or cooling your home. Their answers can range from 1 (not at all) to 5 (a great deal). While participants in the treatment groups showed a greater inclination to adopt such behaviours, the effect does not appear strong enough to produce statistically significant differences between the two groups. Results are reported in Table A6 in the appendix.



(which is significant at 5%). Given a control-group standard deviation of 0.951, the treatment effect of 0.053 SD corresponds to an increase of approximately 0.05 points on the 1–5 policy support scale. Relative to the control-group mean of 3.16, the treatment shifts respondents modestly toward greater support. Looking at the contribution of the individual policy items, it seems that this result is mainly driven by the treatment’s effect on two policies (Figure A3 in Appendix A). In particular, the treatment is associated with a 0.056 standard deviations increase in the share of respondents supporting a tax on flying that would increase ticket prices by 20% and with a 0.052 standard deviations increase in the share of respondents supporting a contribution to a global climate fund to finance clean energy in low-income countries. Although the magnitude of these effects look small by conventional benchmarks, these findings are consistent with typical effect sizes observed in survey experiments on policy attitudes (see for example, Dechezleprêtre et al. (2025)). These results would indicate a measurable, though modest, shift in preferences toward green policies, suggesting that the intervention slightly reduces opposition to the policy, although it does not substantially alter overall attitudes.

Second, we analyse the effect of inequality exposure on climate actions. Specifically, we consider three outcomes, (i) the willingness to sign a petition for stronger government action against climate change, which emphasizes the need for stronger policies to reduce emissions, invest in renewable energy, and protect people and ecosystems; (ii) the willingness to support climate action by volunteering own time to complete effort-based tasks that will result in additional funds donated to an environmental NGO;³ (iii) the total effort exerted in the volunteering tasks measured by counting the amount of puzzles (out of 10) that the participants have solved correctly.

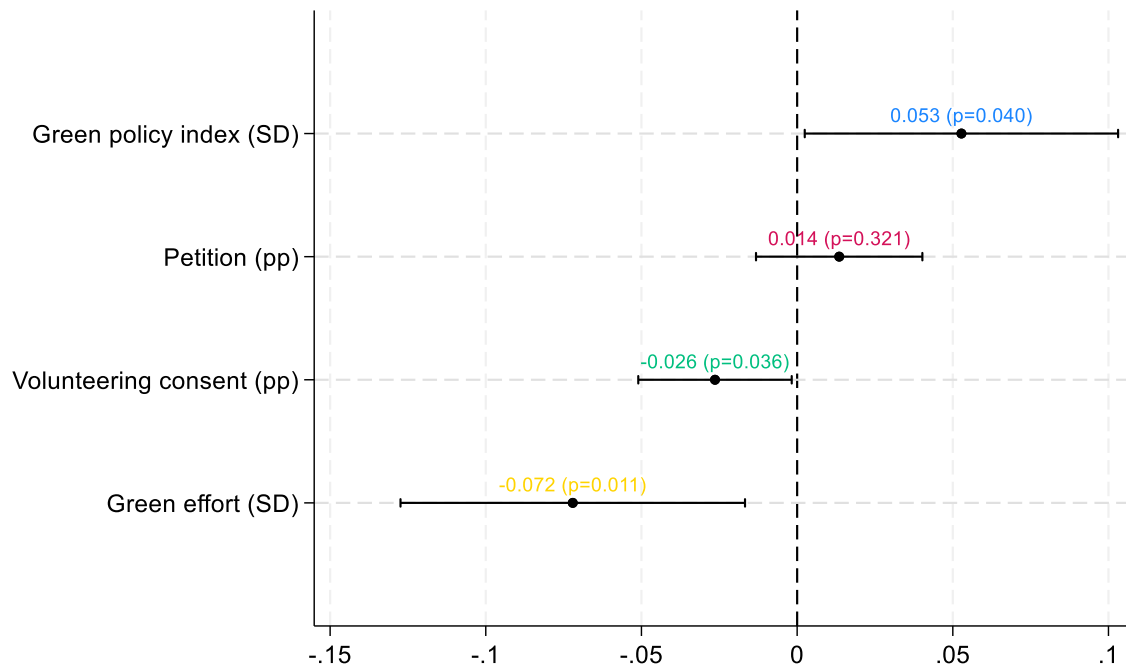
Figure 5 shows that inequality lowers the amount of time and effort participants devote to achieving the collective goal of environmental protection while the treatment has no effects on the decision to sign the petition. In particular, participants who are exposed to inequality are on average 2.6 percentage points less inclined to opt in and volunteer their time for supporting an environmental NGO economically (from 72% in the control group). Even when they choose to participate, participants exposed to inequality put less effort into solving the tasks, resulting in lower revenue for promoting environmental outcomes. In particular, exposing participants to inequality decreases participants’ puzzle-solving performance by 0.072 standard deviations (see Figure 5).⁴

³ For each page they complete accurately, we donate £ 0.1 to an NGO working on climate change and environmental protection.

⁴ There are 3 rounds of volunteering effort tasks with 10 puzzles each. Thus, in total, participants are able to solve 30 puzzles. The environmental NGO receives a 0.10 Pound donation for each solved puzzle. The outcome of the volunteering rounds is conditional on volunteering consent being 1 for the participant, as we want to measure effort conditional on take-up.



Figure 5. Treatment effects on climate policy support and climate action



Notes: Green policy index and volunteering effort are standardized using control group mean and SD. Their coefficients represents effects in standard deviation units. Petition and volunteering consent are binary indicators. P-value in brackets.

4.2 Discussion of the main outcomes

In line with our expectations, we find that exposure to inequality leads participants in the treatment group to adjust their preferences and behaviour. But at the same time, these findings reveal an interesting puzzle. While inequality encourages people to develop green policy preferences on the one hand, it also leads them to assume less climate friendly behaviours on the other. To offer an initial explanation for this puzzle, we discuss each result in more detail below.

The change in policy preferences is mainly explained by the increasing in support for a flying tax and for a global climate fund to finance clean energy in low-income countries. These results can be understood in light of previous research indicating that individuals' support for green policies is shaped by perceptions of both fairness and progressivity, reflecting the distribution of costs across social groups (Ejelöv & Nilsson, 2020; Sommer et al., 2022). For example, a flying tax could be perceived as a progressive tax as flying is a mode of transport used only by 11% of the global population and its frequency is associated with social status (Gössling & Humpe, 2020).⁵ By contrast, others tax or regulation could be perceived as less progressive because they are paid by all. The global climate fund to finance clean energy in

⁵ It is also necessary to report that we show a private jet in the video but also rich vehicles.



low-income countries has also a clear distributional component. It also has a clear global dimension, unlike the previous policy item, which illustrated the video's effect in shifting participants' views from a local to a global perspective.

On the other hand, we can see that exposure to inequality decreases the willingness to take actions against climate change. Specifically, participants in our treatment are less willing to contribute time and effort toward the collective goal of environmental protection (in our case, by supporting an environmental NGO). Although this is in line with findings of the experimental literature on inequality and prosocial behaviour (see Yang and Konrath (2023) for a comprehensive overview, meta-analysis, and summary), the novelty of our study lies in the climate-related context in which participants are required to operate.

In sum, the puzzle mentioned above seems to be explained by the fact that inequality shapes these outcomes through different trajectories. Instead of following a linear path from inequality to preferences to behaviour, the results suggest that these outcomes respond to distinct pathways and may be influenced by different mediators, which we examine in more detail below.

5 Potential Mechanisms: Responsibility Attribution, moral universalism, effort, and competition

Thus far, we find that exposure to inequality increases support for green policies while it reduces the willingness to contribute time and effort toward collective goals such as environmental protection. As discussed above, these results seem to produce an interesting puzzle which might be pointing to a multidimensional persuasion process involving distinct underlying mechanisms.

To better explore this puzzle, we therefore identify four alternative channels.⁶ First, we start taking inspiration from the existing literature suggesting the role of fairness in shaping policy preferences (Dechezleprêtre et al., 2025). But, instead of analysing fairness directly, we test whether responsibility attribution for environmental degradation shapes individuals' responses. Our hypothesis is that people may attribute the responsibility of the climate crisis to all individuals or to certain groups which in turn affects the way in which they form and develop their policy preferences to address climate change. Therefore, as reported in Section 3.1, we identify 5 groups that could be accused to have contributed to the environmental degradation such as wealthy people, the government, companies, past generations or all individuals and ask the participants to what extent they think that the following groups are responsible for climate change in their country. Second, it is also well known that inequality influences people's effort and competitive behaviour (Sommet & Elliot, 2023). For example,

⁶ We test for heterogeneous treatment effects across ideological position, trust, income, employment status, education, and religion. We find no statistically significant differences in treatment effects across these dimensions. This suggests that the treatment operates through common mechanisms and affects respondents in a broadly uniform way, although we cannot rule out smaller subgroup differences given the limited power of interaction tests.



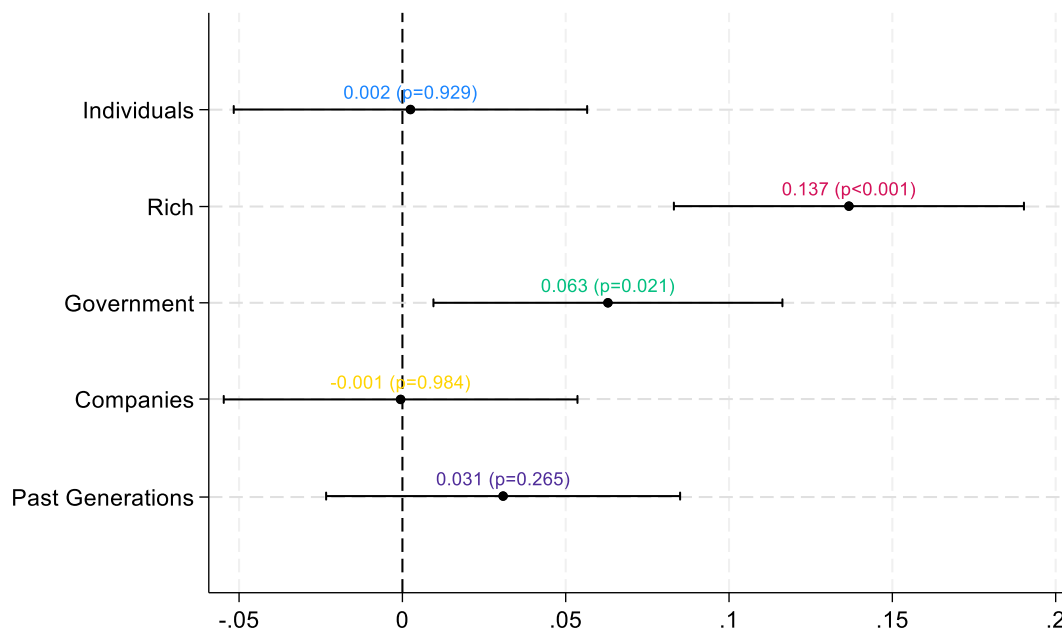
we assume that an increase in competitiveness would, in turn, also influence the willingness to contribute to a common goal (in our case, volunteering time for an environmental NGO). To measure their individual effort and competitiveness, participants perform a standard effort task in which they count the number of 0's in each line over three rounds, as described in Section 3.1. Finally, we hypothesize that inequality may affect universalism by increasing the distance between groups as suggested by the existing literature (see Cappelen et al. (2025)). In a similar situation, citizens may be less willing to contribute to something that benefits other groups. As reported in Section 3.1, we measure universalism taking inspiration from Cappelen et al. (2025) and Enke et al. (2024).

Mediation analysis. To test these alternative channels, we implement a standard regression-based mediation analysis (Baron & Kenny, 1986). Using this method, we are not claiming for strict causality but for a more clean and transparent exercise that may help to better investigate how preferences and behaviour respond to different pathways and mediators in a multidimensional persuasion framework.

We start thus regressing the candidate mediators on the treatment to verify if mediation exist at all. Considering the responsibility attribution dimension, participants exposed to inequality clearly identified the wealthy individuals and the government as responsible for environmental problems while they seem less inclined to assign responsibility for climate change to individuals, companies or previous generations. Specifically, Figure 6 reports that exposure to inequality increases the attribution of responsibility to the wealthy individuals and to the government, respectively, by 0.137 and 0.063 standard deviations. The results of attributing more responsibilities to the wealthy is not surprising due to the fact that the treatment clearly expose participants to inequality and implicitly shows that they may have a greater impact on climate changes with their actions. By contrast, it is interesting to observe that they also attribute more responsibility to the government which is not mentioned at all in the video. One possible explanation is that people blame the government for failing to regulate or act against the climate crisis, which could lead to further environmental degradation.



Figure 6. Treatment effects on responsibility attribution

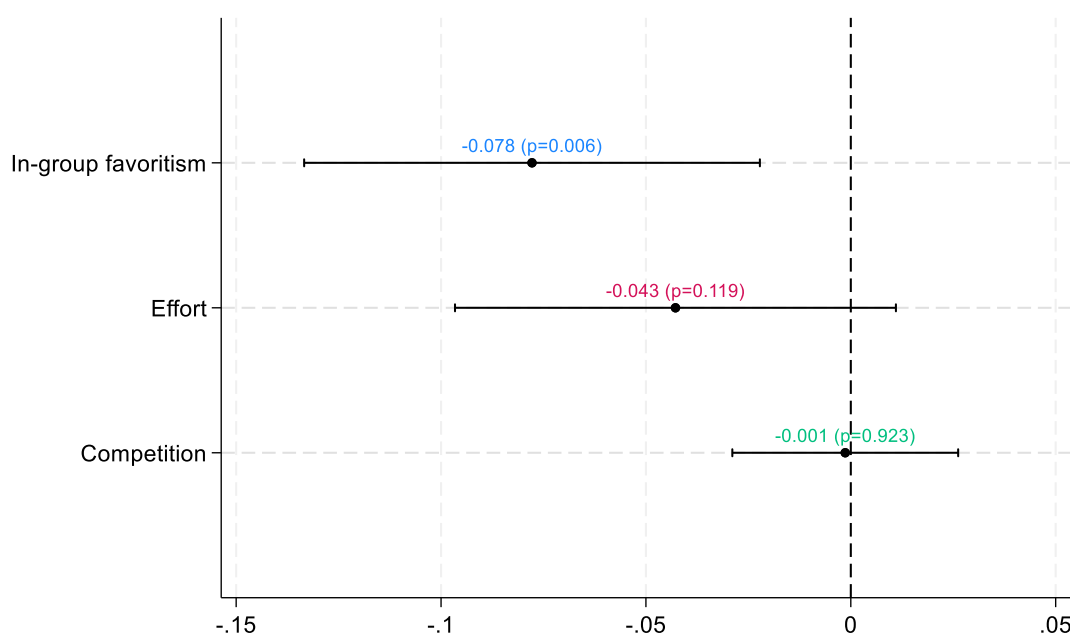


Notes: Responsibility is measured on a 1-5 Likert scale ranging from not at all to a great deal. All outcomes are standardised using the mean and standard deviation of the control group with coefficients representing effects in standard deviation units. P-value in brackets.

Moving to the other mechanisms, Figure 7 shows that exposure to inequality increases moral universalism resulting in a decrease of in-group favouritism. Specifically, compared to the control group, participants exposed to inequality prefer to allocate more money to a random stranger and less to their in-group members (-0.078 standard deviation units). This result not only contradicts our initial hypothesis, but it also contrasts with previous research documenting a negative association between inequality and moral universalism (Cappelen et al., 2025; Enke et al., 2024). This response might be driven by the fact that inequality is problematized in our informational treatment, which breaks participants' identification with their in-group and force them to expand, rather than contract, moral concern toward strangers. Finally, in contrast to previous studies (Breza et al., 2018; Gesiarz et al., 2020; Sommet & Elliot, 2023) Figure 7 indicates that effort and competitiveness remain unaffected.



Figure 7. Treatment effects on moral universalism, effort and competition



Notes: Competition is a binary indicator equal to one if the participant selected the competitive payment scheme. Effort is the total number of correctly solved lines across all rounds of the effort task. In-group favoritism is an index summarizing average allocation to in-group members relative to strangers. All outcomes (excluding competition) are standardised using the mean and standard deviation of the control group, with coefficients representing effects in st. deviation units. P-value in brackets.

In the final stage, we re-run our baseline estimations including both the treatment variable and the mediators that were statistically significant in the previous step (wealthy individuals' responsibility, government responsibility, and moral universalism). We focus only on the green policy index and the willingness to support climate action through the volunteering task as the petition measure does not yield statistically significant effects, and total effort in the volunteering task is mechanically conditional on consent to participate.

Figure 8 reports our findings showing that the effect of the treatment operates differently across outcomes. Starting with the climate policy preferences, once the mediators are included, the treatment coefficient is no longer statistically significant while all the mediators coefficients are statistically significant (Figure 8, Panel A). Specifically, attributing greater responsibility to wealthy individuals and to the government, as well as exhibiting a higher degree of moral universalism, are all factors associated with increased support for climate policy. These findings suggest that the treatment effect appears to be fully mediated by these three factors. Turning to climate behaviour, once the mediators are included, the treatment coefficient remains statistically significant (Figure 8, Panel B). Looking at the mediators, only the coefficient associated to greater responsibility to wealthy individuals is statistically significant. More specifically, assigning greater responsibility to wealthy individuals raises the likelihood of participating in the NGO fundraising exercise, which runs counter to the direction

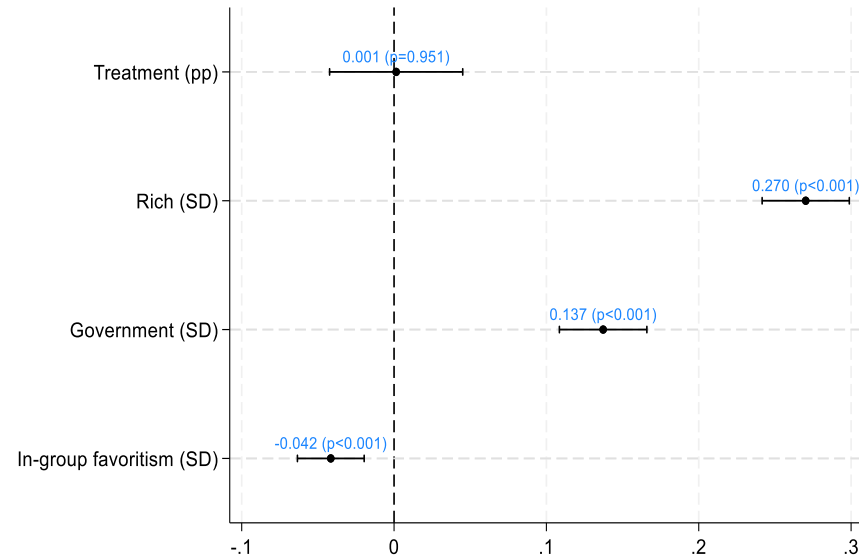


of the treatment effect. In contrast to the previous case, this suggests that the treatment has a direct effect on climate behaviour, while the mediators play a more limited role. These results highlight that the treatment works through multiple mechanisms, with their importance varying by outcome.

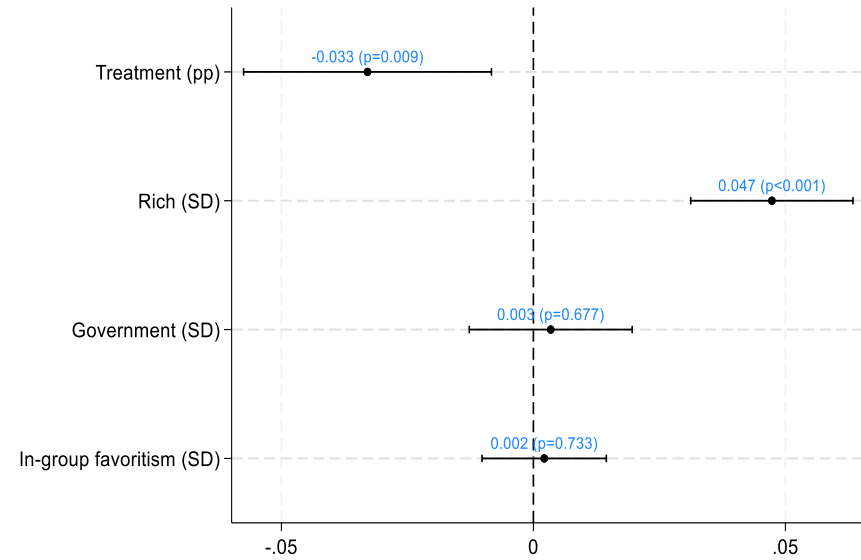


Figure 8. Impact of inequality and mediators on climate preferences (panel A) and climate behaviour (panel B)

Panel A. Climate preferences



Panel B. Climate behaviour



Notes: All outcomes are standardised using the mean and standard deviation of the control group with coefficients representing effects in standard deviation units. P-value in brackets.



6 Conclusion

This paper investigates whether and through which mechanisms inequality shapes preferences for climate policies and climate behavior. We address this question by designing and implementing a large-scale online experiment (nearly 5,000 participants) across five European countries (France, Germany, Italy, Spain, and the United Kingdom). We show that the exposure to inequality increases support for green climate policies but decreases the willingness to take actions against climate change. Specifically, participants exposed to inequality are more in favour of introducing a flying tax and a green climate fund to finance clean energy in low-income countries but they are less willing contribute time and effort toward the collective goal of environmental protection. This puzzle seems to be explained by the fact that inequality shapes these outcomes through different trajectories. Instead of observing a linear path from inequality to preferences to behaviour, we see that they follow and respond to distinct pathways and mediators. For climate policy preferences, our findings show that participants exposed to inequality clearly identified the wealthy individuals and the government as responsible for environmental problems while also shows an increase in moral universalism. The impact of inequality on green policy preferences is fully mediated by these three factors. In contrast, for climate-related behaviour, mediators play a limited role, while inequality has a direct effect on the willingness to take action against climate change.

These results have important policy implications. They demonstrate that inequality has implications for climate change, as high levels of disparity may influence individuals' preferences for green policies and their willingness to address climate change in different directions. The results demonstrate that redistributive responsibility narratives can shift climate policy preferences and, to a lesser extent, climate-related behavior.



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Appendix A. Additional analysis

Figure A1. Balancing check

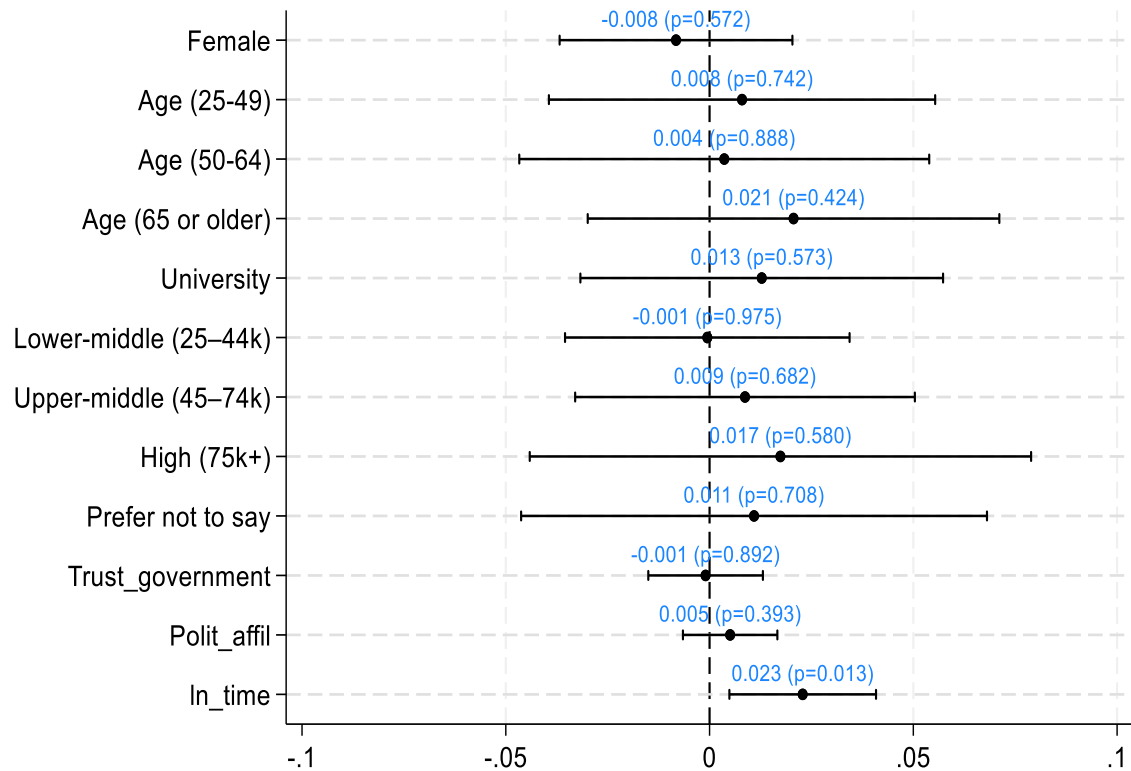
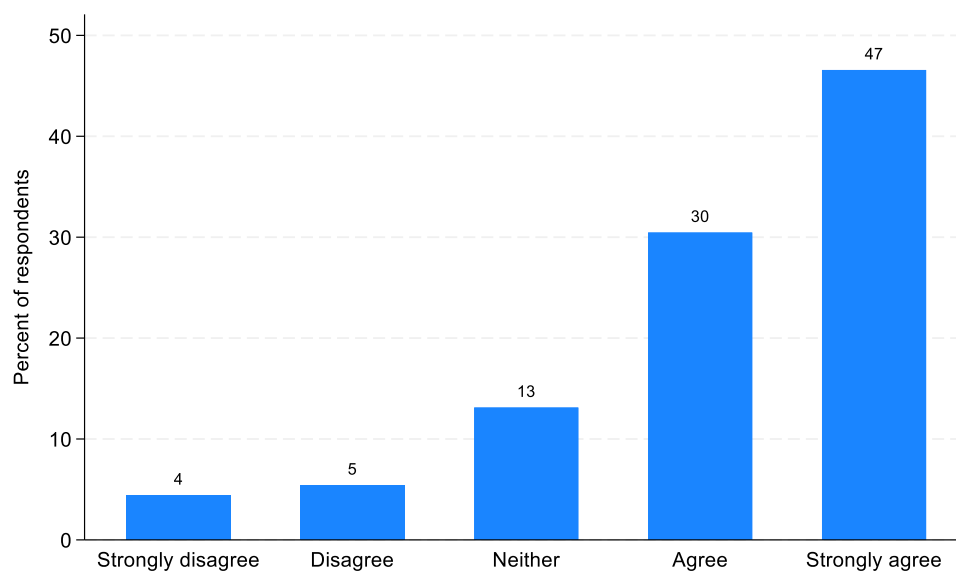


Figure A2. Importance of climate change among participants

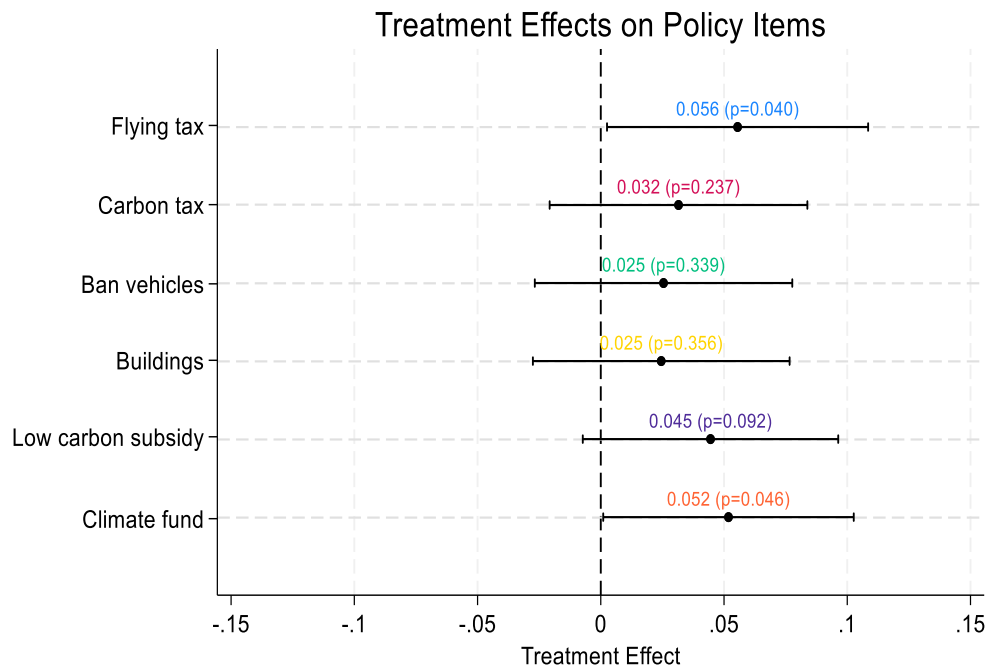


Notes: Participants are asked if they agree or disagree with the following statement: "Climate change is an important problem."



This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

Figure A3. Treatment effects on preferences for climate policy items



Notes: Standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Policy items are standardized using control group mean and SD.



Table A1: Treatment Effects on Policy and Behavioral Outcomes

	Policy index	Petition	Volunteering consent	Volunteering rounds
	(1)	(2)	(3)	(4)
treatment	0.053** [0.026]	0.014 [0.014]	-0.026** [0.013]	-0.072** [0.028]
Control mean	-0.000	1.522	0.725	0.000
Obs.	5,013	5,013	5,005	5,013
R-squared	0.197	0.102	0.065	0.062

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$
Table A2: Treatment Effects on Policy Items

	Flying tax	Carbon tax	Ban vehicles	Buildings	Low carbon subsidy	Climate fund
	(1)	(2)	(3)	(4)	(5)	(6)
treatment	0.056** [0.027]	0.032 [0.027]	0.025 [0.027]	0.025 [0.027]	0.045* [0.026]	0.052** [0.026]
Control mean	-0.000	0.000	0.000	0.000	0.000	-0.000
Obs.	5,013	5,013	5,013	5,013	5,013	5,013
R-squared	0.121	0.139	0.136	0.149	0.127	0.181

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$
Table A3: Treatment Effects on perceived responsibility

	Individuals	Rich	Government	Companies	Past Generations
	(1)	(2)	(3)	(4)	(5)
treatment	0.002 [0.028]	0.137*** [0.027]	0.063** [0.027]	-0.001 [0.028]	0.031 [0.028]
Control mean	-0.000	0.000	-0.000	0.000	-0.000
Obs.	5,013	5,013	5,013	5,013	5,013
R-squared	0.071	0.082	0.061	0.068	0.093

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$


Table A4: Treatment effects on Universalism, Effort and Competition

	In-group favoritism (1)	Effort (2)	Competition (3)
treatment	-0.078*** [0.028]	-0.043 [0.027]	-0.001 [0.014]
Control mean	-0.000	0.000	0.448
Obs.	5,013	5,013	5,013
R-squared	0.077	0.084	0.036

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$ **Table A5: Treatment & Mediators**

	Policy index (1)	Volunteering consent (2)
treatment	0.001 [0.022]	-0.033*** [0.013]
Respondent_HighIncome_sd	0.270*** [0.015]	0.047*** [0.008]
Respondent_Government_sd	0.137*** [0.015]	0.003 [0.008]
ingroup_favoritism_sd	-0.042*** [0.011]	0.002 [0.006]
Obs.	5,013	5,005
R-squared	0.336	0.075

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$ **Table A6: Treatment effects on stated private behaviour**

This project has received funding from the European Union's Horizon Europe under grant agreement No 101132559.

	Flying (1)	Driving (2)	Vehicle (3)	Beef (4)	Heating (5)
treatment	0.070* [0.036]	0.063* [0.033]	0.042 [0.037]	0.061* [0.035]	0.062* [0.033]
Control mean	3.321	2.963	2.781	2.864	3.067
Obs.	4,976	4,976	4,976	4,976	4,976
R-squared	0.088	0.117	0.143	0.145	0.126

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$

Table A7: Treatment Effects on Policy and Behavioral Outcomes without Individual Controls

	Policy index (1)	Petition (2)	Volunteering consent (3)	Volunteering rounds (4)
treatment	0.052* [0.028]	0.010 [0.014]	-0.020 [0.013]	-0.064** [0.029]
Control mean	-0.000	1.522	0.725	0.000
Obs.	5,016	5,016	5,008	5,016
R-squared	0.038	0.024	0.019	0.021

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$

Table A8: Treatment Effects on Policy Items without Individual Controls

	Flying tax (1)	Carbon tax (2)	Ban vehicles (3)	Buildings (4)	Low carbon subsidy (5)	Climate fund subsidy (6)
treatment	0.059** [0.028]	0.036 [0.028]	0.026 [0.028]	0.022 [0.028]	0.043 [0.028]	0.045 [0.028]
Control mean	-0.000	0.000	0.000	0.000	0.000	-0.000
Obs.	5,016	5,016	5,016	5,016	5,016	5,016
R-squared	0.035	0.032	0.053	0.061	0.041	0.048

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$

Table A9: Treatment Effects on Perceived Responsibility without Individual Controls

	Individuals (1)	Rich (2)	Government (3)	Companies (4)	Past Generations (5)
treatment	0.002 [0.028]	0.133*** [0.028]	0.062** [0.028]	-0.001 [0.028]	0.030 [0.028]
Control mean	-0.000	0.000	-0.000	0.000	-0.000



Obs.	5,016	5,016	5,016	5,016	5,016
R-squared	0.023	0.033	0.025	0.025	0.045

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$

Table A10: Treatment Effects on Universalism, Effort and Competition without Individual Controls

	In-group favoritism (1)	Effort (2)	Competition (3)
treatment	-0.078*** [0.029]	-0.058** [0.028]	0.000 [0.014]
Control mean	-0.000	0.000	0.448
Obs.	5,016	5,016	5,016
R-squared	0.031	0.025	0.027

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$

Table A11: Treatment & Mediators without Individual Controls

	Policy index (1)	Volunteering consent (2)
treatment	-0.007 [0.024]	-0.028** [0.013]
Respondent_HighIncome_sd	0.354*** [0.015]	0.056*** [0.008]
Respondent_Government_sd	0.086*** [0.016]	0.003 [0.008]
ingroup_favoritism_sd	-0.053*** [0.012]	0.002 [0.006]
Obs.	5,016	5,008
R-squared	0.221	0.035

Standard errors in brackets

* $p < .1$, ** $p < .05$, *** $p < .01$



Appendix B. Qualitative analysis of open-ended feedback

To better understand how participants interpreted the treatment, we conducted a qualitative analysis of the open-ended feedback provided at the end of the survey. For the purpose of this exercise, we excluded meta-feedback—i.e., comments related to the survey or task difficulty—and focused on responses discussing the content of the study. The qualitative exercise is intended to provide only illustrative evidence of how some respondents interpreted the study.

Using a simple topic-modelling exercise, we identified six categories: economic inequality, responsibility of wealthy individuals, climate change, climate policy, the distributional consequences of climate policies, and the inequality–climate link.

Table B1. Themes in Open-Ended Responses

Category	Description	Evidence from responses	Approximate prevalence among substantive comments
Economic inequality	References to unequal wealth distribution, rich vs. poor, or fairness in economic outcomes	“wealth should be shared more evenly”; “too many inequalities between rich and poor”	Frequent (~40–45%)
Responsibility of wealthy individuals	Statements attributing environmental responsibility to rich individuals or economic elites	“rich people consume more and pollute more”	Moderate (~15–20%)
Climate change	General references to climate change or environmental problems	“climate change must be addressed”; “environmental problems affecting the planet”	Moderate (~20–25%)
Climate policy	Mentions of government action, regulation, or environmental policy responses	“governments should adopt environmental policies”	Limited (~10–15%)
Distributional consequences of climate policies	Discussion of who bears the costs of climate policies or how policies affect different income groups	Very few explicit references	Very rare (<5%)



Category	Description	Evidence from responses	Approximate prevalence among substantive comments
Inequality–climate link	Explicit connection between inequality and environmental impact	“the rich pollute more because they consume more”	Rare (~5–10%)

The most common themes discussed by participants were inequality and the responsibility of wealthy individuals. Open-ended comments indicate that several participants described inequality in terms of differences between rich and poor individuals. By contrast, climate change and environmental policies were mentioned less frequently by participants. Interestingly, only a few participants directly linked inequality to environmental outcomes, typically noting that wealthier individuals contribute disproportionately to environmental degradation.

Knowledge about climate policies. Only a minority of participants explicitly mentioned climate policy instruments. Among these comments, several referred to the role of government intervention, and some highlighted the potential distributional consequences of climate policies. In particular, participants noted that measures such as higher energy or fuel prices may disproportionately affect middle- and lower-income households, showing their awareness of the potential distributional implications of such policies.

Theme	Description	Illustrative Examples from Responses
Climate policy instruments	Explicit references to policy tools such as taxes, subsidies, regulations, or price increases.	“CO ₂ taxes for companies.”; “Increase the price of flights.”; “Subsidies to adapt houses.”
Distributional consequences of policies	Mentions of how climate policies affect different income groups.	“Fuel prices hurt low-income households.”; “Environmental policies make energy expensive.”
Skepticism toward climate policies	Expressions of distrust or criticism of climate policies or environmental regulation.	“Climate policies are ideological.”; “These policies hurt the economy.”
Global responsibility	References to international differences in emissions or policy responsibility.	“Europe acts while China and the US do not.”; “France contributes less than 1% of emissions.”



Appendix C: English questionnaire

1. Informed consent

I hereby give permission to use my data for scientific purposes. I had enough time to decide whether I want to participate in the survey. I know that participation is voluntary and that I can abandon the survey at any time. If I withdraw, I forfeit any monetary compensation. I know that the data will be saved anonymously and will only be made public in aggregate form.

Yes; No

2. Age

What is your age?

18-24; 25-49; 50-64; 65 or older; prefer not to say

3. Identity

How do you identify?

Man; woman; non-binary; prefer not to say

4. Marital status

What is your marital status?

Married; legally recognized civil partnership; single and never married or in a civil partnership; divorced/separated; other

5. Education

What is the highest educational or school qualification you obtained? (If you are currently enrolled, pick the highest degree received to date)

Higher degree level qualification (Masters, PhD or equivalent doctoral level qualification); bachelors or equivalent first-degree qualification; post-secondary vocational training (up to 1 year, or 2 and more years); secondary school; other (please specify)

6. Employment

What is your current employment status?

In paid employment (full or part-time); Self-employed; Unemployed; Retired; Doing something else (please specify)

7. Household income

Roughly, what is your *total* annual household income in Pounds *after* taxes?



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Less than 15,000; 15,000 – 24,999; 25,000 – 34,999; 35,000 – 44,999; 45,000 – 54,999; 55,000 – 64,999; 65,000 – 74,999; 75,000 – 84,999; 85,000 – 94,999; 95,000 – 104,999; 105,000 – 144,999; More than 145,000; Prefer not to say

8. Religion

Which religion do you belong to at present?

Roman Catholic; Protestant; Jewish; Islam; Eastern religions (Buddhist, Hindu, etc.); Not at all religious; Other (please specify); Prefer not to say

9. Born in the UK

Were you born in the United Kingdom?

Yes; No

10. Region

Where do you live?

Greater London; Southeast England; Southwest England; East of England; East Midlands; West Midlands; Northwest England; Yorkshire and the Humber; Northeast England; Scotland; Wales; Northern Ireland

11. Political orientation

When it comes to most political issues, do consider yourself as...?

Left-wing; Left of center; Center; Right of center; Right-wing

12. Trust in the government

How often can you trust the government to do what is right?

All the time; Most of the time; Only some of the time; Rarely; Never

13. Trust in other people

Do you agree or disagree with the following statement: "Most people can be trusted".

Strongly disagree; Somewhat disagree; Neither agree or disagree; Somewhat agree; Strongly agree

14. Attention check

It is vital for the quality of this survey that you devote your full attention to the questions we ask. In your honest opinion, have you devoted your full attention to this study so far? (Your answer to this question does not affect your payment)



Yes, I have devoted my full attention so far and have answered the questions thoroughly; No, I have not devoted my full attention so far and have not answered the questions thoroughly

[INFORMATIONAL TREATMENT – see Appendix D]

15. Emotions

While watching the video, to what extent did you feel the following emotions: positive; negative; good; bad; pleasant; unpleasant; happy; sad; afraid; joyful; angry; contented?

Not at all; a little; moderately; a lot; a great deal

16. Moral universalism

You will now be asked to make a series of brief decisions. Suppose you have earned £1000, but you have to give away the money to two other people. You can't keep any of the money for yourself. Assume that these two people have the same standard of living.

a) family

How much of your £ 1000 would you give to a person in your family, if the rest goes to a random stranger from the UK?

b) friend

How much of your £ 1000 would you give to a friend of yours, if the rest goes to a random stranger from the UK?

c) neighbor

How much of your £ 1000 would you give to a person who lives in your neighborhood, if the rest goes to a random stranger from the UK?

d) religious circle

How much of your £ 1000 would you give to a person who shares your religious beliefs, if the rest goes to a random stranger from the UK?

e) ethnic circle

How much of your £ 1000 would you give a person who shares your ethnic background, if the rest goes to a random stranger from the UK?

f) compatriot

Suppose now that the two people are someone from the UK and someone from anywhere in the world. Again, assume that these two people have the same living standard. How much of your £ 1000 would you give to a random stranger from the UK, if the rest goes to a random stranger from anywhere in the world?



0-1000

17. Altruism

How would you split £ 1000 between yourself and a random stranger from anywhere in the world?
(How much would you keep for yourself)

0-1000

18. Effort

Now, we will ask you to do another brief task. Depending on your performance in this task, you can earn an additional £1. Task: Counting numbers. You will see several lines containing 0's and 1's. For each line, you have to count the amount of 0's and write it in the box. This task has 3 rounds. In each round you will have 40 seconds to count zeros in as many lines as you can. A line would look like this: 101010010001111010101010101011. You can enter your response in numbers. For example, if you count 15 zeros, your response should be: 15 Evaluation: Answers will be evaluated as correct if the number you write corresponds to the exact number of 0's in the line. At the end of the experiment, only one of the 3 rounds in this task will be randomly picked for payment. When you are ready to start this task, please click to move to the next page.

Round 1

If this round is the one selected for payment, then you will receive £ 0.1 per line in which you correctly count the number of zeros within the timeframe of 40 seconds. When you are ready to start this round, please click to move to the next page.

How many zeros? Enter your response in the box below: 10101000000111101010101010101000
How many zeros? Enter your response in the box below: 11111001000100100010001110001010
How many zeros? Enter your response in the box below: 00011000001110100010001010101110
How many zeros? Enter your response in the box below: 0101101110100100010000000001010
How many zeros? Enter your response in the box below: 00000001110100101010000100101010
How many zeros? Enter your response in the box below: 00101101000101101010010100101010
How many zeros? Enter your response in the box below: 00101100000001001010000100001000
How many zeros? Enter your response in the box below: 01101100110001001000000000000000
How many zeros? Enter your response in the box below: 00011101001110101010001110101110
How many zeros? Enter your response in the box below: 11111001000100111010001110101010

Round 2

If this round is selected for payment, your payment depends on your performance relative to that of the other participants in the study. The top 10% of participants who correctly count the most lines within 40 seconds will receive £ 0.40 per correct line, while all other participants will receive no payment. When you are ready to start this round, please click to move to the next page.

How many zeros? Enter your response in the box below: 10101000000111101010101010101000
How many zeros? Enter your response in the box below: 11111001000100100010001110001010



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How many zeros? Enter your response in the box below: 00011000001110100010001010101110
 How many zeros? Enter your response in the box below: 01011101110100100010000000001010
 How many zeros? Enter your response in the box below: 00000001110100101010000100101010
 How many zeros? Enter your response in the box below: 00101101000101101010010100101010
 How many zeros? Enter your response in the box below: 00101100000001001010000100001000
 How many zeros? Enter your response in the box below: 01101100110001001000000000000000
 How many zeros? Enter your response in the box below: 00011101001110101010001110101110
 How many zeros? Enter your response in the box below: 11111001000100111010001110101010

Round 3

You can now choose which of the two previous payment schemes you prefer to apply to your performance in the third round. As before, you have 40 seconds to perform the task. If you choose payment method 1, you will receive £ 0.1 per correct line. If you choose payment method 2, your performance will be evaluated relative to the performance of the other participants in round 2 (the previous round you just finished). If you correctly solve more lines than the top 10% of Round 2 participants, then you will receive £ 0.40 per correct line. Please make your choice. I prefer to be paid:

Payment method 1; payment method 2

How many zeros? Enter your response in the box below: 10101000000111101010101010101000
 How many zeros? Enter your response in the box below: 11111001000100100010001110001010
 How many zeros? Enter your response in the box below: 00011000001110100010001010101110
 How many zeros? Enter your response in the box below: 01011101110100100010000000001010
 How many zeros? Enter your response in the box below: 00000001110100101010000100101010
 How many zeros? Enter your response in the box below: 00101101000101101010010100101010
 How many zeros? Enter your response in the box below: 00101100000001001010000100001000
 How many zeros? Enter your response in the box below: 01101100110001001000000000000000
 How many zeros? Enter your response in the box below: 00011101001110101010001110101110
 How many zeros? Enter your response in the box below: 11111001000100111010001110101010

19. Priority ranking

Please rank the following issues from the one that concerns you the most to the one that concerns you the least.

Jobs; income equality; financial stability; taxes; health care; education; immigration; environment/climate change; government corruption

20. Climate importance

Do you agree or disagree with the following statement: "Climate change is an important problem."

Strongly disagree; Somewhat disagree; Neither agree nor disagree; Somewhat agree; Strongly agree

21. Private behaviors



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Here are possible behaviors that experts say would help reduce greenhouse gas emissions. To what extent would you be willing to adopt the following behaviors: limit flying; limit driving; have an electric vehicle; limit beef consumption; limit heating or cooling your home?

not at all; a little; moderately; a lot; a great deal

22. Allocation of responsibility

To what extent are the following groups responsible for climate change in the UK: each of us; the high-income earners; UK government; companies; previous generations?

not at all; a little; moderately; a lot; a great deal

23. Policy support

Do you support or oppose the following climate policies: a tax on flying (that increases ticket prices by 20%); a carbon tax, increasing gasoline prices by 40 pence per litre; a ban of polluting vehicles in dense areas, like city centers; stricter energy standards for buildings, including renovation targets and a phase-out of fossil fuel heating; subsidies for low-carbon technologies (renewable energy, capture and storage of carbon...); a contribution to a global climate fund to finance clean energy in low-income countries?

strongly oppose; somewhat oppose; neither support nor oppose; somewhat support; strongly support

24. Signing a petition

You can also take action by signing a petition. We will submit a petition urging the government to take stronger action against climate change. We will not share your name, only the number of people in our study who signed the petition. We will send you proof of the petition's submission in the next few weeks. Would you like to sign a petition?

Yes, I want to sign the following petition for stronger government action against climate change: "Climate change is an urgent crisis that requires bold government action. We need stronger policies to reduce emissions, invest in renewable energy, and protect people and ecosystems. I support the implementation of more ambitious climate and environmental policies."; No, I do not want to sign this petition.

25. Volunteering

Thank you very much for participating in this survey. You now have the option to support climate action by volunteering a bit more of your time to complete an effort-based task. In this final section, you will be presented with a series of small tasks. In each task, you will be asked to select a specific number using a slider. For each page you complete accurately, we will donate £ 0.1 to an NGO working on climate change and environmental protection. We will provide you with a link to the charity at the end of the survey and in a few weeks, you will receive proof of the total amount donated to the charity.



You can complete up to 3 tasks in total, and you will be asked before each one whether you would like to continue. Participation is completely voluntary, and you may stop at any time by clicking "No".

Round 1

Would you like to begin with Task 1? (Selecting a number on a slider from 0 to 100)

Yes, I want to start; no, I would prefer to skip this part

Select the number 7 using the slider.

Select the number 22 using the slider.

Select the number 35 using the slider.

Select the number 48 using the slider.

Select the number 63 using the slider.

Select the number 76 using the slider.

Select the number 89 using the slider.

Select the number 3 using the slider.

Select the number 54 using the slider.

Select the number 97 using the slider.

Round 2

Would you like to continue with Task 2?

Yes, I want to continue; no, I would like to end the survey

Select the number 12 using the slider.

Select the number 27 using the slider.

Select the number 40 using the slider.

Select the number 32 using the slider.

Select the number 68 using the slider.

Select the number 81 using the slider.

Select the number 94 using the slider.

Select the number 16 using the slider.

Select the number 33 using the slider.

Select the number 59 using the slider.

Round 3

Would you like to continue with Task 3?



Yes, I want to continue; no, I would like to end the survey

Select the number 5 using the slider.
Select the number 19 using the slider.
Select the number 29 using the slider.
Select the number 43 using the slider.
Select the number 60 using the slider.
Select the number 72 using the slider.
Select the number 85 using the slider.
Select the number 98 using the slider.
Select the number 10 using the slider.
Select the number 37 using the slider.

26. Feedback

You can provide your feedback to the survey team here.

27. Information on the chosen NGO

Thank you very much for participating in this survey. The charity selected to receive the donation is Rewilding Britain, an organization dedicated to restoring and protecting ecosystems across Britain through rewilding efforts. Read more about them at this link: <https://www.rewildingbritain.org.uk/>



Appendix D: English informational treatment

In 2024, the number of billionaires skyrocketed to almost 2800. Their combined wealth grew by nearly \$6 billion every single day! And what about those at the very top, the ten richest men in the world? In the same year, their wealth grew by nearly \$100 million every single day - the equivalent of what more than 3,000 people in the UK each make in a full year.

The problem is that wealth is taken, not made. Many so-called 'self-made' billionaires actually inherited their fortunes—passed down through generations of privilege. While billions of dollars in untaxed inheritance keep wealth and power concentrated in the hands of a few, rising living costs are eroding the financial security of millions. Here are just some real stories from across Europe.

Maurice is from a poor region and couldn't find a job there. So, he had to migrate to a different city and fortunately found a job as a traffic policeman. But even though he now has a job, the salary isn't enough to make ends meet. He lives in a small room and commutes to work on an old bike, and still needs his parents for financial support. With rising living costs, Maurice's situation is becoming even more desperate now.

The situation is becoming more dire still for Jess, who lives with her husband, Jon, and their two-year-old daughter, Robin. Childcare costs are rising, and job cuts are looming over their heads. They have to think twice before adding anything to their shopping trolley. Jess describes the "attitude shift" that sets in at the end of the month: "Rather than thinking, 'What would we like to eat this week?' it's now, 'Well, what's left in the budget this week?'"

Julian, a baker, was forced to close his bakery in December after his electricity costs tripled. Searching for alternative suppliers brought no relief. "It was absolutely inconceivable to me that a power bill could force me to close my shop," he says, as bakery closures become increasingly common across his region.

These are just a few of the many stories of working citizens struggling with rising living costs.

Billions of dollars continue flowing unchecked into the bank accounts of the ultra-rich —untouched and untaxed. At the same time, young people, small businesses, and families fight to make ends meet.



Part 2. Inequality and the emissions footprint: a European empirical perspective. A Technical report

Authors	Önder Nomaler and Bart Verspagen
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Abstract: We estimate the greenhouse gas emissions footprint of households in 17 countries in the European Union, for a selection of years 2010, 2015 and 2020. We find that households with higher income have higher per capita footprints, but lower per euro footprints. This means that the effect of per capita consumption expenditures dominate over the impact of the structure of spending on emissions. This results from the fact that low income households spend a larger part of their consumption budget on high emission goods and services, such as electricity. We also look at the changes of emission footprints, and find that for most of the cases (countries, years, income classes), footprints are reduced over the period 2010 – 2020. The largest reductions tend to be found for high income households. When we decompose the changes of emission footprints into three effects (changes of per capita consumption, changes in consumption structure, and changes in emission coefficients, i.e., emissions per euro spent on goods and services for a specific type), we find that the effect of emission coefficients dominates by far.

Document Revision History

Date	Version	Author/Editor/Contributor	Summary of main changes / Status
3/8/2026	0.1	Ö. Nomaler and B. Verspagen	Draft



Part 2. Inequality and the emissions footprint: a European empirical perspective. A technical report

Executive summary

We estimate the greenhouse gas emissions footprint of households in 17 countries in the European Union, for a selection of years 2010, 2015 and 2020. We find that households with higher income have higher per capita footprints, but lower per euro footprints. This means that the effect of per capita consumption expenditures dominate over the impact of the structure of spending on emissions. This results from the fact that low income households spend a larger part of their consumption budget on high emission goods and services, such as electricity. We also look at the changes of emission footprints, and find that for most of the cases (countries, years, income classes), footprints are reduced over the period 2010 – 2020. The largest reductions tend to be found for high income households. When we decompose the changes of emission footprints into three effects (changes of per capita consumption, changes in consumption structure, and changes in emission coefficients, i.e., emissions per euro spent on goods and services for a specific type), we find that the effect of emission coefficients dominates by far.

1. Introduction

In this part of Deliverable 3.2 for the ST4TE project, we will report on an analysis undertaken for Task 3.2 “Consumption drivers: Income inequality and the consumption carbon footprint”. It is a technical report in the sense that we report on the details of the data analysis and its outcomes, without drawing policy conclusions, and without linking the results to the broader debate on inequality, greenhouse gas emissions, and climate change.

The aim of the analysis is to estimate the greenhouse gas (GHG) emission footprint linked to consumption expenditures of individual households in the EU, and to investigate the correlation between this footprint and household income. By “footprint” we refer to the total global emissions that were caused by the production consumed goods and services, including intermediate deliveries that were made to enable this production. While intermediate deliveries are included, investment made related to production is not included in the footprint. As an example we may consider a loaf of wheat bread. Included in the emission footprint of the bread are all emissions related to the production of the bread (e.g., baking, delivery, etc.), all emissions related to the production of wheat used in the bread, all emissions related to the production of fertilizer used for growing the wheat, etc. Not included are emissions related to producing the oven in which the bread is baked, the tractor used to sow the wheat, etc.



The main aim of the analysis is to relate emissions by households to household income, and thus to provide useful information for judging the fairness of the green transition as it is unfolding in the EU. Because fairness is not objectively measurable, we do not draw final conclusions on fairness. Those willing to subjectively interpret our results, however, can easily draw such conclusions, using the information that we provide on per capita household emissions, per euro (of consumption expenditures) household emissions in 2010, 2015 and 2020, and the change (reduction) in per euro emissions from 2010 – 2015, 2010 – 2020 and 2015 – 2020. Overall, we find that per capita emissions rise with household income, that per euro emissions fall with household income, and that per euro emission reductions fall with household income.

Our analysis uses micro data from the household budget surveys (HBS) as reported by Eurostat, which is combined with macro-sectoral-level data from the multi-regional input-output tables (MRIO) supplied by OECD (ICIO). The main flow of our analysis is to collect data on consumption expenditures for a large number of detailed classes from HBS, then to aggregate those to the level of 45 sectors used in the MRIO, and finally calculate emissions using input-output theory and the satellite accounts of the MRIO. This procedure will be explained in Section 2 below.

Section 3 explains details about the data used, and Section 4 presents the results. Here we look at per capita emissions of households, using 20 quantile groups of per capita income. We investigate the way in which per capita consumption and per euro emissions influence per capita emissions, and we look at the change of the emission footprint over time. Section 5 summarizes the conclusions of the analysis.

2. Methodology: micro-to-macro

2.1. Input-output tables

We will start by explaining the structure and working of the input-output system that is used to calculate emission footprints from consumption data. A small toy version of the basic input-output table is shown in Diagram 1. **A** and **B** are the emitting entities. In reality these are sectors within countries, such as the agriculture sector or the motor vehicles sector in different countries. In the toy example, we have just two emitting entities, and we can think of these as countries without any disaggregation into sectors. The U_{xy} values are intermediate deliveries between the emitting entities, and **FD-X** are deliveries to household consumption in **A** or **B**. **Q** is gross output and **VA** is value added. There are also total emissions **E_A** and **E_B** made by the emitting entities (not documented in the diagram).

As first steps in the analysis, we calculate $d_x = E_x / Q_x$ (emissions divided by gross output), which we call the emission intensities, and all $a_{xy} = U_{xy} / Q_y$ (intermediate use divided by gross output), which are the input coefficients. The *a*'s are then collected in a (2-by-2) matrix **A**, and **I – A** is calculated, where **I** is the 2-by-2 identity matrix. Also, the *d*'s are collected in a 2-by-2 matrix **D** that has elements *d* on the diagonal and zeros elsewhere. Then **D** x (**I – A**) x **F**, where **F** is the matrix of F_{xy} 's, will yield a 2-by-2 matrix that will call **Z**. The row sums of matrix **Z** are equal to total emissions made by the emitting entities (i.e., **E_x**). The column sums are equal to total emissions related to consumption expenditures by consumers in **A** or **B**. If, instead, we construct a 2-by-1 vector **f** that contains consumption expenditures by a single household (in



A or **B**) distributed over the emitting entities, the multiplication $\mathbf{D} \times (\mathbf{I} - \mathbf{A}) \times \mathbf{f}$ will yield a 2-by-1 vector $\mathbf{z}$ that contains emissions due to consumption of the household. The rows of these vectors correspond to the emitting entities, i.e., the first (second) row of $\mathbf{z}$ contains emissions made by **A** (**B**) for consumption of the household.

Diagram 1. Toy example of the basic input-output table

	A	B	FD-A	FD-B	Q
A	U_{11}	U_{12}	F_{AA}	F_{AB}	Q_A
B	U_{21}	U_{22}	F_{BA}	F_{BB}	Q_B
VA	V_A	V_B			
Q	Q_A	Q_B			

Note that in order to construct vector $\mathbf{f}$, we will use information from the HBS that tells us how much the household spends on goods and services in a particular sector (e.g., agriculture), and the MRIO tells us how this is distributed (for the average household) over the supplying countries (agricultural sectors in the various countries). In this procedure, we assume that all households in a country (i.e., independent of household income) distribute their spending in the same way (corresponding to the average). This means that we do not allow for the possibility that, for example, one household buys all agricultural goods from domestic agriculture, and another household buys those goods exclusively from a foreign agricultural sector.

2.2. Micro-to-macro

The micro data for consumption by households come in the form of yearly expenditures in euro for 298 expenditure categories in 2015 and 2020, or 196 categories in 2010. The MRIO has 45 sectors. Thus, in order to be able to feed consumption data into the MRIO, the HBS categories need to be aggregated to the 45 sectors. Obviously, this implies a harsh and large loss of detail that will influence the outcome of the analysis. For example, we (partially) assigned both “Electricity” (HBS category 04510) and “Natural gas or town gas” (04521) to MRIO sector “Electricity, gas, steam and air conditioning supply” (sector D) of the MRIO. Therefore, expenditures in both of these HBS categories will receive identical per euro emissions, even if emissions may in actual fact be different between the two categories.

Another limitation is that we cannot account for so-called direct emissions by final use. This mostly concerns emissions from burning fossil fuels, such as gas, gasoline or diesel, for cooking, heating driving and the like. Aggregate data for these direct emissions by households exist in the MRIO system, but there is no obvious way to link these data to consumption expenditures. In the future, we may specify direct emissions by using expenditures on specific fuels such as diesel (07221) or petrol (07222) combined with average yearly fuel prices, to obtain fuel volumes that can be linked to emissions using standard conversion rates, but this was not done at this stage.

Even if we must accept these limitations, there is another major decision to be made about assigning HBS categories of consumption spending to MRIO sectors. This is related to the fact that very often the spending categories fit to more than a single MRIO sector. There are two main reasons for this. On the one hand, the HBS categories may mix different types of goods



and services that belong to distinct MRIO sectors. For example, “Products for pets” (09342) may refer to animal food (produced by “Food products, beverages and tobacco”, C10T12), a dog collar (produced by “Textiles, textile products, leather and footwear”, C13T15), a doghouse (produced by “Wood and products of wood and cork”, C16), or a food bowl (produced by “Fabricated metal products”, C25). There is no way of knowing which of these sectors was actually involved to what extent in the expenditures for 09342 of a particular household.

Second, most expenditures categories in the HBS originate from more than a single sector. This mostly concerns the role of the “Retail and wholesale” sector (G). This sector brings products and services from other sectors to the consumer, but this is not modelled as an input-output relation in the MRIO (i.e., a pizza sold in a supermarket is not an intermediate delivery to the retail sector). Another example is “support activities for transportation” (part of H52), which includes travel agents who sell air tickets to consumers. We have no way of knowing the margins of retail trade or travel agents from the data that we have, so we will have to estimate their share in total consumption expenditures.

We solve these issues by comparing and matching the aggregated HBS data and the MRIO data. In the MRIO, we have a column for household consumption for each country, containing all combinations of sectors and countries (of origin). Thus, for example, we have total expenditures for household consumption in Spain, split by the supplying sectors agriculture in Germany, agriculture in Spain, fabricated metals in Switzerland, etc. We sum these over countries in a sector, and then obtain total household consumption spending in a country split over the 45 sectors of the MRIO. We calculate the shares of the 45 sectors in this total, and denote this by S_{ij} , where the subscript i denotes the country where consumption expenditure is recorded, and j is the supplying sector (in all countries together). Obviously, the S_{ij} 's will sum to 1.

We also calculate, for each country, total consumption expenditures in HBS category k and denote this by Y_{ik} , where i is (again) the country where consumption expenditures are recorded. This calculation uses the sample weights that are supplied for each household. Next we introduce a set of weights w_{ikj} that relate the HBS categories k to MRIO sectors j . The value of w_{ikj} gives us the share of expenditures in category k that is assigned to sector j , hence the sum of w_{ikj} for a single k (and i) is exactly one. Each country i has its own set of weights w_{ikj} .

We estimate the weights w_{ikj} as follows. First we establish that the sum over k of all pairs $Y_{ik} \times w_{ikj}$ for a single i and single j , represents total expenditures for goods and services supplied by sector j (in all countries) to consumers in country i . This sum is denoted as Y_{ij} , and the values of this for all j within a single country i can be used to calculate the share s_{ij} that denotes the share of supplying sector j in all consumption expenditures in i . Obviously, s_{ij} and S_{ij} measure the same share, but seen from different perspectives: s_{ij} from the point of view of the HBS and S_{ij} from the point of view of the MRIO. We choose the weights w_{ikj} in an iterative procedure that minimizes the sum $(s_{ij} - S_{ij})^2$ over all j , for every country i . This is a constrained optimization because many of the w_{ikj} are set to zero ex ante (because the nature of the good or service does not match the supplying sector, e.g., w_{ikj} for k = “Products for pets” (09342) and j = “Other transport equipment” (C30) is always zero), and because the sum of all w_{ikj} for a single k has to be one.

We use the COIN-OR Bonmin nonlinear solver as implemented in the OpenSolver add-in (v2.9.3) for Excel to solve these optimization problem. For every combination of year and



country (of location of consumption expenditures), we run one optimization, resulting in a tailored set of weights w_{ikj} for the case. We always start the optimization from the same set of initial weights w_{ikj} . These weights are documented in the Excel file called *MicroToMacroInitialWeights.xlsx* that is supplied as part of this deliverable.

3. Data

We use the 2023 version of OECD's ICIO MRIO dataset, which covers all three years for which we have HBS data (2010, 2015, 2020). It must be noted that the satellite accounts of this dataset use only emissions from burning fuels. Other types of emissions are therefore not included in our results. The ICIO dataset contains 76 countries plus a rest-of-the-world, and 45 sectors. The sectors and countries are listed in Appendix 2.

For the HBS data, we use the February 2025 version with microdata, supplied by Eurostat. All microdata variables (consumption expenditures, household income, household size) are included in this dataset. We use only domestic consumption expenditures, which means that direct consumption purchases abroad are excluded from the analysis. The reason for this exclusion is that the data on direct purchases abroad are very broadly defined, and contain many missing values. Three consumption categories are not available in the data: narcotics (HE023), games of chance (HE0943) and prostitution (HE122).

For income, we use monetary income of the household, and for household size, we use the number of persons. Alternative income definitions are available, e.g., including imputed rent of properties owned by the household. We did all calculations using the income measure with imputed rents included, but this did not change the results in any significant way. For household size, there are also two alternative measures of so-called "equivalent size", which take account of scale effects in running a household, accounting for age of household members. Again, we did all calculations with these alternative size measures, but this did not change results in any significant way.

The micro data of some countries contain missing values and/or inconsistencies. The inconsistencies usually concern mismatches between the sum of expenditures at different aggregation levels. For example, for some households, we may have a larger value for expenditures of "Coffee, tea and cacao" (HE0121) than the sum of expenditures for "Coffee" (HE01211), "Tea" (HE01212) and "Cacao and powdered chocolate" (HE01213). In such a case, adjust the lower-level-aggregated categories proportionately to make the totals match.

Where there are many (large) of these inconsistencies, we exclude the country – year combination from the analysis. Some subjective judgment was used in these decisions. For the Netherlands, we observe many negative consumption values in all three years, and we excluded the country all together. Italy has no data for income, and we also had to exclude this country. Finally, we also excluded countries where only one year is left, because no estimations of emission reduction can be made in this case. In the end, we included the countries and years in Table 1 in the analysis.



	2010	2015	2020
Belgium	Good	Patched	Patched
Bulgaria	Good	Good	Good
Cyprus		Patched	Patched
Denmark	Patched	Good	Good
Greece	Patched	Patched	Patched
Spain	Patched	Patched	Good
Finland	Good	Patched	
Croatia	Good	Good	Good
Hungary		Patched	Patched
Ireland	Patched	Patched	Good
Lithuania	Good		Patched
Luxemburg		Patched	Patched
Latvia	Good		Patched
Portugal	Patched	Good	
Romania	Patched	Patched	
Slovenia	Good	Patched	Good
Slovakia	Good	Good	Good

Table 1. Countries and years included in the analysis

Note: Combinations with empty cells are excluded from the analysis; cells containing “Patched” indicate combinations for which inconsistencies in the data had to be handled; cells containing “Good” indicate combinations for which no data handling was necessary.

For the analysis of changes of emission footprints over time we will also use the consumer price index, for which we use Eurostat’s Harmonised index of consumer price, ECOICOP version 2. The base year of this price index is 2025, but we divide the index by the 2020 value, and use the result as a price index with base year 2020.

4. Results

4.1. Total per capita emissions and per euro emissions¹

As the first step in our analysis, we calculate total emissions (in tonnes of CO₂ equivalents) for each household by feeding the vector of consumption expenditures (per MRIO sector) through the MRIO, as described in Section 2. Next we create one dataset for each combination of country and year, and in this dataset we have observations for each household on per capita income, per capita emissions and per euro-consumption emissions. We also round the weight variable of each household, and then repeat the household as many times as the rounded weight indicates.

Then we divide observations into 20 quantile groups (5% each), based on per capita income. These quantile groups are used in Figure 1 below, which is an example chart for Spain 2015.

¹ Lithuania in 2020 is excluded for the analysis in this sector, because repetition of household observations based on sample weights makes one income quantile unavailable.



In the top left chart of Figure 1, we have box charts for the per capita consumption spending variable for each of the 20 quantile groups (lowest income on the left, highest income group on the right). Other charts in Figure 1 are for per capita income (the same variable as used for creating the quantiles), per capita emissions, and per-consumption-euro emissions.

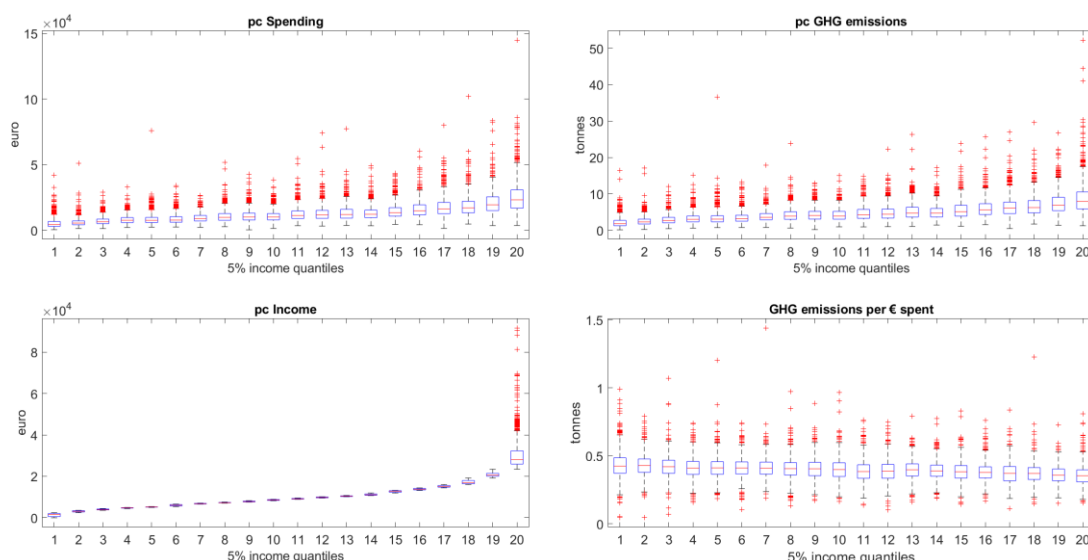


Figure 1. Box plots for Spain, 2015 (example)

Each box (in blue) covers the 25-to-75 percentile values of each quantile group, with the red line inside the box indicating the median value. The whiskers extending from the box indicate the inter-quartile range and red crosses are individual values outside the inter-quartile range (outliers).

The position of the boxes relative to each other indicates whether or not a trend over income quantiles exist for the variable. For example, for per capita consumption spending, we observe that the boxes, and median lines inside the boxes, are generally positioned higher for quantiles with higher income (i.e., going from left to right). This means that per capita consumption spending generally rises with per capita income (for Spain in 2015). By definition, the same is true for per capita income (bottom-left chart). The two charts on the right show results for the two emissions variables. The impression in Figure 1 is that per capita emissions rise with income, but per euro emissions fall with income.

In order to identify such “trends” in a more precise way, we use Kendall’s Tau, which is a non-parametric correlation measure.² Table 2 documents Kendall’s Tau for the median values

² Consider the correlation between per capita income and per capita emissions as an example. Kendall’s Tau first enumerates all possible pairs of observations, in our case $((20 \times 20) - 20)/2 = 190$ pairs. Then it identifies each pair as either concordant, which means that the member of the pair with higher income also has higher emissions, or discordant, which means that the member of the pair with higher income has lower emissions. Then Tau is equal to (Number of concordant pairs – Number of discordant pairs) divided by total number of pairs. Because this is a non-parametric statistic (no assumptions are made about the distributions of the two variables), the variance can be derived analytically (it depends only on the number of observations), which can then be used to calculate *p*-values. In other words, a fixed analytical relation between the value of Tau and its *p*-value exists. This will be used below.



within each income quantile as in Figure 1, for each of the country – year combinations. This shows a very clear and strong pattern. First, per capita emissions are positively correlated to per capita income (as measured by the 20 income quantiles). For this variable, all 43 cases have positive Kendall's Tau with $p < 0.01$. For per euro emissions, all except one correlations are negative (the exception is Finland in 2015). 36 of the 42 cases with negative Tau have $p < 0.01$, four more of those have $0.01 < p < 0.05$. The remaining four cases (including Finland 2015) have $p > 0.1$.

	Per capita emissions						Per euro emissions					
	2010		2015		2020		2010		2015		2020	
Belgium	1.000	***	1.000	***	0.947	***	-0.779	***	-0.684	***	-0.495	***
Bulgaria	0.968	***	0.989	***	0.947	***	-0.716	***	-0.789	***	-0.789	***
Cyprus			0.947	***	0.979	***			-0.863	***	-0.821	***
Denmark	0.863	***	0.947	***	0.905	***	-0.621	***	-0.537	***	-0.200	
Greece	0.958	***	0.958	***	0.958	***	-0.853	***	-0.674	***	-0.758	***
Spain	0.979	***	0.979	***	0.968	***	-0.916	***	-0.916	***	-0.758	***
Finland	0.947	***	0.979	***			-0.379	**	0.221			
Croatia	0.947	***	0.947	***	0.853	***	-0.874	***	-0.800	***	-0.800	***
Hungary			0.979	***	0.989	***			-0.579	***	-0.021	
Ireland	0.937	***	0.979	***	0.895	***	-0.874	***	-0.895	***	-0.663	***
Lithuania	0.979	***	0.621	***			-0.347	**	-0.379	**		
Luxembourg			0.979	***	0.853	***			-0.653	***	-0.474	***
Latvia	0.895	***	0.916	***			-0.800	***	-0.726	***		
Portugal	0.968	***	0.968	***			-0.821	***	-0.874	***		
Romania	1.000	***	1.000	***			-0.979	***	-0.863	***		
Slovenia	0.884	***	0.916	***	0.937	***	-0.663	***	-0.379	**	-0.621	***
Slovakia	0.968	***	0.979	***	0.947	***	-0.863	***	-0.853	***	-0.789	***

Table 2. Kendall's Tau for median values as in Figure 1, for each combination of country and year, per capita income and per capita emissions and per capita income and per euro emissions, 20 observations (per capita income quantiles) for each case

Note: 1, 2 and 3 stars indicate p-values below 0.01, 0.05 and 0.1, respectively.

Kendall's Tau does not give us an indication of the differences between income quantiles in terms of emissions. This is where Figure 2 provides additional information. This figure documents the relative footprints between two income quantiles. The colours of each cell indicates the footprint of the row income quantile divided by the of the column quantile. For example, for the per capita footprint in 2010, the bright yellow colour in the bottom-left cell shows that the per capita footprint in the highest income quantile is about 3.5 times as large as in the lowest income quality. The main diagonal in each chart is 1 by definition.



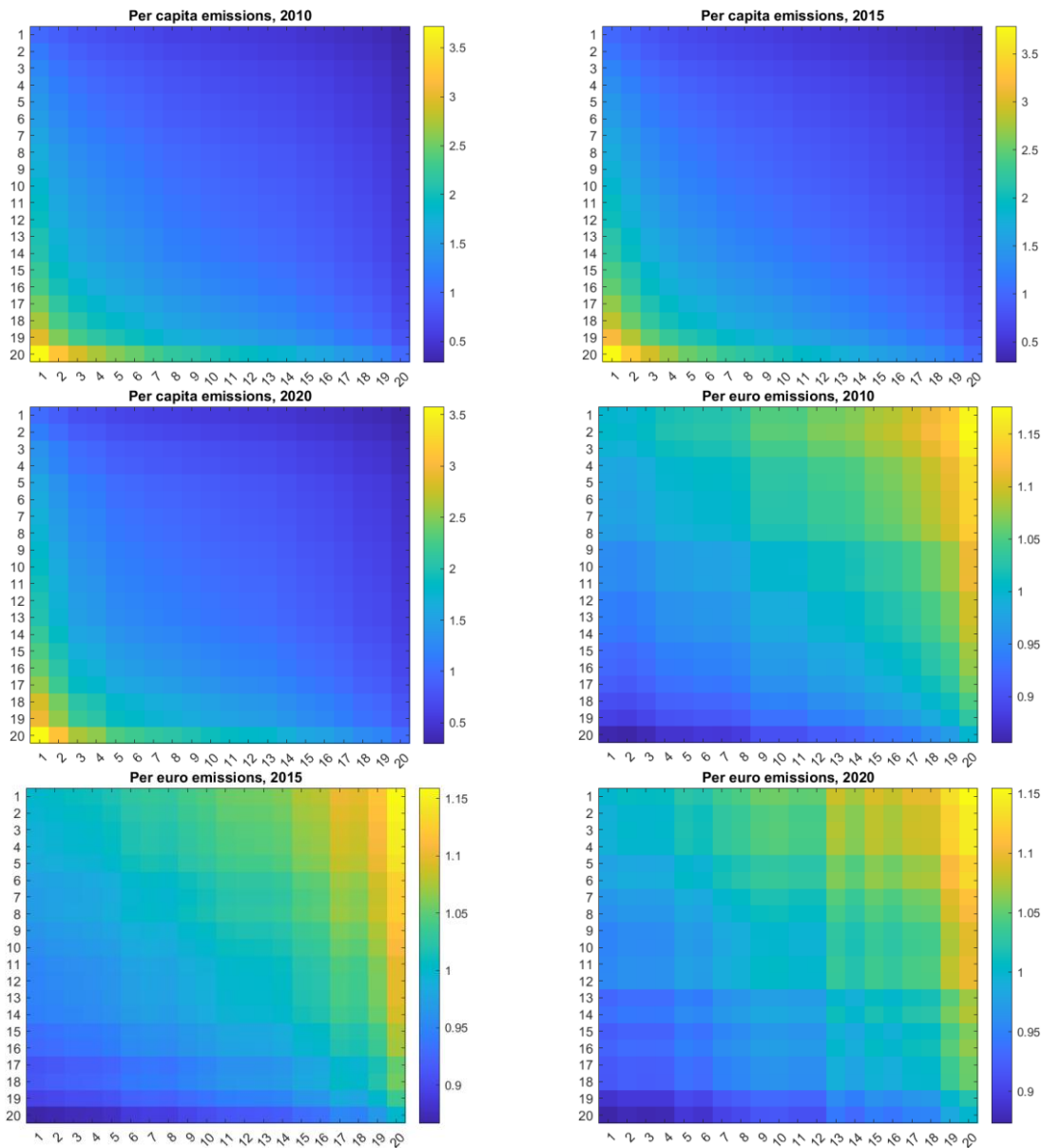


Figure 2. Relative per capita and per euro emission footprints between income classes. The colour in each cell indicates the footprint of the vertical income class divided by the footprint of the horizontal income class; average over available countries in each year

The maximum values in the charts for per capita footprint vs. those of per euro footprint also tell us a story about the relative influence on the per capita footprint of per euro emissions and per capita consumption. For this we can write a simple equation, using E for total emissions of a household, C for total consumption in euro, and N for the number of household members:

$$\frac{E_{pT}/N_{pT}}{E_{qT}/N_{qT}} = \frac{E_{pT}}{C_{pT}} \times \frac{C_{pT}}{N_{pT}} \times \frac{N_{qT}}{C_{qT}} \times \frac{C_{qT}}{E_{qT}} = \frac{E_{pT}}{C_{pT}} \times \frac{C_{pT}}{N_{pT}} \times \frac{N_{qT}}{C_{qT}} \times \frac{C_{qT}}{E_{qT}}$$

where we also use subscripts p and q to indicate income quantile groups, and subscript T for time (years). The division on the left is what is found in the first three sub charts of Figure



2, i.e., per capita emissions in one income quantile divided by that of another. On the right, this is written as the multiplication of two new ratios, with the first ratio being that between per euro emissions, and the second ratio between per capita consumption.

Taking the example of the most extreme differences, i.e., p indicating the highest income quantile and q being the lowest quantile, Figure 2, shows that the expression on the lefthand side is about 3.5 in each of the years. Figure 2 also shows that the ratio between per euro emissions between p and q is close to 0.9. A back-of-the-envelope calculation then shows that the ratio of per capita consumption must be about 3.9, so that $3.5 \approx 0.9 \times 3.9$. Similarly, taking the ratio of per euro emissions as given at 0.9, a ratio of per capita income between the highest and lowest income quantiles equal to about 1.1 would produce equal per capita emission levels between the two quantiles ($1 \approx 0.9 \times 1.1$). In conclusion, the magnitude of differences in per capita income dominates the magnitude of per euro emissions by a factor larger than 3.

This leads us to the first general summary conclusion of the analysis: households with higher per capita income tend to have higher per capita emissions, but also lower per euro emissions. But differences in per capita emissions between households in different income quantiles are mainly driven differences in levels of per capita consumption, i.e., consuming less/more, rather than consuming more/less emission-intensive goods and services is responsible for differences in emission footprints between income classes.

This raises two more questions that we will investigate in the next two sub sections. First, if households with higher income have a lower emission footprint per euro spent, which types of goods services are responsible for this tendency? Which are the high-emission goods and services that households with high income consume relatively less, or which are the low-emission goods and services that they consume relatively more?

The second question is what are the tendencies for changes (reductions) in emission footprints over time? Are these changes also correlated with per capita household income? And which are the main factors (changes in per capita household income, in emission coefficients, or the structure of consumption spending) that contribute to the changes of emission footprint?

4.2. Which sectors make a difference?³

In order to investigate which of the 45 MRIO sectors are responsible for the lower per euro footprint of households with higher incomes, we introduce a new variable, which is

$$Y_{icT} = G_{icT} \frac{1}{45} \sum_d S_{icdT}$$

where G_{icT} is the emission coefficient (emissions in tonnes per euro of consumption spending) for spending on goods and services of MRIO sector i done by consumers in country c in year T , and S_{icdT} is the share of consumption expenditures on MRIO sector i by consumers in country c in income quantile d and year T . Note that emission coefficients (G) bear a subscript c because consumers in each countries buy goods and services of type i from different countries. For example, if i is agriculture (e.g., apples directly from the grower), consumers located in Belgium may buy 90% of their agriculture value from Belgian suppliers, and 10% from Dutch suppliers, whereas German consumers may buy 95% from German

³ Lithuania in 2020 is excluded for the analysis in this sector, because repetition of household observations based on sample weights makes one income quantile unavailable.



suppliers and 5% from Dutch suppliers. Because emissions per unit of output may differ between Belgian, German and Dutch firms, G_i will differ between Belgium and Germany.

Note also that $(1/20) \sum_d S_{icdT}$ is the average over income classes of the share of sector i in total consumption spending in the country and year. Multiplying this by the emission coefficient G_{icT} gives the sector i 's contribution to the per euro emission footprint by an average income class in the country and year. This the variables that is on the horizontal axis of the sub charts of Figure 3 below.

For each of the country-year observations within a sector i , there are 20 expenditure shares, one for each income class (the shares are averages within the class). We calculate the Kendall Tau for these observations, as was done above for emission footprints (Table 2). If this Tau is positive (negative), it indicates that higher income households tend to spend relatively more (less) on goods and services of the sector i . For example, we find that for Belgium in 2010, Tau is -0.863 for the sector "Food products etc.", which indicates that higher income households spend relatively less on these products, compared to households with lower income.

We use this information on Kendall's Tau for the vertical axis of the sub charts in Figure 3. On this axis, we display the number of positive values for Tau minus the number of negative values, counting only those values for which the p -value ≤ 0.1 . Thus, sectors with a positive (negative) value on the vertical axis tend to be sectors for which households with high income have higher (lower) spending shares. For example, in the 2010 chart of Figure 3, "Agriculture" and "Food products" have the lowest values (-13), meaning that these are sectors for which households with lower income tend to have higher spending shares. Thus, on the vertical axis we measure the relative preference of high income households.

The results in Figure 3 are remarkably stable over the decade 2010 – 2020. There is always the same ranking of the top-3 sectors in terms of the average contribution to the per euro emissions footprint: "Electricity and gas" comes first, then "Food products", then "Agriculture". Other sectors have much smaller contributions to the average footprint, although "Trade", "Real estate", "Water", "Chemicals", "Refines petroleum" and "Hotels etc." always rank above the tail of the distribution. Among this set of sectors, only "Refined petroleum" and "Hotels" show a relative preference of high income households. Interestingly, "Air transport", which is also a sector showing a relative preference of high income households, consistently shows a low contribution to the emission footprint.

The conclusion is therefore that the per euro emission footprint of households with low per capita income level tends to be lower than the footprint of high income households because households with lower incomes spend more of their total consumption budget on sectors that have high emission footprints, especially "Electricity and gas", "Food products" and "Agriculture".



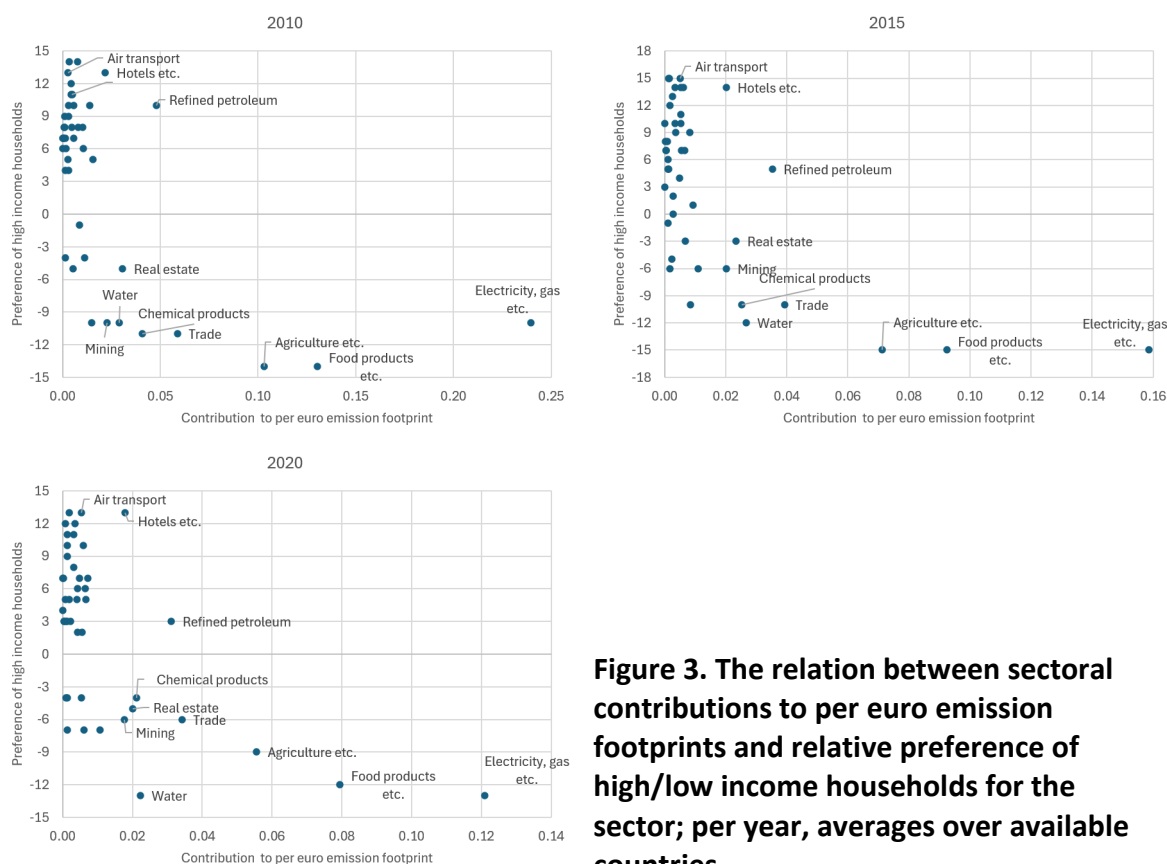


Figure 3. The relation between sectoral contributions to per euro emission footprints and relative preference of high/low income households for the sector; per year, averages over available countries

4.3. Changes in emission footprints⁴

As we have three years of data, there are three possible changes between periods: 2020 – 2010, 2015 – 2010 and 2020 – 2015. For each of those three periods, Figure 4 reports the number of times that the per capita footprint reduced or increased, within each of the income quantiles. These are counts over countries, e.g., we have 10 countries for which we can calculate the 2020 – 2010 change. Reductions of the footprint are most common, but there is always and in each of the income classes a minority of cases for which the footprint increases. Kendall's Tau for the correlation between income class and the number of reductions is always positive, i.e., reductions are (slightly) more common in the high income classes.

⁴ Lithuania is excluded entirely for the analysis in this sector, because repetition of household observations based on sample weights makes one income quantile unavailable.





Figure 4. Number of reductions and increases of per capita footprints, per income quantile, totals over available countries for period; reported Kendall Tau is for number of reductions (number of increases is reported Tau multiplied by -1)

In Section 4.1, we distinguished between per capita consumption and the per euro footprint as two distinct factors underlying per capita emissions. Moreover, Section 4.2 introduced emission coefficients (G) and the structure of total consumption expenditures (S) as factors underlying the per euro emissions footprint. Here we will use those three factors to decompose the change in the per capita emission footprint in each of the income classes.

The mathematical details of our decomposition method are explained in Appendix 1. The intuition behind the method is as follows. In Section 4.1, the total per capita emission footprint was broken down into two components: per capita consumption expenditures, and per euro emissions. In our decomposition method, this distinction is used for a first-level decomposition: changes in the per capita emissions footprint can be broken down into two components: one that measures the impact of changes in per capita consumption, and a second one that measures the impact of changes in per euro emissions. Note that we will be using consumer prices indices to measure consumption in prices of 2020, so that there is no impact of inflation in the decomposition.

Following the use of emission coefficients and spending shares to look at the per euro footprint, the second level of our decomposition decomposes changes in per euro emissions into a part that captures changes in emission coefficients, and a part that captures changes in the structure of consumption spending. Thus, we have three effects that together make up total changes of per capita emissions: (1) changes in per capita consumption (in prices of 2020), (2a) changes in emission coefficients (emissions per euro spent in an MRIO sector), and (2b) changes in the shares of the MRIO sectors in total consumption spending.

This decomposition is performed for every income class in every country in every one of the three periods of change. The results for averages over countries are displayed in Figure 5. In all three period, changes in emission coefficients is by far the largest source of emission reduction. Changes (i.e., increases) in per capita consumption mostly contribute to increasing emissions, except in the period 2015 – 2010, when consumption spending seems to have been influenced by the aftermath of the financial crisis of 2009 and the Euro crisis that



followed. Changes in the structure of consumption spending are small, and whether they tend to increase or reduce depends on the period.

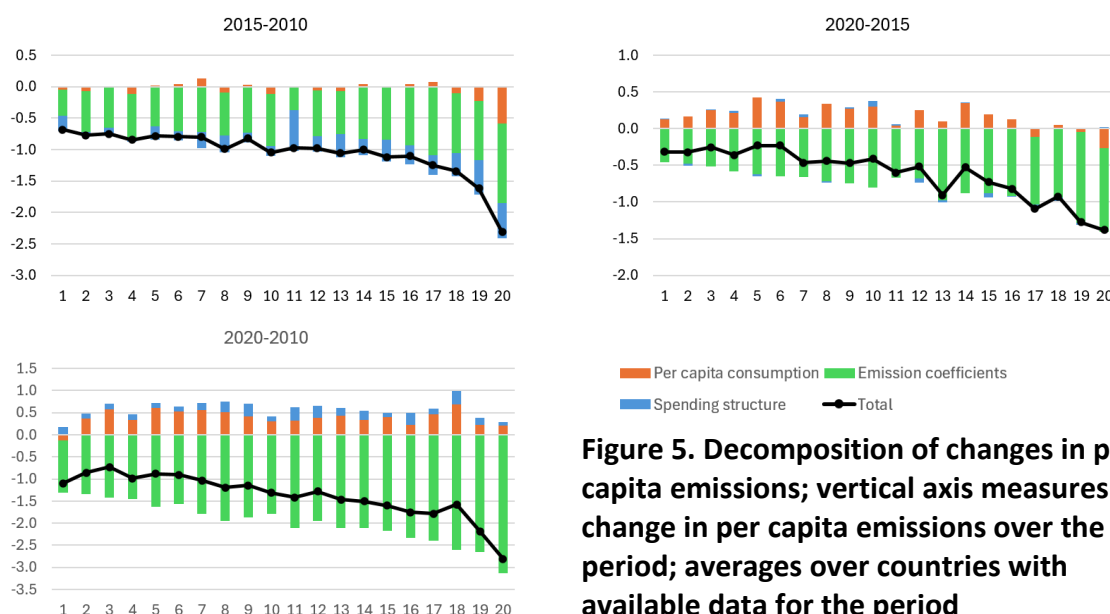


Figure 5. Decomposition of changes in per capita emissions; vertical axis measures change in per capita emissions over the period; averages over countries with available data for the period

Figure 5 also suggests that higher income classes have higher emission reductions, especially the emission coefficients effect. This was tested using Kendall's Tau. Figure 6 presents counts for positive (and $p \leq 0.1$), negative (and $p \leq 0.1$) and non-significant ($p > 0.1$) Tau values within each period, and for totals as well as the three effects. For the total effect, the majority of Tau values are negative and significant. Combined with Figure 4, this means that in the majority of cases, high income households reduce their per capita emissions footprint more than low income households. But note that high income households had much higher footprints to start with, and this remains true even at the end of our period (see Table 2 and Figure 2 above).

For the individual effects, negative and significant Tau values are most common for the emission coefficients and the spending structure, i.e., the two effects that make up changes in per euro emissions. For per capita consumption, negative and positive Tau values are more balanced, but this must also be seen in light of the sign of this effect (Figure 5), that varies between periods.

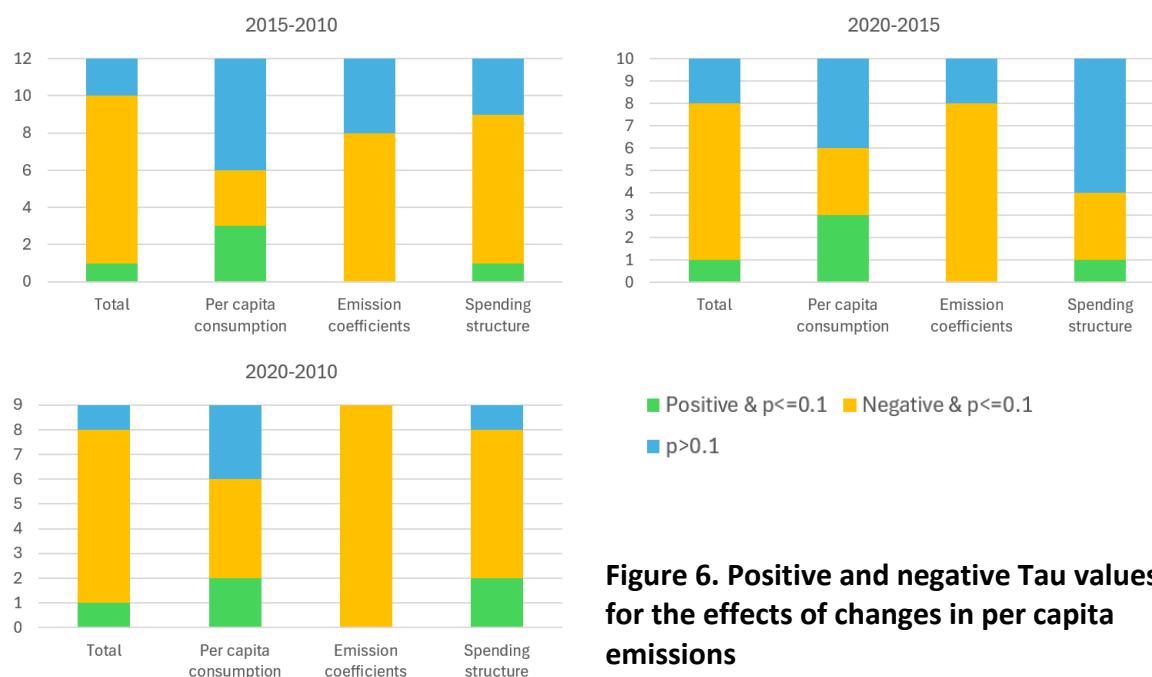


Figure 6. Positive and negative Tau values for the effects of changes in per capita emissions

Note: Spain is excluded because of outliers in the decomposition effects

5. Conclusions

We constructed the per capita emission footprint for households in 17 countries in the European Union, for a selection of years 2010, 2015 and 2020. We divided those households into 20 quantile groups of per capita income for each country – year case, and found that per capita emissions are always positively correlated with these classes, i.e., higher income households have higher emission footprints. The per capita footprint can be broken down into two components: per euro (of consumption expenditure) emissions, and per capita consumption spending. We find that higher income households tend to have lower per euro emissions, but higher per capita consumption expenditures more than make up for this. We also investigated the factors behind the lower per euro footprint of high income households, and found that the sectors that have the highest emissions per euro output are “Electricity and gas”, “Food products” and “Agriculture”, and that lower income households tend to have higher consumption spending shares for these sectors.

Finally, we investigated the change of emission footprints over the period 2010 – 2020 for each country – year combination. In this period, reductions of emission footprints were most common. We were able to calculate three components of the overall change of per capita emission footprints: changes in per capita consumption expenditures (in fixed prices), changes in emission coefficients, and changes in the structure of consumption spending. Of these three components, changes (reductions) in emission coefficients were by far the most important effect, accounting for the largest share of emission footprint reductions. We also



found that high income households tend to have larger reductions of their footprints than lower income households.



Appendix 1 – Decomposition methods for change of per capita emission footprint

We denote total emissions in tonnes of CO₂ equivalents of a household in year T by E_T , the number of members of the household by N_T , and total consumption expenditures in euro by the household by C_T . We also use the consumer price index P_T , with base year 2020. Then consumer expenditures in 2020 prices are equal to $\bar{C}_T = C_T/P_T$. For simplicity, we will omit any subscripts for country or income quantile in this appendix. The equations hold at the household level, but in the main text the equations will be used for a specific income quantile in a specific country.

In the analysis in the main text, we calculate, at the household level, total per capita emissions (E_T/N_T) and total per euro emissions (E_T/C_T). Note that the latter is in current prices of the year T , and the former has been calculated using emission coefficients (emissions per unit of output) from the MRIO that are also in current prices. For analysis of changes over time, we wish to eliminate the effect of price changes, so we would rather use consumption in prices of the base year, as in $\bar{C}_T$.

However, for per capita emissions of the household, it does not matter whether we use consumption in current or constant prices, because we can write:

$$\frac{E_T}{N_T} = \frac{E_T}{C_T} \times \frac{C_T}{N_T} = \frac{E_T}{\bar{C}_T} \times \frac{\bar{C}_T}{N_T} \quad (1)$$

where C_T/N_T is per capita consumption in current prices, or $\bar{C}_T/N_T$ is the same in constant prices. Using consumption in constant prices, there are two alternative ways of writing the difference in per capita emissions between $T = 0$ and $T = 1$:

$$\frac{E_1}{N_1} - \frac{E_0}{N_0} = \frac{E_1}{\bar{C}_1} \left(\frac{\bar{C}_1}{N_1} - \frac{\bar{C}_0}{N_0} \right) + \frac{\bar{C}_0}{N_0} \left(\frac{E_1}{\bar{C}_1} - \frac{E_0}{\bar{C}_0} \right) = \frac{E_0}{\bar{C}_0} \left(\frac{\bar{C}_1}{N_1} - \frac{\bar{C}_0}{N_0} \right) + \frac{\bar{C}_1}{N_1} \left(\frac{E_1}{\bar{C}_1} - \frac{E_0}{\bar{C}_0} \right) \quad (2)$$

In this equation, the change in per capita emissions is decomposed into one effect due to changes in per euro emissions ($E_1/\bar{C}_1 - E_0/\bar{C}_0$) and another effect due to changes in per capita consumption ($\bar{C}_1/N_1 - \bar{C}_0/N_0$). But the alternative ways of writing use different weights for these effects ($E_1/\bar{C}_1$, $\bar{C}_0/N_0$, $E_1/\bar{C}_1$ or $E_1/\bar{C}_1$). Because the choice of these weights would be arbitrary, we use the average, which yields:

$$\frac{E_1}{N_1} - \frac{E_0}{N_0} = \frac{1}{2} \left(\frac{E_1}{\bar{C}_1} + \frac{E_0}{\bar{C}_0} \right) \left(\frac{\bar{C}_1}{N_1} - \frac{\bar{C}_0}{N_0} \right) + \frac{1}{2} \left(\frac{\bar{C}_0}{N_0} + \frac{\bar{C}_1}{N_1} \right) \left(\frac{E_1}{\bar{C}_1} - \frac{E_0}{\bar{C}_0} \right) \quad (3)$$

The change of per euro emissions ($E_1/\bar{C}_1 - E_0/\bar{C}_0$) can be decomposed further. For this, we introduce two further variables: G_{iT} which measures emissions per euro spent in MRIO sector i in year T , and S_{ijT} , which is the share of consumption total expenditures of income quantile j spent on goods and services produced by MRIO sector i (this already incorporates the way spending in i is distributed over supplying countries) in year T . In particular, for any income quantile, $E_T/\bar{C}_T$ for that income quantile (we omit a subscript j) can be written as

$$\frac{E_T}{\bar{C}_T} = \sum_i S_{iT} G_{iT} \quad (4)$$

Note that for this equation to hold, we must measure G in constant prices, which we do by multiplying G_T by the price index P_T .

Now there are again two alternative ways of writing the change of $E_T/\bar{C}_T$:

$$\sum_i S_{i1} G_{i1} - \sum_i S_{i0} G_{i0} = \sum_i S_{i0} \Delta G_i + \sum_i G_{i0} \Delta S_i + \sum_i \Delta G_i \Delta S_i = \sum_i S_{i1} \Delta G_i + \sum_i G_{i1} \Delta S_i - \sum_i \Delta G_i \Delta S_i \quad (5)$$



Appendix 2 – Sectors, countries and consumption categories

1. MRIO sectors

	NACE	DESCRIPTION
1	A01_02	Agriculture, hunting, forestry
2	A03	Fishing and aquaculture
3	B05_06	Mining and quarrying, energy producing products
4	B07_08	Mining and quarrying, non-energy producing products
5	B09	Mining support service activities
6	C10T12	Food products, beverages and tobacco
7	C13T15	Textiles, textile products, leather and footwear
8	C16	Wood and products of wood and cork
9	C17_18	Paper products and printing
10	C19	Coke and refined petroleum products
11	C20	Chemical and chemical products
12	C21	Pharmaceuticals, medicinal chemical and botanical products
13	C22	Rubber and plastics products
14	C23	Other non-metallic mineral products
15	C24	Basic metals
16	C25	Fabricated metal products
17	C26	Computer, electronic and optical equipment
18	C27	Electrical equipment
19	C28	Machinery and equipment, nec
20	C29	Motor vehicles, trailers and semi-trailers
21	C30	Other transport equipment
22	C31T33	Manufacturing nec; repair and installation of machinery and equipment
23	D	Electricity, gas, steam and air conditioning supply
24	E	Water supply; sewerage, waste management and remediation activities
25	F	Construction
26	G	Wholesale and retail trade; repair of motor vehicles
27	H49	Land transport and transport via pipelines
28	H50	Water transport
29	H51	Air transport
30	H52	Warehousing and support activities for transportation
31	H53	Postal and courier activities
32	I	Accommodation and food service activities
33	J58T60	Publishing, audiovisual and broadcasting activities
34	J61	Telecommunications
35	J62_63	IT and other information services
36	K	Financial and insurance activities
37	L	Real estate activities
38	M	Professional, scientific and technical activities
39	N	Administrative and support services
40	O	Public administration and defence; compulsory social security
41	P	Education



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NACE		DESCRIPTION
42	Q	Human health and social work activities
43	R	Arts, entertainment and recreation
44	S	Other service activities
45	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use



2. Countries included in the MRIO

ISO	NAME	ISO	NAME
1 ARG	Argentina	40 KAZ	Kazakhstan
2 AUS	Australia	41 KHM	Cambodia
3 AUT	Austria	42 KOR	Korea, Rep.
4 BEL	Belgium	43 LAO	Lao PDR
5 BGD	Bangladesh	44 LTU	Lithuania
6 BGR	Bulgaria	45 LUX	Luxembourg
7 BLR	Belarus	46 LVA	Latvia
8 BRA	Brazil	47 MAR	Morocco
9 BRN	Brunei Darussalam	48 MEX	Mexico
10 CAN	Canada	49 MLT	Malta
11 CHE	Switzerland	50 MMR	Myanmar
12 CHL	Chile	51 MYS	Malaysia
13 CHN	China	52 NGA	Nigeria
14 CIV	Cote d'Ivoire	53 NLD	Netherlands
15 CMR	Cameroon	54 NOR	Norway
16 COL	Colombia	55 NZL	New Zealand
17 CRI	Costa Rica	56 PAK	Pakistan
18 CYP	Cyprus	57 PER	Peru
19 CZE	Czechia	58 PHL	Philippines
20 DEU	Germany	59 POL	Poland
21 DNK	Denmark	60 PRT	Portugal
22 EGY	Egypt, Arab Rep.	61 ROU	Romania
23 ESP	Spain	62 RUS	Russian Federation
24 EST	Estonia	63 SAU	Saudi Arabia
25 FIN	Finland	64 SEN	Senegal
26 FRA	France	65 SGP	Singapore
27 GBR	United Kingdom	66 SVK	Slovak Republic
28 GRC	Greece	67 SVN	Slovenia
29 HKG	Hong Kong	68 SWE	Sweden
30 HRV	Croatia	69 THA	Thailand
31 HUN	Hungary	70 TUN	Tunisia
32 IDN	Indonesia	71 TUR	Turkiye
33 IND	India	72 TWN	Taiwan
34 IRL	Ireland	73 UKR	Ukraine
35 ISL	Iceland	74 USA	United States
36 ISR	Israel	75 VNM	Viet Nam
37 ITA	Italy	76 ZAF	South Africa
38 JOR	Jordan	77 ROW	Rest of the world
39 JPN	Japan		



3. HBS categories, 2015 and 2020

	code	description
1	he01111	Rice
2	he01112	Flours and other cereals
3	he01113	Bread
4	he01114	Other bakery products
5	he01115	Pizza and quiche
6	he01116	Pasta products and couscous
7	he01117	Breakfast cereals
8	he01118	Other cereal products
9	he01121	Beef and veal
10	he01122	Pork
11	he01123	Lamb and goat
12	he01124	Poultry
13	he01125	Other meats
14	he01126	Edible offal
15	he01127	Dried_ salted or smoked meat
16	he01128	Other meat preparations
17	he01131	Fresh or chilled fish
18	he01132	Frozen fish
19	he01133	Fresh or chilled seafood
20	he01134	Frozen seafood
21	he01135	Dried_ smoked or salted fish and seafood
22	he01136	Other preserved or processed fish and seafood-based preparations
23	he01141	Milk_ whole_ fresh
24	he01142	Milk_ low fat_ fresh
25	he01143	Milk_ preserved
26	he01144	Yoghurt
27	he01145	Cheese and curd
28	he01146	Other milk products
29	he01147	Eggs
30	he01151	Butter
31	he01152	Margarine and other vegetable fats
32	he01153	Olive oil
33	he01154	Other edible oils
34	he01155	Other edible animal fats
35	he01161	Fresh or chilled fruit
36	he01162	Frozen fruit
37	he01163	Dried fruit and nuts
38	he01164	Preserved fruit and fruit-based products
39	he01171	Fresh or chilled vegetables other than potatoes and other tubers
40	he01172	Frozen vegetables other than potatoes and other tubers

	code	description
46	he01182	Jams_ marmalades and honey
47	he01183	Chocolate
48	he01184	Confectionery products
49	he01185	Edible ices and ice cream
50	he01186	Artificial sugar substitutes
51	he01191	Sauces_ condiments
52	he01192	Salt_ spices and culinary herbs
53	he01193	Baby food
54	he01194	Ready-made meals
55	he01199	Other food products NEC
56	he01211	Coffee
57	he01212	Tea
58	he01213	Cocoa and powdered chocolate
59	he01221	Mineral or spring waters
60	he01222	Soft drinks
61	he01223	Fruit and vegetable juices
62	he02111	Spirits and liqueurs
63	he02112	Alcoholic soft drinks
64	he02121	Wine from grapes
65	he02122	Wine from other fruits
66	he02123	Fortified wines
67	he02124	Wine-based drinks
68	he02131	Lager beer
69	he02132	Other alcoholic beer
70	he02133	Low and non-alcoholic beer
71	he02134	Beer-based drinks
72	he02201	Cigarettes
73	he02202	Cigars
74	he02203	Other tobacco products
75	he03110	Clothing materials
76	he03121	Garments for men
77	he03122	Garments for women
78	he03123	Garments_For_Infants-0-to-2-years_and_children-3-to-13-years
79	he03131	Other articles of clothing
80	he03132	Clothing accessories
81	he03141	Cleaning of clothing
82	he03142	Repair and hire of clothing
83	he03211	Footwear for men
84	he03212	Footwear for women
85	he03213	Footwear for infants and children



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	code	description
41	he01173	Dried vegetables_ other preserved or processed vegetables
42	he01174	Potatoes
43	he01175	Crisps
44	he01176	Other tubers and products of tuber vegetables
45	he01181	Sugar

	code	description
86	he03220	Repair and hire of footwear
87	he04110	Actual rentals paid by tenants
88	he04121	Actual rentals paid by tenants for secondary residences
89	he04122	Garage rentals and other rentals paid by tenants
90	he04210	Imputed rentals of owner-occupiers

	code	description
91	he04220	Other imputed rentals
92	he04310	Materials for the maintenance and repair of the dwelling
93	he04321	Services of plumbers
94	he04322	Services of electricians
95	he04323	Maintenance services for heating systems
96	he04324	Services of painters
97	he04325	Services of carpenters
98	he04329	Other services for maintenance and repair of the dwelling
99	he04410	Water supply
100	he04420	Refuse collection
101	he04430	Sewage collection
102	he04441	Maintenance charges in multi-occupied buildings
103	he04442	Security services
104	he04449	Other services related to dwelling
105	he04510	Electricity
106	he04521	Natural gas and town gas
107	he04522	Liquefied_Hydrocarbons-butane-propane-etc
108	he04530	Liquid fuels
109	he04541	Coal
110	he04549	Other solid fuels
111	he04550	Heat energy
112	he05111	Household furniture
113	he05112	Garden furniture
114	he05113	Lighting equipment
115	he05119	Other furniture and furnishings
116	he05121	Carpets and rugs
117	he05122	Other floor coverings
118	he05123	Services of laying of fitted carpets and floor coverings
119	he05130	Repair of furniture_ furnishings and floor coverings
120	he05201	Furnishing fabrics and curtains
121	he05202	Bed linen
122	he05203	Table linen and bathroom linen
123	he05204	Repair of household textiles
124	he05209	Other household textiles
125	he05311	Refrigerators_ freezers and fridge-freezers

	code	description
136	he05330	Repair of household appliances
137	he05401	Glassware_ crystal-ware_ ceramic ware and chinaware
138	he05402	Cutlery_ flatware and silverware
139	he05403	Non-electric kitchen utensils and articles
140	he05404	Repair of glassware_ tableware and household utensils
141	he05511	Motorized major tools and equipment
142	he05512	Repair_ leasing and rental of major tools and equipment
143	he05521	Non-motorized small tools
144	he05522	Miscellaneous small tool accessories
145	he05523	Repair of non-motorized small tools and miscellaneous accessories
146	he05611	Cleaning and maintenance products
147	he05612	Other non-durable small household articles
148	he05621	Domestic services by paid staff
149	he05622	Cleaning services
150	he05623	Hire of furniture and furnishings
151	he05629	Other domestic services and household services
152	he06110	Pharmaceutical products
153	he06121	Pregnancy tests and mechanical contraceptive devices
154	he06129	Other medical products NEC
155	he06131	Corrective eye-glasses and contact lenses
156	he06132	Hearing aids
157	he06133	Repair of therapeutic appliances and equipment
158	he06139	Other therapeutic appliances and equipment
159	he06211	General practice
160	he06212	Specialist practice
161	he06220	Dental services
162	he06231	Services of medical analysis laboratories and X-ray centres
163	he06232	Thermal-baths corrective-gymnastic therapy ambulance services and hire of ther
164	he06239	Other paramedical services
165	he06300	Hospital services
166	he07111	New motor cars
167	he07112	Second-hand motor cars
168	he07120	Motor cycles
169	he07130	Bicycles
170	he07140	Animal drawn vehicles



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	code	description
126	he05312	Clothes washing machines_ clothes drying machines and dish washing machines
127	he05313	Cookers
128	he05314	Heaters_ air conditioners
129	he05315	Cleaning equipment
130	he05319	Other major household appliances
131	he05321	Food processing appliances
132	he05322	Coffee machines_ tea makers and similar appliances
133	he05323	Irons
134	he05324	Toasters and grills
135	he05329	Other small electric household appliances

	code	description
181	he07243	Driving lessons_ tests_ licences and road worthiness tests
182	he07311	Passenger transport by train
183	he07312	Passenger transport by underground and tram
184	he07321	Passenger transport by bus and coach
185	he07322	Passenger transport by taxi and hired car with driver
186	he07331	Domestic flights
187	he07332	International flights
188	he07341	Passenger transport by sea
189	he07342	Passenger transport by inland waterway
190	he07350	Combined passenger transport
191	he07361	Funicular_ cable-car and chair-lift transport
192	he07362	Removal and storage services
193	he07369	Other purchased transport services NEC
194	he08101	Letter handling services
195	he08109	Other postal services
196	he08201	Fixed telephone equipment
197	he08202	Mobile telephone equipment
198	he08203	Other equipment of telephone and telefax equipment
199	he08204	Repair of telephone or telefax equipment
200	he08301	Wired telephone services
201	he08302	Wireless telephone services
202	he08303	Internet access provision services
203	he08304	Bundled telecommunication services
204	he08305	Other information transmission services
205	he09111	Equipment for the reception_ recording and reproduction of sound
206	he09112	Equipment for the reception_ recording and reproduction of sound and vision
207	he09113	Portable sound and vision devices
208	he09119	Other equipment for the reception_ recording and reproduction of sound and picture
209	he09121	Cameras
210	he09122	Accessories for photographic and cinematographic equipment

	code	description
171	he07211	Tyres
172	he07212	Spare parts for personal transport equipment
173	he07213	Accessories for personal transport equipment
174	he07221	Diesel
175	he07222	Petrol
176	he07223	Other fuels for personal transport equipment
177	he07224	Lubricants
178	he07230	Maintenance and repair of personal transport equipment
179	he07241	Hire of garages_ parking spaces and personal transport equipment
180	he07242	Toll facilities and parking meters

	code	description
226	he09222	Major durables for indoor recreation
227	he09230	Maintenance and repair of other major durables for recreation and culture
228	he09311	Games and hobbies
229	he09312	Toys and celebration articles
230	he09321	Equipment for sport
231	he09322	Equipment for camping and open-air recreation
232	he09323	Repair of equipment for sport_ camping and open-air recreation
233	he09331	Garden products
234	he09332	Plants and flowers
235	he09341	Purchase of pets
236	he09342	Products for pets
237	he09350	Veterinary and other services for pets
238	he09411	Recreational and sporting services - Attendance
239	he09412	Recreational and sporting services - Participation
240	he09421	Cinemas_ theatres_ concerts
241	he09422	Museums_ libraries_ zoological gardens
242	he09423	Television and radio licence fees_ subscriptions
243	he09424	Hire of equipment and accessories for culture
244	he09425	Photographic services
245	he09429	Other cultural services
246	he09511	Fiction books
247	he09512	Educational text books
248	he09513	Other non-fiction books
249	he09514	Binding services and E-book downloads
250	he09521	Newspapers
251	he09522	Magazines and periodicals
252	he09530	Miscellaneous printed matter
253	he09541	Paper products
254	he09549	Other stationery and drawing materials
255	he09601	Package domestic holidays



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	code	description
211	he09123	Optical instruments
212	he09131	Personal computers
213	he09132	Accessories for information processing equipment
214	he09133	Software
215	he09134	Calculators and other information processing equipment
216	he09141	Pre-recorded recording media
217	he09142	Unrecorded recording media
218	he09149	Other recording media
219	he09150	Repair of audio-visual_ photographic and information processing equipment
220	he09211	Camper vans_ caravans and trailers
221	he09212	Aeroplanes_ microlight aircraft_ gliders_ hang-gliders and hot-air balloons
222	he09213	Boats_ outboard motors and fitting out of boats
223	he09214	Horses_ ponies and accessories
224	he09215	Major items for games and sport
225	he09221	Musical instruments

	code	description
256	he09602	Package international holidays
257	he10101	Pre-primary education
258	he10102	Primary education
259	he10200	Secondary education
260	he10300	Post-secondary non-tertiary education
261	he10400	Tertiary education
262	he10500	Education not definable by level
263	he11111	Restaurants_ cafés and dancing establishments
264	he11112	Fast food and take away food services
265	he11120	Canteens
266	he11201	Hotels_ motels_ inns and similar accommodation services
267	he11202	Holiday centres_ camping sites_ youth hostels and similar accommodation s
268	he11203	Accommodation services of other establishments
269	he12111	Hairdressing for men and children
270	he12112	Hairdressing for women

	code	description
271	he12113	Personal grooming treatments
272	he12121	Electric appliances for personal care
273	he12122	Repair of electric appliances for personal care
274	he12131	Non-electrical appliances
275	he12132	Articles for personal hygiene and wellness_ esoteric products and beauty products
276	he12311	Jewellery
277	he12312	Clocks and watches
278	he12313	Repair of jewellery_ clocks and watches
279	he12321	Travel goods
280	he12322	Articles for babies
281	he12323	Repair of other personal effects
282	he12329	Other personal effects NEC
283	he12401	Child care services
284	he12402	Retirement homes for elderly persons and residences for disabled persons
285	he12403	Services to maintain people in their private homes
286	he12404	Counselling
287	he12520	Insurance connected with the dwelling
288	he12531	Public insurance connected with health
289	he12532	Private insurance connected with health
290	he12541	Motor vehicle insurance
291	he12542	Travel insurance
292	he12550	Other insurance
293	he12621	Charges by banks and post offices
294	he12622	Fees and service charges of brokers_ investment counsellors



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	code	description
295	he12701	Administrative fees
296	he12702	Legal services and accountancy
297	he12703	Funeral services
298	he12704	Other fees and services



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4. HBS categories, 2010

code	description	code	description
1 he01111	Rice	46 he01178	Other tubers and products of tuber vegetables
2 he01112	Bread and cereals (ND)	47 he01181	Sugar
3 he01113	Pasta products	48 he01182	Jams, marmalades
4 he01114	Pastry-cook products	49 he01183	Chocolate
5 he01115	Sandwiches	50 he01184	Confectionery products
6 he01116	Other products	51 he01185	Edible ices and ice cream
7 he01121	Fresh, chilled or frozen meat of bovine animals	52 he01186	Other sugar products
8 he01122	Fresh, chilled or frozen meat of swine	53 he01191	Sauces, condiments
9 he01123	Fresh, chilled or frozen meat of sheep and goat	54 he01192	Salt, spices and culinary herbs
10 he01124	Fresh, chilled or frozen meat of poultry	55 he01193	Baby food, dietary preparations, baker's yeast and other food preparations
11 he01125	Dried, salted or smoked meat and edible meat offal	56 he01194	Other food products n.e.c.
12 he01126	Other preserved or processed meat and meat preparations	57 he01211	Coffee
13 he01127	Other fresh, chilled or frozen edible meat	58 he01212	Tea
14 he01131	Fresh, chilled or frozen fish	59 he01213	Cocoa and powdered chocolate
15 he01132	Fresh, chilled or frozen seafood	60 he01221	Mineral or spring waters
16 he01133	Dried, smoked or salted fish and seafood	61 he01222	Soft drinks
17 he01134	Other preserved or processed fish and seafood and fish and seafood preparations	62 he01223	Fruit juices
18 he01141	Whole milk	63 he01224	Vegetable juices
19 he01142	Low fat milk	64 he02111	Spirits and liqueurs
20 he01143	Preserved milk	65 he02121	Wine from grapes or other fruit
21 he01144	Yoghurt	66 he02122	Other
22 he01145	Cheese and curd	67 he02131	Beer
23 he01146	Other milk products	68 he02211	Cigarettes
24 he01147	Eggs	69 he02212	Cigars
25 he01151	Butter	70 he02213	Other tobacco
26 he01152	Margarine and other vegetable fats	71 he03111	Clothing materials
27 he01153	Olive oil	72 he03121	Garments for men
28 he01154	Edible oils	73 he03122	Garments for women
29 he01155	Other edible animal fats	74 he03123	Garments for children (3 to 13 years) and infants (0 to 2 years)
30 he01161	Citrus fruits (fresh, chilled or frozen)	75 he03131	Other articles of clothing and clothing accessories
31 he01162	Bananas (fresh, chilled or frozen)	76 he03141	Cleaning, repair and hire of clothing
32 he01163	Apples (fresh, chilled or frozen)	77 he03211	Footwear for men
33 he01164	Pears (fresh, chilled or frozen)	78 he03212	Footwear for women
34 he01165	Stone fruits (fresh, chilled or frozen)	79 he03213	Footwear for children (3 to 13 years) and infants (0 to 2 years)
35 he01166	Berries (fresh, chilled or frozen)	80 he03221	Repair and hire of footwear
36 he01167	Other fresh, chilled or frozen fruits	81 he04111	Actual rentals paid by tenants
37 he01168	Dried fruit	82 he04121	Other actual rentals
38 he01169	Preserved fruit and fruit based products	83 he04211	Imputed rentals of owner occupiers
39 he01171	Leaf and stem vegetables (fresh, chilled or frozen)	84 he04221	Imputed rentals of households housed free.
40 he01172	Cabbages (fresh, chilled or frozen)	85 he04222	Imputed rentals for secondary residences
41 he01173	Vegetables cultivated for their fruit (fresh, chilled or frozen)	86 he04311	Materials for the maintenance and repair of the dwelling



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	code	description
42	he01174	Root crops, non-starchy bulbs and mushrooms (fresh, chilled or frozen)
43	he01175	Dried vegetables
44	he01176	Other preserved or processed vegetables
45	he01177	Potatoes

	code	description
87	he04321	Services for the maintenance and repair of the dwelling
88	he04411	Water supply
89	he04421	Refuse collection
90	he04431	Sewerage collection

	code	description
91	he04441	Other services relating to the dwelling n.e.c.
92	he04511	Electricity
93	he04521	Town gas and natural gas
94	he04522	Liquefied hydrocarbons (butane, propane, etc.).
95	he04531	Liquid fuels
96	he04541	Solid fuels
97	he04551	Hot water, steam and ice
98	he05111	Furniture and furnishings
99	he05121	Carpets and other floor coverings
100	he05131	Repair of furniture, furnishings and floor coverings
101	he05211	Household textiles
102	he05311	Refrigerators, freezers and fridge freezers
103	he05312	Clothes washing machines, clothes drying machines and dish washing machines
104	he05313	Cookers
105	he05314	Heaters, air conditioners
106	he05315	Cleaning equipment
107	he05316	Sewing and knitting machines
108	he05317	Other major household appliances
109	he05321	Small electrical household appliances
110	he05331	Repair of household appliances
111	he05411	Glass and crystal ware, tableware
112	he05412	Cutlery, flatware and silverware
113	he05413	Kitchen and domestic utensils
114	he05414	Repair of glassware, tableware and household utensils
115	he05511	Major tools and equipment
116	he05521	Small tools and miscellaneous accessories
117	he05611	Cleaning and maintenance products
118	he05612	Other non durable household articles
119	he05621	Domestic services
120	he05622	Household services
121	he06111	Pharmaceutical products
122	he06121	Other medical products
123	he06131	Therapeutic appliances and equipment
124	he06211	Medical Services
125	he06221	Dental services
126	he06231	Services of medical analysis laboratories and X-ray centres
127	he06232	Services of medical auxiliaries
128	he06233	Other nonhospital services

	code	description
136	he07221	Fuels and lubricants
137	he07231	Maintenance and repair
138	he07241	Other services in respect of personal transport equipment
139	he07311	Passenger transport by railway
140	he07321	Passenger transport by road
141	he07331	Passenger transport by air
142	he07341	Passenger transport by sea and inland waterway
143	he07351	Combined passenger transport
144	he07361	Other purchased transport services
145	he08111	Postal services
146	he08211	Telephone and telefax equipment
147	he08311	Telephone and telefax services
148	he09111	Equipment for the reception, recording and reproduction of sound
149	he09112	Television sets, video cassette players and recorders
150	he09121	Photographic and cinematographic equipment
151	he09122	Optical instruments
152	he09131	Information processing equipment
153	he09141	Recording media for pictures and sound
154	he09151	Repair of audiovisual, photographic and information processing equipment
155	he09211	Major durables for outdoor recreation
156	he09221	Musical instruments
157	he09222	Major durables for indoor recreation
158	he09231	Maintenance and repair of other major durables for recreation and culture
159	he09311	Games, toys and hobbies (SD)
160	he09321	Equipment for sport, camping and open air recreation
161	he09331	Gardens, plants and flowers
162	he09341	Pets and related products
163	he09351	Veterinary and other services for pets
164	he09411	Recreational and sporting services
165	he09421	Cinemas, theatres, concerts
166	he09422	Museums, zoological gardens and the like
167	he09423	Television and radio taxes and hire of equipment
168	he09424	Other services
169	he09511	Books
170	he09521	Newspapers and periodicals
171	he09531	Miscellaneous printed matter
172	he09541	Stationery and drawing materials
173	he096	Package holidays



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	code	description
129	he063	Hospital services
130	he07111	Purchase of new motor-cars
131	he07112	Purchase of second-hand motor-cars
132	he07121	Motor-cycles
133	he07131	Bicycles
134	he07141	Animal-drawn vehicles
135	he07211	Spare parts and accessories

	code	description
174	he10111	Pre primary and primary education
175	he10211	Secondary education
176	he10311	Post-secondary non-tertiary education
177	he10411	Tertiary education
178	he10511	Education not definable by level
179	he11111	Restaurants
180	he11112	Cafés, bars and the like

	code	description
181	he11121	Canteens
182	he11211	Accommodation services
183	he12111	Hairdressing salons and personal grooming establishments
184	he12121	Electrical appliances for personal care
185	he12131	Other appliance, articles and products for personal care
186	he12311	Jewellery, clocks and watches
187	he12321	Travel goods and other carriers
188	he12322	Other personal effects
189	he12411	Social protection services
190	he12412	Crèches, nurseries
191	he12521	Insurance connected with the dwelling
192	he12531	Insurance connected with health
193	he12541	Insurance connected with transport
194	he12551	Other insurance
195	he12621	Financial services n.e.c.
196	he1271	Other services n.e.c. (S)

