WILLINGNESS TO CONTRIBUTE TO CLIMATE CHANGE MITIGATION

by

SHOUYU ZHANG

(Under the Direction of SUSANA FERREIRA and BERNA KARALI)

ABSTRACT

Climate change mitigation is a public good requires international cooperation and collective actions. This dissertation consists of three essays that focus on European and American public attitudes toward climate change mitigation. The first essay examines regional differences in public support for climate policies and identifies the determinants, which include individual and regional factors. The second essay examines the existence of an environmental belief-action gap and its impact on the subjective well-being of individuals. The third essay examines how the environmental effectiveness, labor market impacts, and revenue distribution attribute associated with climate strategies foster public support. These essays highlight the importance of understanding the public acceptability of climate policies and promoting pro-environmental behaviors in climate change mitigation.

INDEX WORDS: CLIMATE CHANGE MITIGATION; PUBLIC OPINION; PRO-ENVIRONMENTAL BEHAVIORS; SUBJECTIVE WELL-BEING; CLIMATE POLICY; CHOICE EXPERIMENT

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DEDICATION

I dedicate this dissertation to my parents, who always provided endless encouragement throughout my educational journey. Their belief and constant encouragement have been a source of my inspiration.

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TABLE OF CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In recent years, global climate change has emerged as a social dilemma across countries and individuals (Brechin, 2016). To address this pressing challenge, it is crucial to understand the barriers that hinder the implementation of climate policies at both national and individual levels. This dissertation comprises three essays that investigate public willingness to contribute to the public good, that is climate change mitigation.

Our study aims to explore the relationships between individuals’ intentions to take real action against climate change and the potential factors influencing their behavior. As highlighted by Dechezleprêtre et al. (2022), climate actions can manifest in various forms, such as supporting climate policies and engaging in pro-environmental behaviors. By focusing on the consumer’s perspective, we examine the factors that contribute to the barriers to implementing climate policies, analyze people’s willingness to pay for climate achievements, and explore the positive impact of pro-environmental actions on individual well-being. This dissertation provides valuable insights for the design of climate policies, considering their effectiveness in carbon reduction, distributional effects, and individual mental and physical benefits.

In the second chapter, we conduct a comprehensive and comparable study comparing the factors driving public support for three climate policies in Europe: carbon taxation, renewable energy subsidies, and energy efficiency laws. By combining survey data from the 8^{th} round of the European Social Survey with collected regional indicators, our study employs a multilevel approach to comprehensively analyze the contextual factors influencing policy acceptance. The findings reveal an urban-rural gap in public support for carbon taxation, with individuals exposed to higher levels of PM2.5 being more likely to support renewable energy subsidies or energy efficiency laws. Furthermore, residing in regions with a higher GDP per capita increases support for carbon tax more compared to renewable energy. This chapter represents a first attempt to understand the influence of local air pollution on residents' opinions regarding different climate policies.

The third chapter is placed on the existing literature that suggests reducing greenhouse gas emissions necessitates adjustments in lifestyle and a shift in culture (Liu & Segev, 2017; Hoffman 2019), while only a fraction of individuals who exhibit concern about climate change engage in substantial climate-friendly actions (Landry et al., 2018). We examine the divergence between people's environmental attitudes and their pro-environmental behaviors and explore the consequences of this environmental cognitive dissonance on subjective well-being. We find that individuals experiencing environmental cognitive dissonance report lower subjective well-being compared to those exhibiting consistent pro-environmental behaviors and proactive environmental attitudes. This chapter aims to improve understanding of individuals' preferences and barriers in their daily environmental behaviors and has implications for environmental policies aiming to promote consistency between actions and awareness to enhance citizens' happiness.

In the fourth chapter, we design and implement a discrete choice survey experiment in the United States to examine Americans' willingness-to-pay for climate change mitigation under different climate policy schemes. The study utilizes both of mixed logit model and latent class model to measure the marginal willingness-to-pay for each climate policy attribute and incorporates respondents' environmental attitudes to understand heterogeneous policy choices.

We find that job opportunities and losses, regardless of industry type, significantly influence public support. People are willing to pay an additional $4.77 per month for one million green jobs created by 2035, while requiring compensation of $5.02 per month for each million fossil fuel jobs lost. Additionally, individuals are willing to pay $4.55 to limit global warming by one degree and $0.61 per year to expedite the expected date to be carbon neutrality in the nationwide. Financial rebates to households are the most preferred revenue distribution option.

This dissertation specifically investigates public willingness in Europe and the United States, as both are historically account for the largest greenhouse gas emissions. They bear a moral responsibility to contribute to global climate change mitigation efforts. Furthermore, despite Europe's reputation as a leader in climate action, there remains resistance to certain policies like carbon taxation (e.g., the Yellow Vest protests in France). Understanding the drivers behind public perceptions of climate policies is crucial in designing acceptable and feasible climate strategies on a global scale.

1.1 References

Brechin, S. R. (2016). Climate Change Mitigation and the Collective Action Problem: Exploring Country Differences in Greenhouse Gas Contributions. *Sociological Forum*, *31*(S1), 846–861. https://doi.org/10.1111/socf.12276

Dechezleprêtre, A., Fabre, A., Kruse, T., Planterose, B., Chico, A. S., & Stantcheva, S. (2022). Fighting climate change: International attitudes toward climate policies (No. w30265). National Bureau of Economic Research. http://dx.doi.org/10.2139/ssrn.4165337

Hoffman, A. J. (2019). Our emerging cultural shift: Regaining the moral case to address climate change. *Behavioral Scientist, September*, *30*.

Landry, N., Gifford, R., Milfont, T. L., Weeks, A., & Arnocky, S. (2018). Learned helplessness moderates the relationship between environmental concern and behavior. *Journal of Environmental Psychology*, *55*, 18–22. https://doi.org/10.1016/j.jenvp.2017.12.003

Liu, Y., & Segev, S. (2017). Cultural orientations and environmental sustainability in households: A comparative analysis of Hispanics and non-Hispanic Whites in the United States. *International Journal of Consumer Studies, 41*(6), 587–596. https://doi.org/10.1111/ijcs.12370

CHAPTER 2

UNDERSTANDING PUBLIC ACCEPTABILITY OF CLIMATE POLICY IN EUROPE[1]

[1] Zhang, S., Ferreira, S., & Karali, B. To be submitted to *Energy Economics*.

2.1 Abstract

Urgent and decisive government action to mitigate greenhouse gas emissions is more likely when the proposed measures are popular among the public. This paper compares the drivers of European public support for three alternative policies to combat climate change: carbon taxation, renewable energy subsidies, and energy efficiency laws. We combine survey data with regional socio-economic and environmental indicators to provide a comprehensive, comparative analysis of policy acceptance that accounts for the geographic context in which these policies would be implemented. By comparing the drivers among three climate policies, we identify a rural-urban gap in predicting public perception of carbon taxation, which does not exist in the other policy. We also found a positive relationship between regional PM2.5 exposure and public support for climate policy, providing novel insights into the influence of environmental factors on public perceptions. This research contributes to the growing body of knowledge on climate policy acceptance and offers valuable implications for policymakers seeking to gain public support for effective climate change mitigation strategies.

Key words: Climate change mitigation; policy support; policy preferences; carbon tax; energy efficiency; renewable energy subsidies

2.2 Introduction

To limit global warming below two degrees Celsius, an urgent action about greenhouse gas emissions is necessary. Policy makers have a wide array of instruments at their disposal ranging from conventional regulation policy (command-and-control) to market-based instruments including taxes, subsidies, and tradable permits (Fisher 1995). The market-based approach, which puts a price on carbon, is widely supported by economists as a cost-effective tool for emissions reductions (Boyce 2018). However, as of November 2022, only 47 national jurisdictions had implemented carbon pricing initiatives, and only 28 had a carbon tax (World Bank 2022). Why so few? Mainly because carbon taxes are very unpopular among the public.

For example, in France, the "Yellow Vests" protests erupted in 2018 after the French government proposed to increase fossil fuel taxes, responding to what was perceived as uneven tax policies and privileges for the upper class (Chamorel 2019). Australia also repealed a carbon tax proposal due to public opposition (Wente 2014), and in the United States, a carbon tax in the state of Washington was voted down twice in the 2016 and 2018 referendums with less than 50% support (Reed et al. 2019; Karceski et al. 2020). These cases provide evidence that the public acceptability of a policy is crucial for its implementation. However, until very recently this factor had been largely neglected by economists, who mainly focused on efficiency considerations (and to a lesser extent on equity) when designing environmental policies (Klenert et al. 2018).

In this paper, we provide additional, independent evidence for the drivers of public perceptions towards three climate policies commonly considered for greenhouse gas mitigation: carbon taxation, renewable energy subsidies, and energy efficiency laws. We combine survey data from the 8th round of the European Social Survey (ESS8 hereafter) with regional socio-economic and environmental indicators to provide a comprehensive, comparative analysis of the drivers of public support for those policies.

Our study contributes to the growing literature on public opinion about climate change mitigation in the following ways. First, we model the regional variation in public perception of climate policies. This contrasts with most previous studies that only considered individual characteristics and country-level variation (Davidovic & Harring 2020). We do so by incorporating regional factors in the analysis and by using a two-level (individual-region) linear regression model based on the hierarchical structure of the nested ESS8 data. By incorporating regional factors, we can capture the unique contextual characteristics of each individual, which helps us gain deeper understanding of how contextual factors shape public opinions and provides a more accurate analysis compared with considering only national variation.

The second contribution of our study is to examine whether the air quality respondents experience in their region is associated with their support for climate policies under consideration. We explore a novel reason to support climate policies that relies on the complementarity and correlation between carbon emissions, a global pollutant, with other pollutants responsible for local environmental quality. That is, everything else being equal, support for climate policies may arise out of an immediate concern to improve the quality of the local environment rather than the desire to reduce regional industrial carbon emission. Climate change and local air pollution are two major environmental challenges that are intertwined. A carbon tax designed to reduce greenhouse gas emissions would reduce PM2.5 and other local air pollutants by reducing fossil fuel combustion (Takeshita 2012; Rafaj et al. 2013). To the best of our knowledge, ours is the first study investigating the existence and strength of this link in the public's attitudes towards climate change policies.

The third contribution of our work is to examine whether a concern for unemployment and economic development would be a severe barrier to supporting the implementation of climate policies, especially carbon taxation. Former President Trump portrayed a negative attitude towards climate policies by repeatedly arguing that climate actions are “job-killing” and “economy-destroying” policies (Bomberg 2021). Researchers and practitioners alike put a large weight on labor market outcomes when they analyze policy preferences. Therefore, we incorporated regional economic indicators to test whether this connection exists and shapes resident’s climate policy preferences.

In this study, we aim to assess the diverse effects of individual and regional factors on public support for three distinct climate policies. The findings confirm the importance of individuals’ political trust and climate change concerns reported in previous studies (Drews & van den Bergh 2016; Klenert et al. 2018; Fairbrother et al. 2019; Davidovic & Harring 2020). In addition, we provide insights into the climate policy preferences of two population sub-groups: elder people and those living in rural areas, who are politically important due to their relatively high voter turnout (Wolfinger & Rosenstone 1980; Zaslove et al. 2021). In our study, older people tend to be more accepting of energy efficiency mandates than young people but not of the other two policies. Those living in rural areas, on the other hand, strongly reject a carbon tax but their level of support for the other two policies is no different from their urban counterparts.

Our results suggest that a focus on regional economic and environmental factors of public support for climate policies is well placed. People more exposed to PM2.5 are more willing to support renewable energy subsidies and energy efficiency laws rather than a carbon tax. A larger level of regional economic activity, measured by regional GDP, however, is associated with a larger acceptance of carbon taxation but not of the other two policies. By examining how contextual factors shape public support among different climate policies, our study contributes to a deeper understanding of the complex dynamics between spatial factors and public opinion, shedding light on the key drivers of public support for climate policies.

2.3 Literature Review

A common explanation in the past studies for the rejection of climate action by the public has been the outright denial of climate change (Ding et al. 2011) or the perception that climate change is a future concern that competes with more pressing demands (Brügger 2020). Even though only a small number of people remain skeptical about the scientific basis of anthropogenic climate change (Leiserowitz et al. 2021), believing in climate change has a limited effect on how people act to reduce carbon emissions (Hornsey et al. 2016).[2]

Carattini et al. (2017) summarize five reasons behind the public rejection of carbon taxation: perceptions of high personal cost, perceived low efficiency in discouraging high carbon footprint behavior, potential regressivity, fear of negative effects on the economy, and lack of trust in government. People might overestimate the negative impact of a tax on their purchasing power and hold a biased belief about the environmental effectiveness of carbon taxes (Douenne & Fabre 2020). This is despite a growing number of empirical studies demonstrating that carbon tax is an effective tool for reducing greenhouse gas emissions (see, for example, Hájek et al. 2019; Tan & Lin 2020; Metcalf & Stock 2020; Chen et al. 2021). Other studies posit personal responsibility, revenue salience, and policy stability as additional determinants of public perceptions towards carbon taxation and argue that an appropriate allocation of the generated revenue (e.g., distributing it as a “dividend” to the public) and making it salient can raise public support (Klenert et al. 2018; Levi 2021). These findings are consistent with older literature on

[2] For example, Landry et al. (2018) show that learned helplessness moderates the role of climate change concerns in predicting people’s pro-environmental behaviors.

public support for environmental taxation. For example, Dresner et al. (2006) identify that, historically, the main reasons for the unpopularity of environmental taxes in the U.K. have been conceptual problems in policy design, distrust about the distribution of revenue, lack of understanding of the purpose of increasing environmental taxes, as well as a perceived "penalty" of bad behaviors. On the last point, De Groot & Schuitema (2012) illustrate that providing correct and transparent social norms for environmental policies increases their popularity.

The public perception of carbon taxes is more negative than that of other climate policies (Davidovic & Harring 2020), but few studies compare how the specific drivers of public acceptance, including those discussed above, differ among alternative policy instruments (Rhodes et al. 2017; Davidovic & Harring 2020; Kulin & Johansson Sevä 2021). In fact, the literature exploring the acceptability of policy instruments other than carbon taxes is scant, which is at odds with the urgent need to find politically feasible ways of reducing greenhouse emissions (Fairbrother 2022).

2.4 Data Construction

We employ data from the ESS8, which was specifically designed to study attitudes, perceptions, and policy preferences toward climate change across Europe. The merged dataset contains 25,033 observations from 19 countries.[3] We utilize individual-level variables from the survey which we match to regional factors to understand whether public perceptions of a carbon tax depend on local environmental and economic conditions. The descriptive statistics of the

[3] The countries included in the sample are Austria, Belgium, Czech Republic, Germany, Estonia, Spain, Finland, France, United Kingdom, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Sweden, Slovenia. Russia and Israel are excluded since they do not belong to the European co-operation for Accreditation (EA) nor the European Economic Area (EEA). Iceland and Switzerland lack regional GDP data. Excluding these two countries does not affect the results for the individual-level variables; in multilevel regression models (available from the authors upon request) keeping Iceland and Switzerland, results for individual-level variables were similar.

variables are shown in Table 2.1 and data sources and a brief description are presented in the Appendix Table A.1.

[Table 2.1]

Support for climate policy variables

To understand public perceptions of different policies, we use three response variables in our analyses. The first one measures people's support for a carbon tax policy by their answer to the question "To what extent are you in favor or against increasing taxes on fossil fuels, such as oil, gas, and coal to reduce climate change?" Answers are coded into a five-point Likert scale from 0 ("strongly against") to 4 ("strongly in favor"). The second dependent variable captures the public perception of a renewable energy subsidy policy, using the answers (also on a 0 - 4 point scale) to the question "To what extent are you in favor or against using public money to subsidize renewable energy such as wind and solar power?" The third dependent variable measures the public perception of an energy efficiency policy by the answers (0 - 4 point scale) to the question "To what extent are you in favor or against a law banning the sale of the least energy efficient household appliances?"

It is evident from Figure 2.1 that carbon taxes have the least support among the three policy options in all countries. The national average support for a carbon tax is around 2, ("neither in favor nor against"). The subsidy for renewable energy has the highest average support, at around 3 ("somewhat in favor"). Sweden and Finland show the highest national support for carbon taxation and relatively small gaps between support for the three policies. The average levels of support for a carbon tax in these two countries are around 2.5. Poland shows the lowest level of national support for carbon taxation, between 1 ("somewhat against") and 2.

This is not surprising considering Poland's strong dependence on fossil fuels, which constituted 90.3% of its total energy consumption in 2015 (World Bank 2015).

[Figure 2.1]

Individual-level explanatory variables

We capture people's beliefs towards climate change with a variable calculated based on trend, attribution, and impact skepticism. For trend skepticism, we use the answers to the question "Do you think the world's climate is changing?" which range from 1 ("definitely changing") to 4 ("definitely not changing"). We reverse the scale and convert it to a 0-to-3-point scale, with higher values referring to a stronger belief in climate change. The answer to "Do you think that climate change is caused by natural processes, human activity, or both?" ranging from 1 ("entirely by natural processes") to 5 ("entirely by human activity") measures attribution skepticism. For impact skepticism, we use the answers to "How good or bad do you think the impact of climate change will be on people across the world?" which ranges from 0 ("extremely bad") to 10 ("extremely good"). We reverse this eleven-point scale from 0 to 10, with higher values indicating more negative views of climate change impacts. We then calculate an index for climate change beliefs in a principal component analysis with factor loadings of 0.71, 0.73, and 0.71, respectively.

Political trust is a significant factor influencing public support for climate policies (Kousser & Tranter 2018; Davidovic & Harring 2020; Kitt et al. 2021). Political trust in the ESS8 is measured in three dimensions based on the answers to the questions "How much do you personally trust parliament?", "How much do you personally trust politicians?", and "How much do you personally trust political parties?" on a scale from 0 (no trust at all) to 10 (complete trust).

We use factor analysis to convert these three variables into an index (with factor loadings of 0.88, 0.95, and 0.93, respectively).

We also control for political alignment and egalitarianism attitudes as in Fairbrother et al. (2019) and Douenne & Fabre (2020). We measure the left- vs. right-wing political preferences by the answer to the question "Where would you place yourself on this scale, where 0 means left and 10 means right?" with higher values indicating a preference for a right political ideology. We capture egalitarian attitudes by the extent of acceptability of the statements "Large differences in people's incomes are acceptable to properly reward differences in talents and efforts" and "For a society to be fair, differences in people's standard of living should be small." We calculate the egalitarian index from 0 to 8 by summarizing the two statements (the first one reverse-coded). A respondent who believes in egalitarianism would have a higher value in this index.

Individual demographic characteristics are significant determinants of policy perceptions as well, see e.g., Gupta (2016) or Rotaris & Danielis (2019). Accordingly, we control for doing activities in the last 7 days, age, subjective general health, education level, household income, and a dummy variable for gender (1 for females). The income level is categorized into 10 country deciles. We convert it into a continuous variable by assigning respondents the average income value for each decile in their countries. Finally, we control for rurality with a dummy variable for living in a rural area (country village, farm, or home in the countryside).

In a multilevel regression analysis, the process of centering level 1 predictors is crucial for facilitating interpretation. Following the guidelines proposed by Enders & Tofighi (2007), we utilize group mean-centered individual variables to account for level 1 covariates, given that our study examines both individual- and region-level variables concerning public support for three climate policies.

Regional environmental and socio-economic explanatory variables

We hypothesize that local air pollution influences people's attitudes towards climate policy options. Thus, we combine individual-level ESS8 data with the spatial distribution of air quality and regional socio-economic activity, collected from the European Environmental Agency and Eurostat, respectively. The matching is based on the Nomenclature of Territorial Units for Statistics (NUTS) classification, a hierarchical system representing the regions of each country in the European Union.[4]

Besides carbon emissions[5], the burning of fossil fuels releases emissions of PM2.5, NO2, and PM10, which pose a direct health risk to local residents, particularly in the case of PM2.5 which can penetrate deeply into the respiratory tract (Feng et al. 2016; Perera 2017). In addition, PM2.5 concentrations are strongly correlated with atmospheric visibility (Pui et al. 2014). We use PM2.5 to represent local air pollution because of its visibility and health risks.

Inverse distance weighting (IDW) interpolation across pollution monitoring stations is a common method to calculate air pollutant concentrations (Ajaj et al. 2018). However, it does not directly account for the size and location of the population being exposed (Andersson & Mitchell 2006). Air quality models utilizing the Population-Weighted Exposure (IPWE) method do (Hystad et al. 2011; Aunan et al. 2018; Shakor et al. 2020; Singh et al. 2020). Using ArcGIS, we apply this method to the air quality database of the European Environment Agency to construct population-weighted PM2.5 concentrations, selecting a 1-km^2 cell size grid population dataset

[4] We use a NUTS 3-level classification, except for respondents in Austria, Belgium, Switzerland, Spain, France, Italy, Netherlands, Norway, Poland, and Portugal, for which we use a NUTS 2-level classification, and those in the United Kingdom and Germany for which we use a NUTS 1-level classification.

[5] We collected regional CO2 emissions (NUTS2) for the year 2016 from Global Atmospheric Research EDGAR and regional population data (NUTS2) for the same year from Eurostat for robustness checks. Regional carbon emissions per capita were calculated by dividing regional total carbon emissions by regional population density. It should be noted that the regional carbon emissions per capita data is missing for the UK and Norway, resulting in a smaller sample size for these variables. The analysis can be found in the Appendix for reference and will be discussed in later sections.

available from Eurostat for the year 2011, which is the latest available year before the ESS8 survey.

The population-weighted average exposure of PM2.5 ($PWEL_k$) in region k, is given by:

$$PWEL_k = \frac{\sum(P_{m,k} \times C_{m,k})}{\sum P_{m,k}} \quad (1)$$

where $C_{m,k}$ is the PM2.5 concentration level in grid m, $P_{m,k}$ is the population in the same grid m, and $\sum P_{m,k}$ is the total population of all grids in region k.

We calculate the annual PM2.5 exposure in 2016, as the ESS8 survey was fielded in 2016. There are large regional differences in the exposure to PM2.5 (Appendix Figure A.1). Residents of the four northernmost European countries including Sweden, Norway, and Finland suffer little exposure (e.g., the lowest exposure level is 3.15 $\mu g/m^3$ in Jämtlands region located in the middle of Sweden). People living in the eastern part of Europe, especially in Poland, which relies heavily on fossil fuel energy generation, are much more heavily exposed (with average levels of exposure up to 26.79 $\mu g/m^3$, almost six times larger than the 5 $\mu g/m^3$ recommended by the World Health Organization).

In terms of spatial socio-economic variables, we include the NUTS 3-level GDP per capita and the NUTS 2-level unemployment rate[6]. All these variables are available for the year 2016 from Eurostat. The spatial distributions of GDP per capita and unemployment rate are presented in Figure A.2 of the Appendix.[7] The region-level variables are centered on its grand mean.

[6] We also include the manufacturing share of employment in the robustness check. The regional number of persons employed in the manufacturing industry is derived from Eurostat. The employment share is calculated by dividing the number of persons in the manufacturing industry by the total employment. It should be noted that we lack manufacturing sector data for all regions, which is why the analysis of this variable is included in the appendix.
[7] There is much regional variation in these two variables. In general, northern European countries have a higher level of GDP per capita compared to all other countries in the map. In Scandinavia, average GDP per capita ranges from €40,000 to €60,000 in 2015, and the unemployment rate is lower than 10%. GDP per capita in the southern

2.5 Empirical Model

The ESS8 data are drawn from 25,033 individuals in 254 regions within 19 European countries. The dataset is thus considered to show a hierarchical structure since individuals are nested within regions which, in turn, are nested within countries. The traditional ordinary least squares (OLS) method applied to data with a hierarchical structure would lead to correlated error terms and therefore to inefficient coefficient estimates (Stock & Watson 2003). More specifically, OLS would underestimate standard errors when applied to clustered data because of the dependency among observations (McNeish 2014). Therefore, we use a multilevel mixed-effects linear regression model to exploit the regional characteristics in our dataset and to account for the potential spatial autocorrelation in the public perception of climate policies within groups. To control for the country-level fixed effect, we include country dummy variables in the regression. We use a multilevel random intercept regression model, which implicitly assumes that slopes are fixed but allows the intercept to vary across groups:

$$Y_{ik} = \alpha + X_{ik}'\beta + Z_k'\gamma + u_k + \varepsilon_{ik}, \quad (2)$$

where individuals i are nested in regions $k = 1, \ldots, 254$. The variable Y_{ik} represents the extent of individual i's support for a specific climate policy (carbon tax, renewable energy subsidy, or energy efficiency law). X_{ik} is a vector of individual-level variables described in Section 2.2 and Appendix Table A.1 with coefficient vector β. $Z_k$is a vector of regional socio-economic and environmental variables (GDP per capita in 2016 Euros, unemployment rate, and annual population-weighted exposure to PM2.5) with coefficient vector γ. Based on our research goals, we have employed group-mean centering for indicators in X_{ik}, while indicators in Z_k have been

part of Europe is lower, below €40,000. In southern Spain, several regions had about a 30% unemployment rate in 2015.

grand-mean centered, as discussed previously. u_k represents the random effects for each region k and ε_{ijk} is the disturbance term, assumed to be independently and normally distributed.

We estimate equation (2) for each policy option separately, but before doing so we checked whether the two-level random intercept model was indeed appropriate for our application. As stated by Peugh (2010), both the intraclass correlation coefficient (ICC) and design effect measures can be used to determine the need for a multilevel model. The ICC is calculated from the estimates of a null model, which includes only random intercepts and no explanatory variables, as the ratio of variance of each cluster to the overall variance. In our case, they are given by:

$$ICC_{region} = \frac{\sigma_k^2}{\sigma_k^2 + \sigma^2} \tag{3}$$

where σ_k^2 is the between-region variance and σ^2 is the between-individual variance. ICC values greater than 0.05 indicate the need to utilize a multilevel modeling (Hox 1998; Raudenbush & Liu 2000; Li 2014). Based on the results of our null models (Appendix Table A.2), the ICC in the carbon tax model is 0.096, indicating that 9.6% of the overall variance in carbon tax support occurs between regions. The ICC in the model for renewable energy subsidies is 8.1% for the region level. In the model for energy efficiency laws, it is 5.5% for the region level.

Since for each policy option, the dependent variable Y_{ik} is an ordinal categorical variable, we also performed our analysis using a multilevel ordinal probit model. However, for an easier interpretation, we present the results from the two-level mixed-effects linear model in the main text and provide the results from the multilevel ordinal probit model in the Appendix (Table A.3). We note that the ordinal probit model led to equivalent marginal effects as in the mixed-effects model.

2.6 Empirical Results

Table 2.2 presents the results from multilevel mixed-effects linear regressions that examine the determinants of public attitudes towards the three different climate policies. The first column in the table shows the estimated coefficients for the carbon taxation policy support. As in Fairbrother et al. (2019), higher trust in the country's political system and being more concerned about climate change are associated with stronger support for carbon taxation policy. Egalitarian attitudes are also associated with higher support for a carbon tax. On average, females, those more educated or currently under education, being in a better health condition, with higher income and left-wing political preferences are more supportive of carbon taxation. The coefficient of the rural dummy variable is negative and statistically significant, indicating that residents of rural areas are less supportive of carbon taxation than urban residents. The mean value of the difference between the two groups is 0.084, about the 10% of a response scale. Compared to those residing in cities, residents in rural areas are likely more dependent on fossil fuels for transportation and agricultural equipment use. By increasing the price of fossil fuels, a carbon tax would disproportionally increase their energy bill, explaining their opposition. Neither living in a region with high unemployment rate nor being unemployed in the last 7 days has any influence on individuals' support to carbon taxation. As for other regional factors, exposure to PM2.5 is not statistically significant, suggesting that the local air quality does not alter the extent of residents' support for carbon taxation. People living in areas with higher GDP, however, would be more likely to vote for carbon taxation. The effect of regional GDP on public support to carbon taxation is significant.

[Table 2.2]

The second column in Table 2.2 presents the results for support of renewable energy subsidies. Those more educated, richer, or leaning left politically, are more likely to support renewable energy subsidies. These results are qualitatively similar to carbon tax. Unlike for carbon tax support, however, there is no statistical difference between the urban and rural area residents in their support for renewable energy subsidies. As for the regional factors, contrary to carbon taxation, residents' support for renewable energy subsidies increases with larger exposure to PM2.5. Residents of high-GDP regions are more inclined to support renewable energy subsidies. The coefficient associated with renewable energy subsidies is relatively smaller in magnitude when compared to that of carbon taxation.

The third column in Table 2.2 presents the multilevel regression results for energy efficiency policy; a law banning the least energy efficient household appliances. Females, those more educated, with higher income levels, and on the left regarding political preferences are more likely to vote for energy efficiency laws. Residents living in regions with higher exposure to PM2.5 are more supportive of the energy efficiency law ($\hat{\beta}$=0.018). The coefficients on the regional GDP and unemployment rate are not statistically significant.

In the robustness check, we report the multilinearity regression results by controlling for the share of manufacturing employment in 2016 and CO2 emission per capita in 2016, respectively (Appendix Table A.4, Table A.5). The sample size in the robustness check is smaller due to missing values of greenhouse gas emissions in the UK and Norway. The share of manufacturing employment was used to control for the extent to which the regional labor market relies on economic structural change (Essletzbichler et al., 2018; Luukkonen et al., 2022; Weckroth & Ala-Mantila, 2022). CO2 emissions per capita were employed to control for regional carbon intensity. The results are robust after adding additional controls to the smaller sample. We didn't find any evidence showing the regional CO_2 emission or share of employment in the manufacturing industry would affect residents' preferences toward any climate policy.

2.7 Discussion

To better compare the relative influence of the different determinants of public perceptions towards the three climate policies considered, we plot the estimated coefficients of key variables from Table 2.2 with their 95% confidence intervals in Figure 2.2. Political trust is the most important determinant of carbon taxation support ($\hat{\beta}$=0.208) but is much less important for the other two policies ($\hat{\beta}$=0.068 for renewable energy subsidies, $\hat{\beta}$=0.064 for energy efficiency laws). This suggests that to win the public support for a carbon tax, governments need to focus on raising public confidence in the whole political system of the country (Fairbrother et al. 2019).

[Figure 2.2]

The correlation between local air pollution and GHG emissions has led academics and practitioners to highlight local air quality improvements for gaining support for regulations aimed at reducing power plant emissions, which, in turn, would reduce climate change risks (Hart & Feldman 2018; Zhang et al. 2018). Local air pollution has immediate health effects which are associated with a willingness to change behaviors to improve air quality (Bazrbachi et al. 2017). In addition, perceived impacts of climate change are positively correlated with the country's actual vulnerability and with PM2.5 exposure (Dechezleprêtre et al. 2022). In our study, public support for carbon taxation is not positively related to local PM2.5 exposure. However, public acceptability of the other two policies is. This underscores an important difference between the three policies being considered. Subsidies towards renewable energy can be regarded as directly targeting the development of renewable energy industries that would produce "clean" energy. The replacement of conventional fossil fuel by renewable energy has been proved to reduce local atmospheric pollutant efficiently (Koengkan et al. 2022). Energy efficiency laws would reduce energy demand and associated emissions. This is supported by the previous finding that energy efficiency could reduce local PM2.5 concentration (Yang et al. 2021). While carbon taxation would create similar incentives, it would do it *indirectly*, by increasing the cost of fossil fuel energy generation. As such, it may be perceived as less effective in reducing local pollution than renewable energy subsidies and laws that ban energy inefficient appliances. This may explain why PM2.5 exposure affects the support for the latter policies and not for a carbon tax.

A major obstacle to carbon mitigation policies Is the concern about their macroeconomic impacts. Workers' support for climate policies can be highly discouraged by the 'job-killing' arguments, usually associated with carbon taxation policies. Although Metcalf and Stock (2020) found no evidence of a negative effect of carbon taxes in Europe on employment or GDP growth at the national level, adjustment costs are to be expected at the regional level. In fact, regional socioeconomic conditions may help shape people's perceptions of climate change (Weckroth & Ala-Mantila 2022). We report a positive correlation between regional GDP and public acceptability of a carbon tax, but an insignificant relationship with support for renewable energy subsidies or energy efficiency laws. This result suggests that a stronger macroeconomic situation may help mitigate concerns about potential economic costs of a carbon tax. It contrasts with Levi (2021), who reports that country-level GDP per capita decreases public acceptability of a carbon tax by up to three percent. Although Drews & van den Bergh (2016) report that the unemployment rate is related with a lower acceptance of a carbon tax, we do not find evidence of a significant association between the actual regional unemployment and people's support for any climate policy.

Among all the demographic characteristics of respondents, we pay special attention to age and living in rural areas, two population characteristics that are related to voter turnout (Zaslove et al. 2021). In addition, as populations age in many European countries, understanding the policy preferences of the elder group is a crucial part to win public support for any policy. The signs of the age coefficient for the three policies are different, which is worth discussing. Older people are favor of energy efficiency laws instead of the other two climate policies. Older people are more likely to live in older and larger houses, stay at home for longer periods, and own more house appliances (Yagita & Iwafune 2021). Therefore, they might favor policies such as energy efficiency laws which they may perceive as being more effective in reducing their energy bills. The differentiated attitudes towards carbon taxation between urban and rural areas are also notable. Rural people have larger dependency on fossil fuels and higher demand for electricity (Muratori 2014). It is not surprising that they strongly oppose increasing taxes on fossil fuels.

2.8 Conclusion

As the consequences of climate change become painfully apparent and they intensify, strong and sustained reductions in emissions that would limit climate change are urgently needed. In this context, carbon pricing and alternative policies to mitigate greenhouse gas emissions have been much discussed by economists and policy makers but their implementation, in democratic societies, hinges critically on their acceptance by the public. As a beneficiary of early industrialization and now a leader in the fight against climate change, the European Union aims to achieve climate neutrality by 2050. The drastic reductions in greenhouse gas emissions required to achieve that goal will require European citizens' support of the mitigation policies that make them possible. This study uses survey data from 19 European countries to identify and compare the drivers of public perceptions towards three climate policies that are typically considered by policy makers: carbon taxation, subsidies to renewable energy, and energy efficiency laws. We combine individual and contextual level predictors in analyzing people's support for climate policies, as individuals' preferences towards climate policies are likely to be driven not only by personal characteristics, but also by social and natural experienced contexts.

Although carbon taxation is favored by economists because it is a cost-effective policy tool to reduce carbon emissions (Hájek et al. 2019; Tan & Lin 2020; Chen et al. 2021), its cost-effectiveness does not seem to play a dominant role in public preferences towards climate policies. In fact, carbon taxes are unpopular, much less preferred by the public than subsidies to renewable energy or energy efficiency mandates. Digging into what explains the level of public support for carbon taxation, our results show that it is linked to political trust, regional GDP, and whether the respondent lives in a rural area which might be related to energy use habits. Promoting carbon taxation cannot rely only on its effectiveness, but on changing people's beliefs and perceptions of costs at the individual and social levels. Without further details on how the tax revenues are going to be distributed, carbon taxation is likely perceived as very costly for those with higher dependence on fossil fuels, such as people in living in rural areas. Our results highlight the urban-rural gap in the public acceptance towards carbon taxation. Narrowing that gap requires further consideration of flexible solutions for carbon emission reductions according to the level of urbanization (Weckroth & Ala-Mantila 2022). Our findings also support previous argument that increasing people's confidence in the political system would be very effective in laying the foundation for a carbon tax (Davidovic & Harring 2020).

To gain public support for a specific climate policy, local environmental benefits also need to be taken into consideration. In the areas with high exposure to local air pollution, emphasizing the local environmental benefits of renewable energy subsidies and energy efficient laws could be the key to increasing people's acceptance.

2.9 References

Ajaj, Q., Shareef, M., Hassan, N., Hasan, S., & Noori, A. (2018). GIS Based Spatial Modeling to Mapping and Estimation Relative Risk of Different Diseases Using Inverse Distance Weighting (IDW) Interpolation Algorithm and Evidential Belief Function (EBF) (Case study: Minor Part of Kirkuk City, Iraq). *International Journal of Engineering and Technology*, *7*, 185–191. https://doi.org/10.14419/ijet.v7i4.37.24098

Andersson, N., & Mitchell, S. (2006). Epidemiological geomatics in evaluation of mine risk education in Afghanistan: Introducing population weighted raster maps. *International Journal of Health Geographics*, *5*(1), 1. https://doi.org/10.1186/1476-072X-5-1

Aunan, K., Ma, Q., Lund, M. T., & Wang, S. (2018). Population-weighted exposure to PM2.5 pollution in China: An integrated approach. *Environment International*, *120*, 111–120. https://doi.org/10.1016/j.envint.2018.07.042

Bazrbachi, A., Sidique, S. F., Shamsudin, M. N., Radam, A., Kaffashi, S., & Adam, S. U. (2017). Willingness to pay to improve air quality: A study of private vehicle owners in Klang Valley, Malaysia. *Journal of Cleaner Production*, *148*, 73–83. https://doi.org/10.1016/j.jclepro.2017.01.035

Bomberg, E. (2021). The environmental legacy of President Trump. *Policy Studies*, *42*(5–6), 628–645. https://doi.org/10.1080/01442872.2021.1922660

Boyce, J. K. (2018). Carbon pricing: effectiveness and equity. *Ecological Economics*, *150*, 52-61. http://dx.doi.org/10.1016/j.ecolecon.2018.03.030

Brügger, A. (2020). Understanding the psychological distance of climate change: The limitations of construal level theory and suggestions for alternative theoretical perspectives. *Global Environmental Change*, *60*, 102023. https://doi.org/10.1016/j.gloenvcha.2019.102023

Carattini, S., Carvalho, M., & Fankhauser, S. (2017). How to make carbon taxes more acceptable. *London: Grantham Research Institute on Climate Change and the Environment, and Centre for Climate Change Economics and Policy, London School of Economics and Political Science*, *57*.

Chamorel, P. (2019). C. *Journal of Democracy*, *30*(4), 48-62. http://dx.doi.org/10.1353/jod.2019.0068

Chen, Y., Nie, P., & Wang, C. (2021). Effects of carbon tax on environment under duopoly. *Environment, Development and Sustainability*, *23*(9), 13490–13507. https://doi.org/10.1007/s10668-020-01222-x

Crippa, Monica; Guizzardi, Diego; Muntean, Marilena; Schaaf, Edwin; Lo Vullo, Eleonora; Solazzo, Efisio; Monforti-Ferrario, Fabio; Olivier, Jos; Vignati, Elisabetta (2021): EDGAR v6.0 Greenhouse Gas Emissions. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/97a67d67-c62e-4826-b873-9d972c4f670b

Davidovic, D., & Harring, N. (2020). Exploring the cross-national variation in public support for climate policies in Europe: The role of quality of government and trust. *Energy Research & Social Science*, *70*, 101785. https://doi.org/10.1016/j.erss.2020.101785

Dechezleprêtre, A., Fabre, A., Kruse, T., Planterose, B., Chico, A. S., & Stantcheva, S. (2022). Fighting climate change: International attitudes toward climate policies (No. w30265). National Bureau of Economic Research. http://dx.doi.org/10.2139/ssrn.4165337

De Groot, J. I. M., & Schuitema, G. (2012). How to make the unpopular popular? Policy characteristics, social norms and the acceptability of environmental policies. *Environmental Science & Policy*, *19–20*, 100–107. https://doi.org/10.1016/j.envsci.2012.03.004

Ding, D., Maibach, E. W., Zhao, X., Roser-Renouf, C., & Leiserowitz, A. (2011). Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*, *1*(9), 462–466. https://doi.org/10.1038/nclimate1295

Douenne, T., & Fabre, A. (2020). French attitudes on climate change, carbon taxation and other climate policies. Ecological Economics, 169, 106496. http://dx.doi.org/10.1016/j.ecolecon.2019.106496

Dresner, S., Jackson, T., & Gilbert, N. (2006). History and social responses to environmental tax reform in the United Kingdom. Energy Policy, 34(8), 930–939. https://doi.org/10.1016/j.enpol.2004.08.046

Drews, S., & van den Bergh, J. C. (2016). What explains public support for climate policies? A review of empirical and experimental studies. Climate Policy, 16(7), 855–876. https://doi.org/10.1080/14693062.2015.1058240

Echavarren, J. M. (2017). From Objective Environmental Problems to Subjective Environmental Concern: A Multilevel Analysis Using 30 Indicators of Environmental Quality. *Society & Natural Resources*, *30*(2), 145–159. https://doi.org/10.1080/08941920.2016.1185555

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods*, *12*(2), 121–138. https://doi.org/10.1037/1082-989X.12.2.121

Essletzbichler, J., Disslbacher, F., & Moser, M. (2018). The victims of neoliberal globalization and the rise of the populist vote: A comparative analysis of three recent electoral decisions. *Cambridge Journal of Regions, Economy and Society*, *11*(1), 73–94. https://doi.org/10.1093/cjres/rsx025

ESS Round 8: European Social Survey Round 8 Data (2016). Data file edition 2.2. Sikt - Norwegian Agency for Shared Services in Education and Research, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi:10.21338/NSD-ESS8-2016.

Fairbrother, M., Johansson Sevä, I., & Kulin, J. (2019). Political trust and the relationship between climate change beliefs and support for fossil fuel taxes: Evidence from a survey of 23 European countries. *Global Environmental Change*, *59*, 102003. https://doi.org/10.1016/j.gloenvcha.2019.102003

Fairbrother, M. (2022). Public opinion about climate policies: A review and call for more studies of what people want. PLOS Climate, 1(5), e0000030. http://dx.doi.org/10.1371/journal.pclm.0000030

Feng, S., Gao, D., Liao, F., Zhou, F., & Wang, X. (2016). The health effects of ambient PM2.5 and potential mechanisms. Ecotoxicology and Environmental Safety, 128, 67–74. https://doi.org/10.1016/j.ecoenv.2016.01.030

Fisher, B. S., Barrett, S., Bohm, P., Kuroda, M., Mubazi, J. K. E., Shah, A., ... & Thorpe, S. (1995). An economic assessment of policy instruments for combatting climate change.

Gupta, M. (2016). Willingness to pay for carbon tax: A study of Indian road passenger transport. *Transport Policy*, *45*, 46–54. https://doi.org/10.1016/j.tranpol.2015.09.001

Hájek, M., Zimmermannová, J., Helman, K., & Rozenský, L. (2019). Analysis of carbon tax efficiency in energy industries of selected EU countries. *Energy Policy*, *134*, 110955. https://doi.org/10.1016/j.enpol.2019.110955

Hart, P. S., & Feldman, L. (2018). Would it be better to not talk about climate change? The impact of climate change and air pollution frames on support for regulating power plant emissions. *Journal of Environmental Psychology*, *60*, 1–8. https://doi.org/10.1016/j.jenvp.2018.08.013

Hoffman, A. J. (2019). Our emerging cultural shift: Regaining the moral case to address climate change. *Behavioral Scientist, September*, *30*.

Hornsey, M. J., Harris, E. A., Bain, P. G., & Fielding, K. S. (2016). Meta-analyses of the determinants and outcomes of belief in climate change. *Nature Climate Change*, *6*(6), 622–626. https://doi.org/10.1038/nclimate2943

Hox, J. (1998). Multilevel modeling: When and why. In I. Balderjahn, R. Mathar, & M. Schader (Eds.), Classification, data analysis, and data highways (pp. 147-154). Berlin, Germany: Springer. http://dx.doi.org/10.1007/978-3-642-72087-1_17

Hystad, P., Setton, E., Cervantes, A., Poplawski, K., Deschenes, S., Brauer, M., van Donkelaar, A., Lamsal, L., Martin, R., Jerrett, M., & Demers, P. (2011). Creating National Air Pollution Models for Population Exposure Assessment in Canada. *Environmental Health Perspectives*, *119*(8), 1123–1129. https://doi.org/10.1289/ehp.1002976

Karceski, S. M., Dolšak, N., Prakash, A., & Ridout, T. N. (2020). Did TV ads funded by fossil fuel industry defeat the Washington carbon tax?. Climatic Change, 158(3), 301-307. http://dx.doi.org/10.1007/s10584-019-02626-z

Kim, S., Egerter, S., Cubbin, C., Takahashi, E. R., & Braveman, P. (2007). Potential implications of missing income data in population-based surveys: an example from a postpartum survey in California. Public health reports, 122(6), 753-763.

Kitt, S., Axsen, J., Long, Z., & Rhodes, E. (2021). The role of trust in citizen acceptance of climate policy: Comparing perceptions of government competence, integrity and value similarity. *Ecological Economics*, *183*, 106958. https://doi.org/10.1016/j.ecolecon.2021.106958

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., & Stern, N. (2018). Making carbon pricing work for citizens. *Nature Climate Change*, *8*(8), 669–677. https://doi.org/10.1038/s41558-018-0201-2

Koengkan, M., Fuinhas, J. A., Kazemzadeh, E., Alavijeh, N. K., & de Araujo, S. J. (2022). The impact of renewable energy policies on deaths from outdoor and indoor air pollution: Empirical evidence from Latin American and Caribbean countries. Energy, 245, 123209. https://doi.org/10.1016/j.energy.2022.123209

Kousser, T., & Tranter, B. (2018). The influence of political leaders on climate change attitudes. *Global Environmental Change*, *50*, 100–109. https://doi.org/10.1016/j.gloenvcha.2018.03.005

Kulin, J., & Johansson Sevä, I. (2021). Who do you trust? How trust in partial and impartial government institutions influences climate policy attitudes. *Climate Policy*, *21*(1), 33–46. https://doi.org/10.1080/14693062.2020.1792822

Landry, N., Gifford, R., Milfont, T. L., Weeks, A., & Arnocky, S. (2018). Learned helplessness moderates the relationship between environmental concern and behavior. *Journal of Environmental Psychology*, *55*, 18–22. https://doi.org/10.1016/j.jenvp.2017.12.003

Leiserowitz, A., Roser-Renouf, C., Marlon, J., & Maibach, E. (2021). Global Warming's Six Americas: A review and recommendations for climate change communication. Current Opinion in Behavioral Sciences, 42, 97-103. http://dx.doi.org/10.1016/j.cobeha.2021.04.007

Levi, S. (2021). Why hate carbon taxes? Machine learning evidence on the roles of personal responsibility, trust, revenue recycling, and other factors across 23 European countries. *Energy Research & Social Science*, *73*, 101883. https://doi.org/10.1016/j.erss.2020.101883

Li, B. (2014, June 17). Multilevel Regression Models for Mean and (Co)variance: with Applications in Nursing Research. Erasmus University Rotterdam. Retrieved from http://hdl.handle.net/1765/51520

Luukkonen, J., Weckroth, M., Kemppainen, T., Makkonen, T., & Sirviö, H. (2022). Urbanisation and the shifting conditions of the state as a territorial-political community: A study of the geographies of political efficacy. *Transactions of the Institute of British Geographers*, *47*(2), 409–425. https://doi.org/10.1111/tran.12503

McNeish, D. M. (2014). Analyzing clustered data with OLS regression: the effect of a hierarchical data structure. Multiple Linear Regression Viewpoints, 40(1), 11-16.

Metcalf, G. E., & Stock, J. H. (2020, May). Measuring the macroeconomic impact of carbon taxes. In AEA papers and Proceedings (Vol. 110, pp. 101-06). http://dx.doi.org/10.1257/pandp.20201081

Muratori, M. (2014). Rural Energy Use and the Challenges for Energy Conservation and Efficiency. In Our Energy Future (pp. 163-178). Routledge.

Perera, F. P. (2017). Multiple Threats to Child Health from Fossil Fuel Combustion: Impacts of Air Pollution and Climate Change. Environmental Health Perspectives, 125(2), 141–148. https://doi.org/10.1289/EHP299

Peugh, J. L. (2010). A practical guide to multilevel modeling. Journal of school psychology, 48(1), 85-112. http://dx.doi.org/10.1016/j.jsp.2009.09.002

Pui, D. Y. H., Chen, S.-C., & Zuo, Z. (2014). PM 2.5 in China: Measurements, sources, visibility and health effects, and mitigation. Particuology, 13, 1–26. https://doi.org/10.1016/j.partic.2013.11.001

Rafaj, P., Schöpp, W., Russ, P., Heyes, C., & Amann, M. (2013). Co-benefits of post-2012 global climate mitigation policies. Mitigation and Adaptation Strategies for Global Change, 18(6), 801-824. http://dx.doi.org/10.1007/s11027-012-9390-6

Raudenbush, S. W., & Liu, X. (2000). Statistical power and optimal design for multisite randomized trials. Psychological methods, 5(2), 199. http://dx.doi.org/10.1037/1082-989X.5.2.199

Reed, M., O'Reilly, P., & Hall, J. (2019). The economics and politics of carbon taxes and regulations: Evidence from voting on Washington State's Initiative 732. Sustainability, 11(13), 3667. http://dx.doi.org/10.3390/su11133667

Rhodes, E., Axsen, J., & Jaccard, M. (2017). Exploring citizen support for different types of climate policy. Ecological Economics, 137, 56-69. http://dx.doi.org/10.1016/j.ecolecon.2017.02.027

Rotaris, L., & Danielis, R. (2019). The willingness to pay for a carbon tax in Italy. Transportation Research Part D: Transport and Environment, 67, 659-673. http://dx.doi.org/10.1016/j.trd.2019.01.001

Shakor, A., Su'ad, A., Pahrol, M. A., & Mazeli, M. I. (2020). Effects of population weighting on PM10 concentration estimation. Journal of Environmental and Public Health, 2020.

Singh, V., Sokhi, R. S., & Kukkonen, J. (2020). An approach to predict population exposure to ambient air PM2.5 concentrations and its dependence on population activity for the megacity London. Environmental Pollution, 257, 113623. https://doi.org/10.1016/j.envpol.2019.113623

Stock, J. H., & Watson, M. W. (2003). Introduction to econometrics (Vol. 104). Boston: Addison Wesley.

Takeshita, T. (2012). Assessing the co-benefits of CO2 mitigation on air pollutants emissions from road vehicles. Applied Energy, 97, 225–237. https://doi.org/10.1016/j.apenergy.2011.12.029

Tan, R., & Lin, B. (2020). The influence of carbon tax on the ecological efficiency of China's energy intensive industries—A inter-fuel and inter-factor substitution perspective. Journal of Environmental Management, 261, 110252. https://doi.org/10.1016/j.jenvman.2020.110252

Vona, F. (2019). Job losses and political acceptability of climate policies: Why the 'job-killing' argument is so persistent and how to overturn it. Climate Policy, 19(4), 524–532. https://doi.org/10.1080/14693062.2018.1532871

Weckroth, M., & Ala-Mantila, S. (2022). Socioeconomic geography of climate change views in Europe. Global Environmental Change, 72, 102453. https://doi.org/10.1016/j.gloenvcha.2021.102453

Wente, M. (2014). Why Australia's carbon tax bombed. Globe Mail.

Wolfinger, R. E., & Rosenstone, S. J. (1980). Who votes?. Yale University Press.

Woltman, H., Feldstain, A., MacKay, J. C., & Rocchi, M. (2012). An introduction to hierarchical linear modeling. Tutorials in quantitative methods for psychology, 8(1), 52-69. http://dx.doi.org/10.20982/tqmp.08.1.p052

World Bank, World Development Indicators. (2015). Fossil fuel energy consumption (% of total). https://data.worldbank.org/indicator/EG.USE.COMM.FO.ZS

World Bank (2022), "Carbon Pricing Dashboard", https://carbonpricingdashboard.worldbank.org (data as of 1 April 2022, accessed on 15 October 2022).

Yagita, Y., & Iwafune, Y. (2021). Residential energy use and energy-saving of older adults: A case from Japan, the fastest-aging country. Energy Research & Social Science, 75, 102022. https://doi.org/10.1016/j.erss.2021.102022

Yang, C., Li, T., & Albitar, K. (2021). Does energy efficiency affect ambient PM2. 5? The moderating role of energy investment. *Frontiers in Environmental Science*, *9*, 707751. https://doi.org/10.3389/fenvs.2021.707751

Zanocco, C., Boudet, H., Nilson, R., & Flora, J. (2019). Personal harm and support for climate change mitigation policies: Evidence from 10 U.S. communities impacted by extreme weather. Global Environmental Change, 59, 101984. https://doi.org/10.1016/j.gloenvcha.2019.101984

Zaslove, A., Geurkink, B., Jacobs, K., & Akkerman, A. (2021). Power to the people? Populism, democracy, and political participation: a citizen's perspective. West European Politics, 44(4), 727–751. https://doi.org/10.1080/01402382.2020.1776490

Zhang, S., Li, Y., Hao, Y., & Zhang, Y. (2018). Does public opinion affect air quality? Evidence based on the monthly data of 109 prefecture-level cities in China. Energy Policy, 116, 299-311

Table 2.1. Descriptive Statistics

Variables	Mean	Std. Dev.	Min.	Max.
Level 1 (Individual)				
Carbon tax support	1.84	1.23	0.00	4.00
Renewable energy subsidy support	3.03	1.02	0.00	4.00
Energy efficiency law support	2.59	1.16	0.00	4.00
Climate change concern (index)	0.00	1.00	-4.20	2.01
Political trust (index)	0.00	1.00	-1.90	2.71
Egalitarian attitudes (index)	4.54	1.70	0.00	8.00
Education level	4.13	1.84	1.00	7.00
Female	0.51	0.50	0.00	1.00
Age	49.91	17.74	15.00	100.00
Left-and-right preference	5.06	2.17	0.00	10.00
Income (1000 Euros)	29.38	21.12	1.91	126.66
Health	2.19	0.88	0.00	4.00
Rural	0.37	0.48	0.00	1.00
Doing in the last 7 days:				
Unemployed, not actively looking for job	0.04	0.19	0.00	1.00
Unemployed, actively looking for job	0.02	0.13	0.00	1.00
Retired	0.27	0.44	0.00	1.00
Permanent sick	0.03	0.18	0.00	1.00
Paid work	0.57	0.49	0.00	1.00
Housework, looking after children, others	0.14	0.35	0.00	1.00
Education	0.08	0.27	0.00	1.00
Community or military service	0.00	0.04	0.00	1.00
Level 2 (Region)				
PM2.5 annual mean level (2016)	10.66	4.49	3.15	26.79
GDP per capita (2016)	32.04	16.19	5.17	81.45
Unemployment rate (2016)	7.53	4.12	2.20	28.90
Observations	25,033			

Notes: Descriptive statistics of variables employed in the empirical analysis. Level1/Individual variables come from ESS8 for 19 countries in 2016. Level 2/Region variables come from Eurostat and EEA in 2016.

Table 2.2. Multilevel Linear Regression

	(1) Carbon Tax	(2) Renewable Energy Subsidy	(3) Energy Efficiency Law
Individual-level			
Climate change concern (index)	0.172***	0.203***	0.198***
	(0.008)	(0.006)	(0.008)
Political trust (index)	0.208***	0.068***	0.064***
	(0.008)	(0.007)	(0.008)
Egalitarian attitudes (index)	0.025***	0.034***	0.029***
	(0.005)	(0.004)	(0.004)
Education level	0.062***	0.029***	0.022***
	(0.005)	(0.004)	(0.004)
Female	0.045**	0.049***	0.089***
	(0.015)	(0.012)	(0.014)
Age	-0.001	-0.000	0.003***
	(0.001)	(0.001)	(0.001)
Left-and-right preference	-0.033***	-0.020***	-0.014***
	(0.004)	(0.003)	(0.003)
Income	0.003***	0.001**	0.002***
	(0.001)	(0.000)	(0.000)
Health	0.026**	0.002	0.007
	(0.010)	(0.008)	(0.009)
Rural	-0.084***	-0.006	-0.029
	(0.016)	(0.014)	(0.016)
Doing last 7 days:			
Unemployed, actively looking for job	-0.025	0.031	0.026
	(0.045)	(0.037)	(0.043)
Unemployed, not actively looking for job	-0.029	0.068	0.011
	(0.060)	(0.050)	(0.059)
Permanent sick	0.003	0.021	0.113**
	(0.045)	(0.038)	(0.044)
Retired	0.038	0.003	0.037
	(0.034)	(0.029)	(0.033)
Paid work	-0.013	0.070**	0.089***
	(0.028)	(0.024)	(0.027)
Education	0.147***	0.082**	-0.059
	(0.035)	(0.029)	(0.034)
Housework, looking after children, others	0.005	0.006	0.062**
	(0.023)	(0.019)	(0.023)
Community or military service	0.085	0.230	0.230
	(0.200)	(0.167)	(0.194)
Region-level			
PM2.5 annual exposure level 2016	0.015	0.018**	0.018*
	(0.008)	(0.007)	(0.007)
GDP per capita 2016	0.011***	0.003*	0.001
	(0.002)	(0.002)	(0.002)
Unemployment rate 2016	-0.004	-0.006	0.002
	(0.006)	(0.005)	(0.006)
Constant	1.650***	3.258***	2.856***
	(0.074)	(0.061)	(0.067)
Country dummy variables	Yes	Yes	Yes
Variance (region)	0.029	0.018	0.024
Variance (residual)	1.288	0.898	1.212
Observations	25033	25033	25033
AIC	77744.610	68710.248	76189.741
BIC	78085.984	69051.622	76531.115

Notes: Results correspond to the estimation of Equation (2), where we construct a two-level random intercept model for the hierarchical survey data. The individual variables are group-mean centered, while regional variables are centered by grand mean. Table lists estimated coefficients with standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

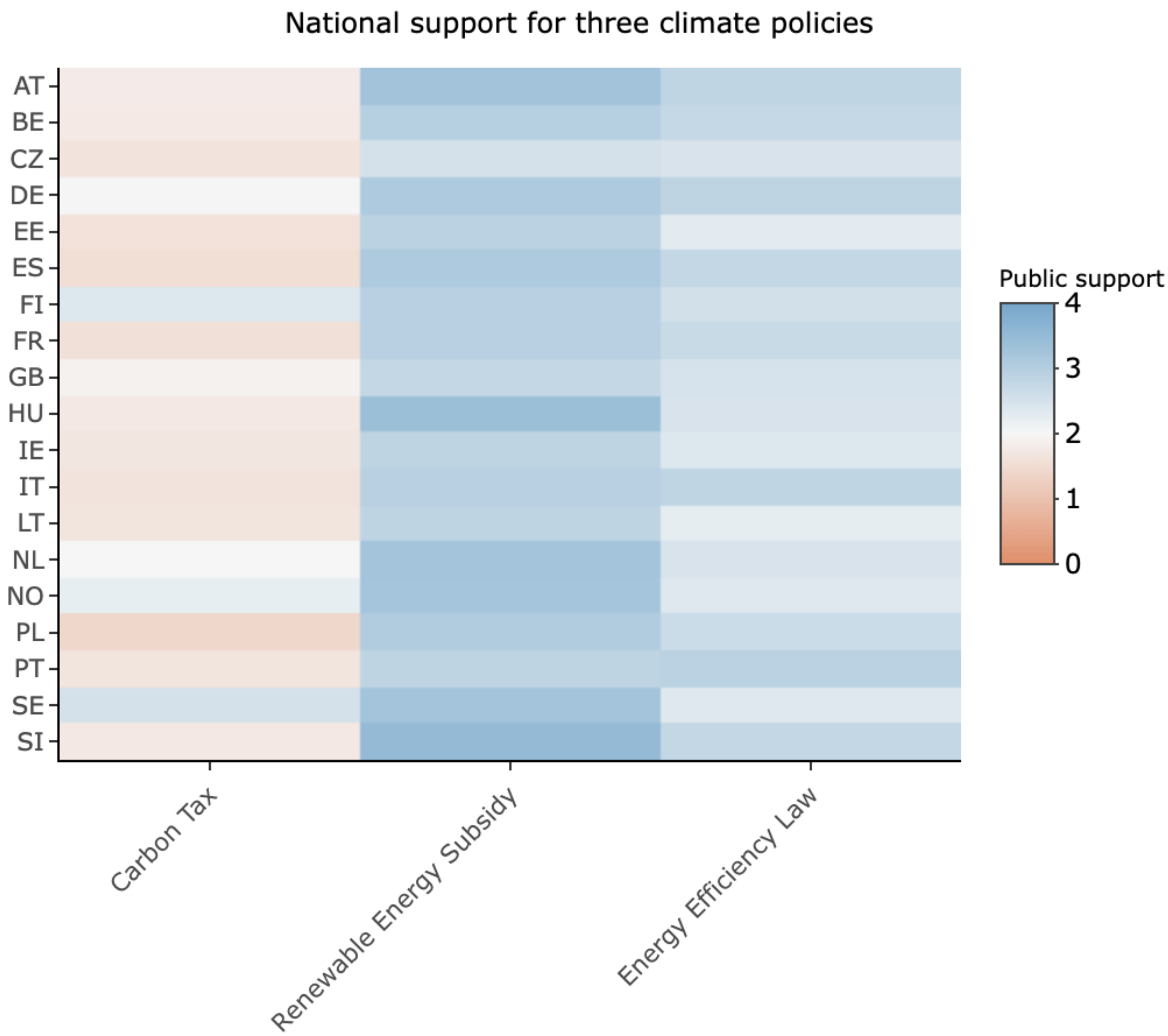


Figure 2.1. Mean national support for three climate policies.

Notes: This figure shows the national mean support level for each climate policy. People's support to carbon tax was measured by their answer to the question "To what extent are you in favor or against increasing taxes on fossil fuels, such as oil, gas, and coal to reduce climate change?" People's support to a renewable energy subsidy policy was measured using the answers to the question "To what extent are you in favor or against using public money to subsidize renewable energy such as wind and solar power?" Public perception of an energy efficiency policy was measured by the answers to the question "To what extent are you in favor or against a law banning the sale of the least energy efficient household appliances?" The public support values range from 0 to 4. 0 = strongly against, 1 = somewhat against, 2 = neither against nor in favor, 3 = somewhat in favor, and 4 = strongly in favor. The abbreviations of the countries are AT Austria, BE Belgium, CZ Czech Republic, EE Estonia, ES Spain, FI Finland, FR France, GB United Kingdom, DE Germany, HU Hungary, IE Ireland, SI Slovenia, IT Italy, LT Lithuania, NL Netherlands, NO Norway, PL Poland, PT Portugal, SE Sweden, SI Slovenia.

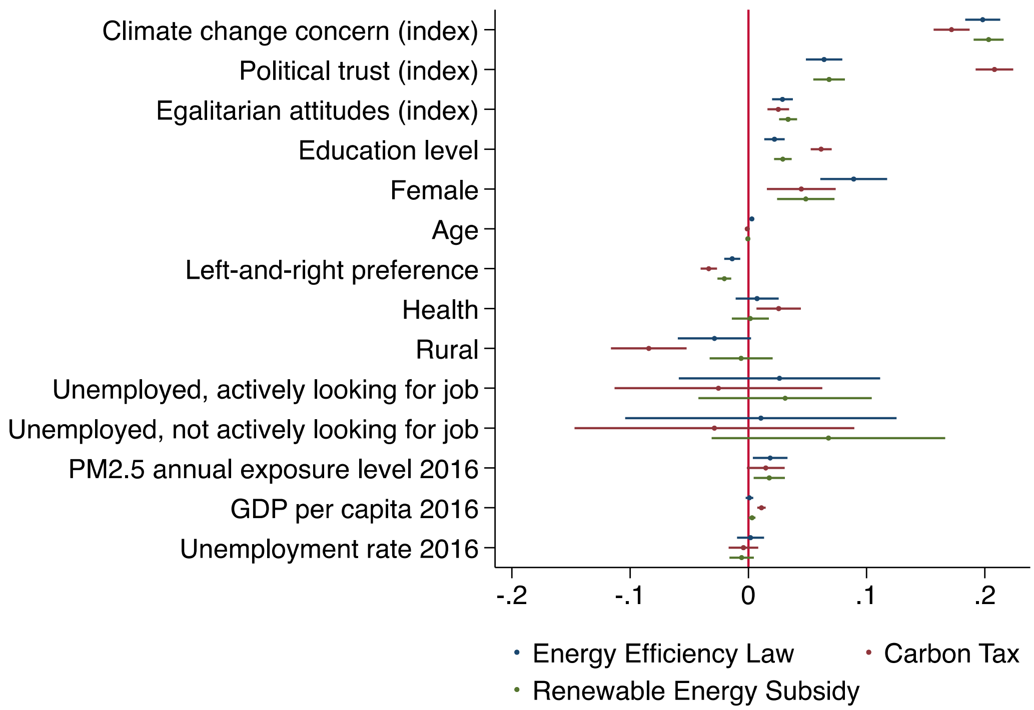


Figure 2.2. Selected coefficients with 95% Confidence Interval of three climate policies
Notes: This figure depicts the 95% confidence interval of selected coefficients in Table 2.1 corresponding to Equation (2). For the variables indicating activities doing in the last 7 days, we only include unemployment status.

Appendix A

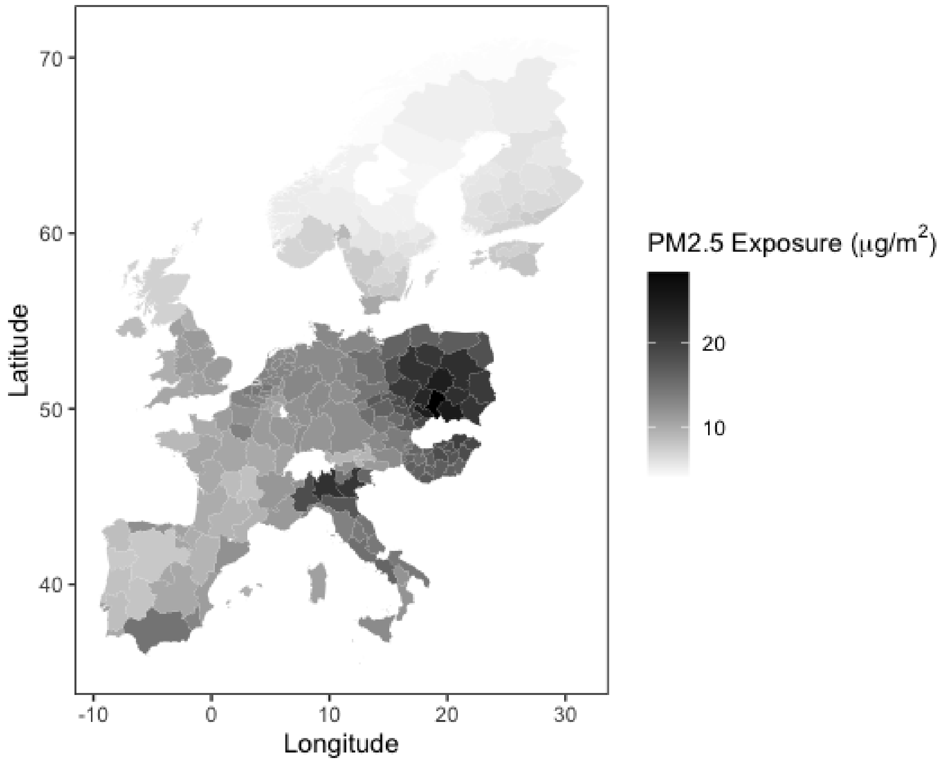
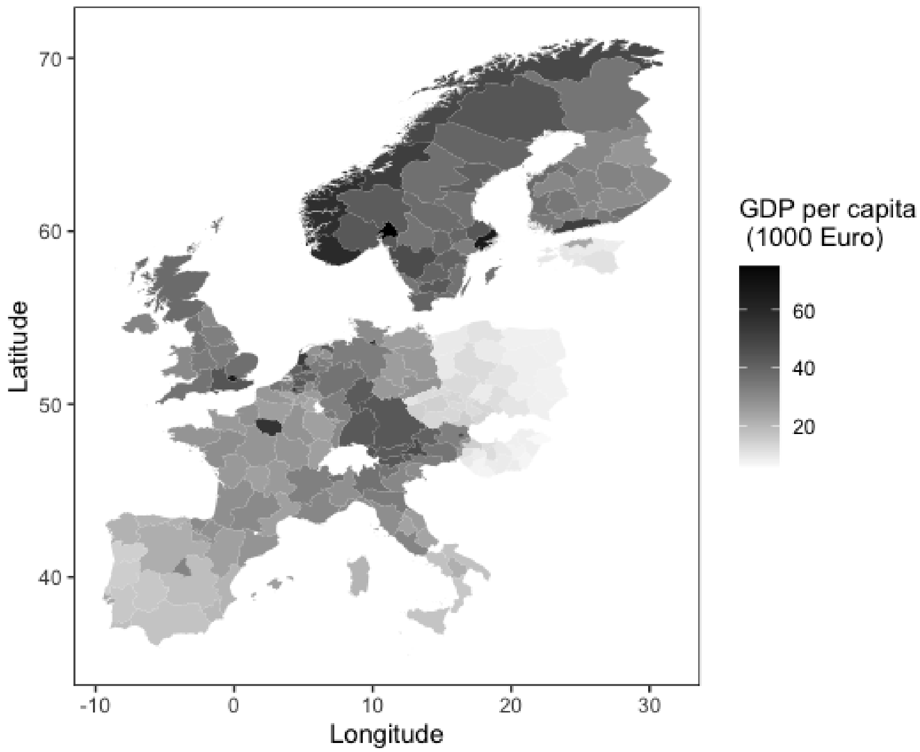


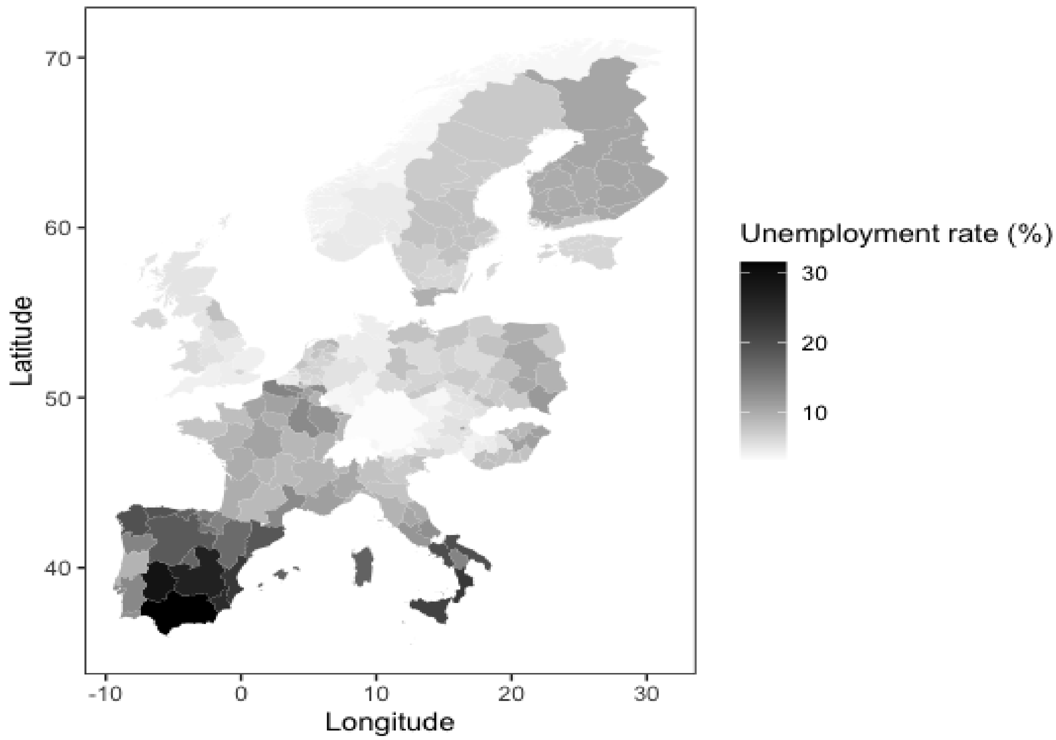
Figure A.1. Spatial distribution of the mean level of PM2.5 population-weighted exposure in 2016 (NUTS level)

Notes: The spatial distribution of population-weighted exposure to PM2.5 is calculated based on Equation (1). The interpolation data for PM2.5 in 2016 was collected from the EEA, and the GEOSTAT 2011 population-grid dataset was derived from Eurostat.



(a) GDP per capita

Notes: The GDP per capita (Thousand euros) in 2016 based on the NUTS3 region was derived from Eurostat.



(b) Unemployment rate
Notes: The unemployment rate (%) in 2016 based on the NUTS2 region was derived from Eurostat.

Figure A.2. Spatial distribution of 2016 GDP per capita and unemployment rate (NUTS level)

Table A.1. Description of Variables

Variables	Source	Description
Individual Variables	8th ESS	
Carbon Tax Support		Favor increasing taxes on fossil fuels to reduce climate change: 0 (Strongly against) - 4 (Strongly in favor)
Renewable Energy Subsidy Support		Favor using public money to subsidize renewable energy such as wind and solar power: 0 (Strongly against) - 4 (Strongly in favor)
Energy Efficiency Law Support		Favor a law banning the sale of the least energy efficient household appliances: 0 (Strongly against) - 4 (Strongly in favor)
Climate Change Concern (Index)		Factor score of "Do you think the world's climate is changing", "Do you think that climate change is caused by natural processes, human activity, or both?" and "How good or bad do you think the impact of cli-mate change will be on people across the world?"
Political Trust (Index)		Factor score of "how much do you personally trust parliament?", "how much do you personally trust politicians?" and "how much do you personally trust political parties?"
Egalitarian Attitudes (Index)		Sum index of "Large differences in people's incomes are acceptable to properly reward differences in talents and efforts" (reverse-coded) and "For a society to be fair, differences in people's standard of living should be small"
Household Income		Households' total net income (deciles of income level in their country), We take mean level for each decile.
Education Level		Highest education level based on ES-ISCED Levels (1-7)
Left-and-Right Preference		Self-placement of political ideology 0(Left)-10(Right)
Female (Dummy Variable)		1: Female 0: Male
Age		Respondent' age in years
Rural (Country village, farm or home in countryside)		1: Living in the rural area 0: Not living in the rural area
Health		Subjective general health: 0 (Very bad) – 4 (Very good)
Doing in the last 7 days:		Main activities in the last 7 days: Unemployed, actively looking for job; Unemployed, inactively looking for job; Education; Retired; Permanently sick; Housework, looking after children, others; Paid work; Community or military service.
Regional Environmental Variables		
PM2.5 Interpolation data ($\mu g/m^3$)	EEA	1km grid
GEOSTAT 2011 population-grid dataset	Eurostat	1km grid
Regional Socio-economic Variables		
GDP per capita (Thousand Euro)	Eurostat	GDP measured by 2015 Euro at NUTS 3 level in 2016
Unemployment rate (%)	Eurostat	Unemployment rate at NUTS 2 level in 2016
CO2 emission per capita	Global Atmospheric Research EDGAR	CO2 emission per capita at NUTS2 level in 2016
Manufacturing employment	Eurostat	Employment (thousand persons) in manufacturing sector by NUTS 3 regions

Table A.2: Multilevel Linear Regression - Null Models

	(1) Carbon tax	(2) Renewable Energy Subsidy	(3) Energy Efficiency Laws
Constant	1.794***	3.045***	2.592***
	(0.026)	(0.020)	(0.019)
Variance (region)	0.148	0.084	0.073
Variance (residual)	1.398	0.962	1.268
Observations	25033	25033	25033
AIC	79985.98	70578.23	77408.63
BIC	80010.36	70602.61	77433.01

Notes: The null models are estimated using only random intercepts without explanatory variables. We calculate ICC values based on the estimated variance in null models. The ICC values calculated correspond to Equation (3). Table lists estimated coefficients with standard errors in parentheses: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.3: Multilevel Ordinal Probit Regression

	Carbon Tax	Renewable Energy Subsidy	Energy Efficiency Law
Individual-level			
Climate change concern (index)	0.165***	0.255***	0.199***
	(0.007)	(0.008)	(0.007)
Political trust (index)	0.193***	0.067***	0.055***
	(0.008)	(0.008)	(0.008)
Egalitarian attitudes (index)	0.025***	0.045***	0.029***
	(0.004)	(0.005)	(0.004)
Education level	0.057***	0.040***	0.021***
	(0.004)	(0.004)	(0.004)
Female	0.037**	0.035*	0.079***
	(0.014)	(0.015)	(0.014)
Age	-0.001	0.000	0.003***
	(0.001)	(0.001)	(0.001)
Left-and-right preference	-0.033***	-0.027***	-0.013***
	(0.003)	(0.001)	(0.001)
Income	0.003***	0.001**	0.001**
	(0.000)	(0.001)	(0.000)
Health	0.024**	0.006	0.010
	(0.009)	(0.009)	(0.009)
Rural	-0.077***	-0.007	-0.031*
	(0.015)	(0.016)	(0.015)
Doing last 7 days:			
Unemployed, actively looking for job	-0.020	0.056	0.019
	(0.042)	(0.044)	(0.042)
Unemployed, not actively looking for job	-0.033	0.090	0.008
	(0.056)	(0.059)	(0.056)
Permanent sick	0.003	0.034	0.110**
	(0.042)	(0.044)	(0.043)
Retired	0.036	-0.005	0.024
	(0.032)	(0.034)	(0.032)
Paid work	-0.009	0.086**	0.077**
	(0.032)	(0.034)	(0.032)
Education	0.130***	0.107**	-0.062
	(0.033)	(0.035)	(0.033)
Housework, looking after children, others	0.003	0.024	0.065**
	(0.022)	(0.023)	(0.022)
Community or military service	0.085	0.252	0.174
	(0.186)	(0.197)	(0.186)
Region-level			
PM2.5 annual exposure level 2016	0.014	0.021*	0.018*
	(0.008)	(0.008)	(0.007)
GDP per capita 2016	0.010***	0.003	0.001
	(0.002)	(0.002)	(0.002)
Unemployment rate 2016	-0.004	-0.005	0.002
	(0.006)	(0.006)	(0.006)
Observations	25033	25033	25033
AIC	73497.807	59496.160	71121.084
BIC	73855.436	59853.790	71478.714

Notes: The multilevel ordinal probit model is estimated as a robustness check. Table lists estimated coefficients with standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A.4: Robustness check with regional carbon intensity

	(1) Carbon Tax	(2) Renewable Energy Subsidy	(3) Energy Efficiency Law
Region-level			
PM2.5 annual exposure level	0.015	0.018^{*}	0.019^{*}
(2016)	(0.009)	(0.007)	(0.008)
GDP per capita (2016)	0.011^{***}	0.002	0.001
	(0.002)	(0.002)	(0.002)
Unemployment rate (2016)	-0.003	-0.005	0.002
	(0.007)	(0.006)	(0.006)
CO2 emission per capita (2016)	-1.028	-1.122	2.740
	(3.042)	(2.533)	(2.825)
Observations	22249	22249	22249
AIC	69251.772	61484.022	67797.335
BIC	69580.184	61812.434	68125.747

Notes: In the robustness check, we include the same individual variables as in Table 2 for control purposes. However, we do not present the specific results for these variables in this analysis. Instead, we focus solely on presenting the region-level results in the robustness check. Table lists estimated coefficients with standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A.5: Robustness check with regional economic structure (manufacturing sector)

	(1) Carbon Tax	(2) Renewable Energy Subsidy	(3) Energy Efficiency Law
Region-level			
PM2.5 annual exposure level (2016)	0.015	0.018*	0.019*
	(0.009)	(0.007)	(0.008)
GDP per capita (2016)	0.010***	0.002	0.001
	(0.002)	(0.002)	(0.002)
Unemployment rate (2016)	-0.008	-0.007	0.001
	(0.008)	(0.006)	(0.007)
Share (%) of manufacturing employment	-0.008	-0.007	0.001
(2016)	(0.008)	(0.006)	(0.007)
Observations	21937	21937	21937
AIC	68350.388	60653.665	66809.495
BIC	68678.221	60981.498	67137.329

Notes: In the robustness check, we include the same individual variables as in Table 2 for control purposes. However, we do not present the specific results for these variables in this analysis. Instead, we focus solely on presenting the region-level results in the robustness check. Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

CHAPTER 3

ENVIRONMENTAL BELIEF-ACTION GAP AND SUBJECTIVE WELL-BEING[8]

[8] Zhang, S., Ferreira, S., & Karali, B. To be submitted to *Journal of Environmental Psychology*.

3.1 Abstract

Environmental attitude-behavior gap has been well discussed in previous studies, but its impact on subjective well-being has received limited attention. Using the 8th round of the European Social Survey, we examine the link between the environmental belief-action gap, described as the discrepancy between environmental attitude regarding climate change issues and pro-environmental behavior, and individuals' subjective well-being. Our findings also reveal that the relationship between green behaviors and subjective well-being is nuanced. Purchasing energy-efficient household appliances is positively related to an individual's subjective well-being, while reducing energy consumption by saving utility use in the daily life is negatively correlated with subjective well-being.

Key words: Pro-environmental behavior; Subjective well-being; Environmental attitude-behavior gap.

3.2 Introduction

Reducing the negative impacts of climate change requires rapidly reducing global greenhouse gas emissions. Changes in lifestyle can help reduce personal emissions and many are calling for a cultural shift (Liu & Segev, 2017; Hoffman 2019), as changes in culture and values can in turn drive long-lasting changes in behavior (Park et al., 2007; Ringov & Zollo, 2007; Schumacher, 2015; Palomo-Vélez & van Vugt, 2021). However, even among those in the public who declare to be concerned about climate change, only a fraction engages in meaningful climate-friendly actions (Landry et al., 2018). That there is a gap between environmental attitudes and pro-environmental behaviors is well documented (Klockner, 2013), and there has been much effort devoted to the study of the factors that help reduce that gap (Kollmuss & Agyeman, 2002; Tam & Chan, 2018; Wintschnig, 2021). At the same time, it is well known that cognitive dissonance can negatively affect how people feel and view themselves (Harmon-Jones et al., 2015). Our objective in this paper is to estimate the relationship between environmental belief-action gap and subjective well-being.

Cognitive dissonance is a psychological phenomenon that occurs when people behave inconsistently with their attitudes, leading to uncomfortable feelings (Festinger, 1957). In our study, we define the cognitive dissonance in acting pro-environmentally as the disparity between individuals' environmental attitudes and pro-environmental behaviors. Many papers show a positive link between self-reported happiness and pro-environmental behaviors (Kasser, 2017; Binder et al., 2020; Welsch, 2020; Zawadzki et al., 2020; Capstick et al., 2022). In economic terms, this suggests that people make suboptimal choices with respect to pro-environmental behavior, and that an increase in environmental-friendliness would be utility-increasing (Welsch & Kühling, 2010), especially when a greener self-image is consistent with the social norm

(Welsch & Kühling, 2018). Therefore, we hypothesize that environmental belief-action gap is negatively correlated to subjective well-being.

In this paper we measure the gap between environmental attitude and behavior regarding climate change and estimate its influence on individuals' subjective well-being for a large, representative sample of Europeans. Data come from the European Social Survey Round 8 (ESS8). The ESS is an academically driven cross-national survey that measures the attitudes, beliefs, and behavior patterns of diverse populations across Europe. In its 8^{th} round, implemented in 2016, the ESS included a module on public attitudes to climate change, energy security and energy preferences. The module collected information on beliefs and concerns about climate change as well as on climate-friendly behaviors in addition to a rich set of socio-demographic controls (health, age, education, income level, social activity participation, etc.) We created environmental attitude indicator as the sum index of three questions: "*Do you think the world's climate is changing*"; "*Do you think that climate change is caused by natural processes*"; "*How good or bad do you think the impact of climate change will be on people across the world*". The pro-environmental behaviors are measured on two scales: activities reducing energy use in daily life, green consumption related to energy-efficient household appliances. The sum indices of PEB and environmental attitude are all standardized with a mean value of 0 and a standard deviation of 1. The environmental belief-action gap is coded as 1 if the sum index of attitude is at least one point larger than the PEB index. Building upon this background, our study aims to investigate the extent to which environmental belief-action gap related to individuals' subjective well-being by controlling for green lifestyle.

3.3 Literature Review

Environmental Belief-action Gap

The correlation between pro-environmental behaviors and environmental attitudes has been well discussed for decades. People are typically assumed to exhibit pro-environmental behaviors under the assumption that they are well-educated, fully informed, and have strong environmental concerns. The positive relationship between environmental beliefs and pro-environmental behaviors was confirmed in some studies, suggesting that a high level of environmental concerns raised the probability of pro-environmental behaviors (Chan & Lau, 2000; Mostafa, 2007; Kilbourne & Pickett, 2008). Individuals with a higher level of environmental concerns will be more willing to pay the premium for "green products" (Pagiaslis & Krontalis, 2014), and reduce consumption of polluting products (Fraj & Martinez, 2007; Liu & Segev, 2017).

However, the attitude-behavior gap is well discussed in the psychology literature, since people may not act to do what they want to do, affecting the expected behavioral outcome (Sheeran & Webb, 2016). In the environmental area, several literatures revealed that not all the environmental awareness would be correspondent with subsequent pro-environmental behaviors (Kollmuss & Agyeman, 2002; Bamberg & Möser, 2007; Wang et al., 2021). Additionally, research further supports the existence of a significant gap between purchase intentions and actual pro-environmental behaviors in the context of environment-friendly product purchases and adoption of renewable energy systems (Claudy et al., 2013; Moser, 2015; Grimmer & Miles, 2017).

Research on pro-environmental behaviors focused on observing the "green gap" and analyzing its predominant drivers. Tam & Chan (2017) provided an alternative explanation that higher levels of distrust contribute to the attitude-behavior gap, as the attitude-behavior association is weakened in societies with higher level of individualism. Kulin & Johansson Sevä (2021) stated that people who are environmentally concerned are more likely to act pro-environmentally in countries with trustworthy government, although environmentally concerned individuals are observed with weak pro-environmental action in general. Onwezen et al. (2013) provided evidence from a survey conducted in the Netherlands regarding the effect of anticipated pride and guilt on individual's compliance with personal norm. Farjam et al. (2019) found that environmental attitudes would only predict behaviors in low-cost situations.

Several hypotheses have been proposed and examined in prior studies to determine how to bridge the intention-behavior gap. Tam & Chan (2018) argued that generalized trust in the entire society can narrow the gap which was caused by the concerns about free riders. Redondo & Puelles (2017) contributed to explaining the environmental attitude–behavior gap via self-control channel and suggested the effectiveness of enhancing self-control to narrow the intention-behavior gap. Binder & Blankenberg (2017) identified being retired and having a green preference as efficient indicators to narrow the gap. While numerous studies have focused on identifying the existence of the attitude-behavior gap and suggesting the way to narrow it, our paper is the first study examining how this gap affects individuals' subjective feelings, specifically in terms of life satisfaction and happiness.

Subjective Well-being

Subjective measures of well-being have become important indicators for examining levels of social welfare as reported by individuals themselves in the past decades. Subjective well-being has been considered in two dimensions: affective and cognitive components (Chamberlain 1988). The two components always refer to happiness and life satisfaction separately, which are closely connected. However, there are distinct differences between life satisfaction and happiness

(Lewinsohn et al., 1991): life satisfaction refers more to judgmental processes, while happiness is related to affective emotions or feeling states.

Dolan et al. (2008) provided a review of the literature exploring the determinants of subjective well-being in both economic and psychological areas. Subjective well-being is found to be correlated with income (Sacks et al., 2012; Boyce et al., 2013; D'Ambrosio et al., 2020; Tan et al., 2020), education (Zhu & Yu, 2022), unemployment (Di Tella et al., 2001), marriage and children (Cao et al., 2015; Tao, 2019), physical (Angner et al., 2013) and mental health (Phillips, 1967), and social activity (Cooper et al., 1992). SWB is also related to environmental conditions (Malkoç, 2011; Ferreira et al., 2013; Weinhold, 2013; Rehdanz et al., 2015; Li & Zhou, 2020) and, importantly for this paper, green behaviors (Brown & Kasser, 2005; Videras & Owen, 2006; Welsch & Kühling, 2010), with a very active literature concerning the mechanisms.

Suárez-Varela et al. (2016) found that both awareness and behaviors can have a positive effect on SWB and that the effect is amplified when both are combined. They found that not all types of green behavior led to an increase in SWB: water conservation practices have no effect, whereas the use of energy-efficient devices has positive effects on SWB. Welsch et al. (2021) examined the impact of green lifestyles on both affective and cognitive subjective well-being using the mediation model. They used UK panel data to analyze the relationship between a green lifestyle and life satisfaction. Their findings revealed that pro-environmental behaviors have an indirect effect on life satisfaction through the affective well-being channel, and there is also a direct effect of having a positive self-image as an environmentally conscious individual on life satisfaction.

Existing research has focused on the relationship between pro-environmental behavior and subjective well-being, but the impact of the attitude-behavior divide on individual well-being has received little attention. Binder & Blankenberg (2017) identified varying degrees of the attitude-behavior gap associated with various categories of behavior, but their primary emphasis was on the loss of life satisfaction due to a green self-image rather than the negative effects of the attitude-behavior gap itself. Although prior research has established the groundwork for understanding the relationship between subjective well-being and pro-environmental behaviors, there is a significant lack of research examining the impact of the environmental attitude-behavior divide on subjective well-being.

We extend Ismael & Ploeger's (2020) investigation into the intention-behavior gap in organic food purchases to look into the potential effects of the environmental belief-action gap on subjective well-being. Specifically, we investigate energy-saving behaviors, such as purchasing energy-efficient home appliances and making daily patterns that reduce energy consumption. Our study seeks to cast light on the psychological consequences of the environmental belief-action gap and provide insights for designing effective climate nudges to improve social welfare.

3.4 Survey Data and Processing of Variables

This study uses the European Social Survey (ESS), which was designed to measure how social attitudes change in Europe. In its 8th round in 2016, the ESS included a rotating module about perceptions of climate change, pro-environmental behaviors, and green self-image, providing a sample of 31,844 observations to analyze people's environmental beliefs and behaviors across 23 European countries[9].

[9] The 8th round of European Social Survey was conducted in 23 countries, including Austria, Belgium, Czech Republic, Estonia, Spain, Finland, France, United Kingdom, Germany, Hungary, Ireland, Slovenia, Israel, Italy, Iceland, Lithuania, Netherlands, Norway, Poland, Portugal, Russia, Sweden, and Slovenia.

Subjective well-being in the ESS is measured with two variables: life satisfaction and happiness, to capture affective and cognitive components of SWB, respectively. Both are closely correlated. The numerical level of affective subjective well-being (happiness) is reported by the answer to the question "*All things considered, how satisfied are you with your life as a whole nowadays? Please answer using this card, where 0 means extremely dissatisfied and 10 means extremely satisfied*" on the scale ranging from 0 to 10. The average level of happiness in the whole sample is approximately equal to 7.53 with a s.d. of 1.79. Life satisfaction is measured by the question "*Taking all things together, how happy would you say you are? Please use this card,*" with responses ranging from 0 (extremely unhappy) to 10 (extremely happy). The mean value reported in Table 1 is 7.23 with standard deviation of 2.02, indicating an average score of life satisfaction around 7 out of 10 credits.

[Table 3.1]

A key explanatory variable in our study is whether an individual exhibits a disparity between environmental belief and pro-environmental behaviors. Pro-environmental behaviors are measured by two questions. The first one measures "green consumption" or people's decision to purchase environment-friendly products (Cleveland et al., 2012; Ghafari et al., 2020), which in the case of climate-friendly behavior refers to the purchase of energy efficient electric appliances: "*If you were to buy a large electrical appliance for your home, how likely is it that you would buy one of the most energy efficient ones"* Answers to the question range from 0 (not at all likely) to 10 (extremely Likely). The second question is "*There are some things that can be done to reduce energy use, such as switching off appliances that are not being used, walking for short journeys, or only using the heating or air conditioning when really needed. In your daily life, how often do you do things to reduce your energy use,*" with responses ranging from 1 (never) to 6 (always). While in the first question respondents report a behavioral intention, the second question asks about their actual "energy-conscious" behavior, whereby people are more willing to take actual pro-environmental action to save utility use in their daily lives (Cleveland et al., 2012; Ghafari et al., 2020). For comparability, we recode the scale of "energy-conscious" behavior to 0 – 5. The mean values of "green consumption" and "energy-conscious" behavior are 7.84 (s.d. = 1.02) and 3.21 (s.d. = 1.17), respectively.

[Figure 3.1]

Environmental attitudes are measured by the answers to three relevant questions regarding perceptions of climate change: "*Do you think the world's climate is changing*" on the scale of 1 (definitely changing) – 4 (definitely not changing), "*Do you think that climate change is caused by natural processes*" on the scale of 1 (entirely by natural processes) – 5 (entirely by human activity), and "*How good or bad do you think the impact of climate change will be on people across the world*" on the scale of 0 (extremely bad) – 10 (extremely good). The first and third measures are reversely coded into 0 (definitely not changing) – 3 (definitely changing), and 0 (extremely good) – 10 (extremely bad). The scale of the second question is also adjusted to 0–4 to be consistent with the others.

We combine the three attitude variables into a single indicator using a principal component analysis[10]. The sum index is a factor score calculated by principal factor analysis with factor loadings of 0.72, 0.71, and 0.70, respectively. The sum index of PEB is the factor score by principal factor analysis with same factor loading of 0.81.

As shown in Figure 1, we observe a discrepancy in environmental attitudes and pro-environmental behaviors across countries. In general, most countries lie on the line, showing that

[10] For robustness, we also take simple average values as an alternative way to construct the indicators of environmental belief and pro-environmental behavior. The results are presented in Appendix Table B.1.

average levels of environmental attitudes are approximately consistent with pro-environmental behavior mean levels. Russia and Iceland exhibit relatively strong attitude-behavior disparities compared to the other countries. Some countries lie below the 45-degree reference line, suggesting that their behaviors may be more environmentally friendly than their attitudes. This could be attributed to the influence of social norms and other motivating factors (Farrow et al., 2017). Additionally, in regions with high utility prices, the adoption of green behaviors may be driven by the intention to reduce electricity bills. In our study, we specifically focused on the situation that individuals exhibit a high belief in climate change but engage in a low frequency of pro-environmental behaviors.

As we described above, the sum indices of PEB and environmental attitude are all standardized with a mean value of 0 and a standard deviation of 1. The environmental belief-action gap is coded as 1 if the sum index of attitude is at least one point larger than the PEB index. We find 6,636 people representing significant environmental belief-action gap in the full sample.

[Figure 3.2]

Respondents are also asked to rate the extent of their subjective green self-image on the scale of 1 (very much like me) to 6 (not like me at all) in "*He / She strongly believes that people should care for nature. Looking after the environment is important to him.*" This scale is reversely coded to 0 (not like me at all) - 5 (very much like me). This indicator is distinguished from PEB (pro-environmental behavior), which refers to taking actual action to protect the environment, as it evaluates to what extent people see themselves as environmentalists (Binder & Blankenberg, 2017; Welsch et al., 2021).

[Table 3.2]

The Pearson correlation coefficients are shown in Table 3.2. The correlation between happiness and life satisfaction is 0.70 with significance at 0.10 confidence level, indicating, as expected, that affective subjective well-being is highly correlated with cognitive subjective well-being at 0.10 level. Among the independent variables, the dummy variable of environmental belief-action gap is identified as moderately correlated with “green consumption” behavior (coefficient = -0.48) and “energy-conscious” behavior (coefficient = -0.42). The two types of pro-environmental behaviors are also moderately correlated, with a 0.32 significant correlation coefficient at the 0.1 percentage level. Besides, the green self-image has a small correlation with “green consumption” behavior (coefficient = 0.23) and “energy-conscious” behavior (coefficient = 0.26). The multicollinearity is not severe, since all Pearson correlation coefficients are less than 0.8 (Shrestha, 2020).

In addition to the core independent variables, including environmental belief-action gap, two types of green behaviors (green consumption and energy-conscious behaviors), and green self-image, we control for other socio-economic covariates (income, age, gender, education level, employment status, marriage status, frequency of participating in social activities). In the ESS, household income is recorded as an interval variable, with respondents reporting their decile in the respondent’s country income distribution. The income level is categorized into 10 country deciles and recoded as the median of each category. Health status is measured by asking the question, "*How is your health in general?*" The range is from 1 (very good) to 5 (very bad). We reverse coded it to 0 (very bad) - 4 (very good) scale. Besides, we evaluate the frequency of social activities by asking “*How often do you meet socially with friends, relatives or work colleagues?*” The answers are coded from 0 (never) to 6 (everyday).

Among the 31,844 respondents, 52% of them are female; 51% of them are in legally married status; 29% are never legally married; 9% legally divorced or civil union dissolved; 8% widowed or civil partner died; 1% in a legally registered civil union; 1% legally separately; 57% get paid work; 26% are retired; 6% are unemployed, and 3% are permanently sick (shown in Table 3.1).

3.5 Empirical Methods

Firstly, we examine the relationships between subjective well-being (in terms of happiness and life satisfaction) and environmental belief-action gap with control for green self-image, two types of pro-environmental behaviors, and related demographic information. The following equations represent these associations:

$$H_i = constant_1 + \alpha_1 GC_i + \beta_1 EC_i + \gamma_1 GSI_i + \delta_1 GAP_i + \eta_1 controls_i + \epsilon_{i1} \qquad (1)$$

$$LS_i = constant_2 + \alpha_2 GC_i + \beta_2 EC_i + \gamma_2 GSI_i + \delta_2 \mathrm{GAP_i} + \eta_2 controls_i + \epsilon_{i2} \qquad (2)$$

The core independent variables and control variables are explained in the data section above. It should be noted that we control for country dummy variables in the OLS regression with survey weights to obtain more accurate results. In the H=h (GAP, GC, EC, GSI) and LS=f (GAP, GC, EC, GSI) equations, GAP_i represents the dummy variable indicating environmental belief-action gap. GC_i and EC_i are "green consumption" indicator and "energy-conscious" indicator, respectively. GSI_i refers to the variable measuring the extent of green self-image.

3.6 Empirical Results

OLS estimates results

We firstly test the multicollinearity in the core dependent and independent variables we selected by the variance inflation factor. The variance inflation factors of key variables are all close to 1, which excludes the multicollinearity.

The OLS regression results of the two indicators of subjective well-being are shown in Table 3.3. The first column corresponds to Equation (1) explaining happiness. The findings concerning control variables are not surprising, as they are consistent with previous research. Women are in general happier than men (Zweig, 2015); being rich, healthy, retired, or legally married is associated with higher happiness (Diener et al., 1999; Headey & Wooden, 2004; Dolan et al., 2008).

[Table 3.3]

Regarding the relationships of interest, individual happiness is positively related to green consumption behaviors, and green self-image as expected (Welsch & Kühling, 2011). Individuals with environmental belief-action gap have a relatively modest self-reported happiness level, 0.18 points lower than individuals who act consistent with their environmental beliefs. The magnitude is equal to half of the coefficient of marriage status that indicates people who are widowed. Both green self-image and “green consumption” behaviors are positively correlated with happiness level ($\beta_1 = 0.07, \gamma_1 = 0.04$). People will be much happier if they change from "not at all likely" to "extremely likely" regarding their "green consumption" behavior. The utility they obtained from adopting a greener lifestyle is sufficient to compensate for the utility loss caused by their legal separation in marriage. In contrast, the coefficient of “energy-conscious” behavior is not statistically significant at the 0.05 level. We don’t find evidence that taking real action to save utility, such as "switching off the household appliance when it is not used", "walking for a short journey", or "only using heat or air conditioning in necessary situations" could contribute to people’s happiness.

The second column refers to Equation (2) and presents the results of regression with life satisfaction as the dependent variable and explanatory variables remaining unchanged. Figure 3.3

depicts the effects of the core independent variables with a 95% confidence interval. The estimated coefficients of explanatory variables on life satisfaction are comparable to those listed in column (1) except for “energy-conscious” behavior, which has a negatively significant effect on life satisfaction with a coefficient equal to -0.05. In contrast with previous findings that climate change concerns or corresponding pro-environmental behaviors will never have a negative influence on subjective well-being (Suárez-Varela et al., 2016), we found that "energy-conscious" behaviors are negatively correlated with people’s life satisfaction. Schmitt et al. (2018) found that observability, costs, and socialness are three main factors affecting the strength of the behavior-satisfaction relationship. The "energy-conscious" behaviors we described in our study might be costly and might not be visible in people’s social activities and thus not be effective in contributing to one’s reputation. The negative correlation could therefore be explained because this type of pro-environmental behavior is regarded as a sacrifice for individuals (Prinzing, 2023).

[Figure 3.3]

Robustness Check

According to the OLS estimates above, we identify a statistically significant relationship between core explanatory variables and life satisfaction as well as happiness. Since previous studies discussed the potential correlation between climate change concern and individuals’ subjective well-being, we run additional robustness checks in the Appendix by using alternative ways to construct the environmental belief-action gap and including additional variables to control for climate change worries. Appendix Table B.1 represents the robustness check by taking a simple average to construct the alternative indicators for PEB and the Environmental Attitude Index. Appendix Table B.2 represents a robustness check by controlling for climate change concern, which is measured by the question "How worried are you about climate change". The results are robust in terms of life satisfaction but not significant in the relationship between happiness and the environmental belief-action gap. We conclude that the environmental belief-action gap is more significant in the relationship with life satisfaction which refers to the cognitive component of subjective well-being.

3.7 Conclusion

Our results demonstrate a statistically significant negative correlation between the environmental belief-action gap and subjective well-being. Consistent with previous findings by Welsch et al. (2021), we found that subjective well-being is not only influenced by pro-environmental behaviors but also by individuals' green self-images. We have extended our understanding of the behavior-satisfaction association by focusing specifically on the environmental belief-action gap, controlling for variables related to green lifestyle. Our results indicate that individuals experiencing an environmental belief-action gap are more likely to report lower levels of happiness and life satisfaction. Despite the distinction between the two components of subjective well-being, the effects of the environmental belief-action gap on subjective well-being in both components are similar. These findings emphasize the vital role of bridging the gap between environmental attitudes and behaviors for promoting individuals' well-beings.

This study contributes to our understanding of how the belief-action gap in climate change mitigation influences subjective well-being and identifies the specific pathways through which it operates. Our research has implications for climate policymakers. We recommend that environmental policies give priority to social well-being. By implementing stricter environmental policies, either through regulatory measures or by incentivizing market-based instruments, we can encourage green behaviors and narrow the gap between environmental beliefs and actions. Furthermore, it can help to decrease the likelihood of an environmental belief-action gap among individuals who hold relatively high climate change beliefs. The psychological and affective aspects of an individual's well-being need to be taken into consideration when the government is designing and implementing climate policies. By addressing the environmental belief-action gap and promoting sustainable behaviors, policymakers may foster harmony between individuals' environmental beliefs and actual behaviors, thereby contributing to enhanced happiness and life satisfaction.

While our study focuses on the effect of the environmental belief-action gap on subjective well-being, there is still a lack of a convincing indicator for measuring the magnitude of such dissonance. One of the limitations of our study is that the dummy variable can only count for the existence of an environmental belief-action gap but lacks the power to analyze how large the gap is. The second issue is that the ESS8 survey data is cross-sectional, so we might have unobserved variables. The measurements of pro-environmental behaviors are self-reported and not observable. We expect future research to delve into the causal relationship in the lab experiment with more detail. Future studies exploring interventions and strategies aimed at reducing the environmental belief-action gap and enhancing subjective well-being are expected to provide policy insights for a more sustainable and fulfilling society.

3.8 References

Angner, E., Ghandhi, J., Williams Purvis, K., Amante, D., & Allison, J. (2013). Daily Functioning, Health Status, and Happiness in Older Adults. *Journal of Happiness Studies*, *14*(5), 1563–1574. https://doi.org/10.1007/s10902-012-9395-6

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology*, *27*(1), 14–25. https://doi.org/10.1016/j.jenvp.2006.12.002

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037/0022-3514.51.6.1173

Binder, M., & Blankenberg, A.-K. (2017). Green lifestyles and subjective well-being: More about self-image than actual behavior? *Journal of Economic Behavior & Organization*, *137*, 304–323. https://doi.org/10.1016/j.jebo.2017.03.009

Binder, M., Blankenberg, A.-K., & Welsch, H. (2020). Pro-environmental Norms, Green Lifestyles, and Subjective Well-Being: Panel Evidence from the UK. *Social Indicators Research*, *152*(3), 1029–1060. https://doi.org/10.1007/s11205-020-02426-4

Boyce, C. J., Wood, A. M., Banks, J., Clark, A. E., & Brown, G. D. A. (2013). Money, Well-Being, and Loss Aversion: Does an Income Loss Have a Greater Effect on Well-Being Than an Equivalent Income Gain? *Psychological Science*, *24*(12), 2557–2562. https://doi.org/10.1177/0956797613496436

Brown, K. W., & Kasser, T. (2005). Are Psychological and Ecological Well-being Compatible? The Role of Values, Mindfulness, and Lifestyle. *Social Indicators Research*, *74*(2), 349–368. https://doi.org/10.1007/s11205-004-8207-8

Cao, Y., Krause, J. S., Saunders, L. L., & Clark, J. M. R. (2015). Impact of Marital Status on 20-Year Subjective Well-being Trajectories. *Topics in Spinal Cord Injury Rehabilitation*, *21*(3), 208–217. https://doi.org/10.1310/sci2103-208

Capstick, S., Nash, N., Whitmarsh, L., Poortinga, W., Haggar, P., & Brügger, A. (2022). The connection between subjective wellbeing and pro-environmental behaviour: Individual and cross-national characteristics in a seven-country study. *Environmental Science & Policy*, *133*, 63–73. https://doi.org/10.1016/j.envsci.2022.02.025

Chamberlain, K. (1988). On the structure of subjective well-being. Social indicators research, 20, 581-604. https://doi.org/10.1007/BF03359559.

Chan, R. Y. K., & Lau, L. B. Y. (2000). Antecedents of green purchases: A survey in China. *Journal of Consumer Marketing*, *17*(4), 338–357. https://doi.org/10.1108/07363760010335358

Claudy, M. C., Peterson, M., & O’Driscoll, A. (2013). Understanding the Attitude-Behavior Gap for Renewable Energy Systems Using Behavioral Reasoning Theory. *Journal of Macromarketing*, *33*(4), Article 4. https://doi.org/10.1177/0276146713481605

Cleveland, M., Kalamas, M., & Laroche, M. (2012). “It’s not Easy Being Green”: Exploring Green Creeds, Green Deeds, and Internal Environmental Locus of Control: “IT’S NOT EASY BEING GREEN.” *Psychology & Marketing*, *29*(5), 293–305. https://doi.org/10.1002/mar.20522

Cooper, H., Okamura, L., & Gurka, V. (1992). Social activity and subjective well-being. *Personality and Individual Differences*, *13*(5), 573–583. https://doi.org/10.1016/0191-8869(92)90198-X

D'Ambrosio, C., Jäntti, M., & Lepinteur, A. (2020). Money and Happiness: Income, Wealth and Subjective Well-Being. *Social Indicators Research*, *148*(1), 47–66. https://doi.org/10.1007/s11205-019-02186-w

Di Tella, R., MacCulloch, R. J., & Oswald, A. J. (2001). Preferences over Inflation and Unemployment: Evidence from Surveys of Happiness. *American Economic Review*, *91*(1), 335–341. https://doi.org/10.1257/aer.91.1.335

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, *125*(2), 276–302. https://doi.org/10.1037/0033-2909.125.2.276

Dolan, P., Peasgood, T., & White, M. (2008). Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. *Journal of Economic Psychology*, *29*(1), 94–122. https://doi.org/10.1016/j.joep.2007.09.001

ESS Round 8: European Social Survey Round 8 Data (2016). Data file edition 2.2. Sikt - Norwegian Agency for Shared Services in Education and Research, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi:10.21338/NSD-ESS8-2016.

Farjam, M., Nikolaychuk, O., & Bravo, G. (2019). Experimental evidence of an environmental attitude-behavior gap in high-cost situations. *Ecological Economics*, *166*, 106434. https://doi.org/10.1016/j.ecolecon.2019.106434

Ferreira, S., Akay, A., Brereton, F., Cuñado, J., Martinsson, P., Moro, M., & Ningal, T. F. (2013). Life satisfaction and air quality in Europe. *Ecological Economics*, *88*, 1–10. https://doi.org/10.1016/j.ecolecon.2012.12.027

Farrow, K., Grolleau, G., & Ibanez, L. (2017). Social Norms and Pro-environmental Behavior: A Review of the Evidence. *Ecological Economics*, *140*, 1–13. https://doi.org/10.1016/j.ecolecon.2017.04.017

Festinger, L. (1957). A theory of cognitive dissonance Row. *Peterson and company*.

Fraj, E., & Martinez, E. (2007). Ecological consumer behaviour: An empirical analysis. *International Journal of Consumer Studies*, *31*(1). https://doi.org/10.1111/j.1470-6431.2006.00565.x

Ghafari, S., Kaviani, B., Sedaghathoor, S., & Allahyari, M. S. (2020). Ecological potentials of trees, shrubs and hedge species for urban green spaces by multi criteria decision making. *Urban Forestry & Urban Greening*, *55*, 126824. https://doi.org/10.1016/j.ufug.2020.126824

Grimmer, M., & Miles, M. P. (2017). With the best of intentions: A large sample test of the intention-behaviour gap in pro-environmental consumer behaviour: Intention-behaviour gap in PECB. *International Journal of Consumer Studies*, *41*(1), Article 1. https://doi.org/10.1111/ijcs.12290

Han, M. S., & Cudjoe, D. (2020). Determinants of energy-saving behavior of urban residents: Evidence from Myanmar. *Energy Policy*, *140*, 111405. https://doi.org/10.1016/j.enpol.2020.111405

Harmon-Jones, E., Harmon-Jones, C., & Levy, N. (2015). An Action-Based Model of Cognitive-Dissonance Processes. *Current Directions in Psychological Science*, *24*(3), Article 3. https://doi.org/10.1177/0963721414566449

Headey, B., & Wooden, M. (2004). The Effects of Wealth and Income on Subjective Well-Being and Ill-Being*. *Economic Record*, *80*(s1), S24–S33. https://doi.org/10.1111/j.1475-4932.2004.00181.x

Ismael, D., & Ploeger, A. (2020). The Potential Influence of Organic Food Consumption and Intention-Behavior Gap on Consumers' Subjective Wellbeing. *Foods*, *9*(5), Article 5. https://doi.org/10.3390/foods9050650

Kasser, T. (2017). Living both well and sustainably: A review of the literature, with some reflections on future research, interventions and policy. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *375*(2095), 20160369. https://doi.org/10.1098/rsta.2016.0369

Kilbourne, W., & Pickett, G. (2008). How materialism affects environmental beliefs, concern, and environmentally responsible behavior. *Journal of Business Research*, *61*(9), 885–893. https://doi.org/10.1016/j.jbusres.2007.09.016

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behaviour—A meta-analysis. *Global Environmental Change*, *23*(5), Article 5. https://doi.org/10.1016/j.gloenvcha.2013.05.014

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, *8*(3), Article 3. https://doi.org/10.1080/13504620220145401

Kulin, J., & Johansson Sevä, I. (2021). Who do you trust? How trust in partial and impartial government institutions influences climate policy attitudes. *Climate Policy*, *21*(1), 33–46. https://doi.org/10.1080/14693062.2020.1792822

Landry, N., Gifford, R., Milfont, T. L., Weeks, A., & Arnocky, S. (2018). Learned helplessness moderates the relationship between environmental concern and behavior. *Journal of Environmental Psychology*, *55*, 18–22. https://doi.org/10.1016/j.jenvp.2017.12.003

Lewinsohn, P. M., Redner, J., & Seeley, J. R. (1991). The relationship between life satisfaction and psychosocial variables: New perspectives. *Subjective well-being: An interdisciplinary perspective*, *21*, 141-169.

Li, F., & Zhou, T. (2020). Effects of objective and subjective environmental pollution on well-being in urban China: A structural equation model approach. *Social Science & Medicine*, *249*, 112859. https://doi.org/10.1016/j.socscimed.2020.112859

Liu, Y., & Segev, S. (2017). Cultural orientations and environmental sustainability in households: A comparative analysis of Hispanics and non-Hispanic Whites in the United States. *International Journal of Consumer Studies*, *41*(6), 587–596. https://doi.org/10.1111/ijcs.12370

Malkoç, A. (2011). Quality of life and subjective well-being in undergraduate students. *Procedia - Social and Behavioral Sciences*, *15*, 2843–2847. https://doi.org/10.1016/j.sbspro.2011.04.200

Moser, A. K. (2015). Thinking green, buying green? Drivers of pro-environmental purchasing behavior. *Journal of Consumer Marketing*, *32*(3), Article 3. https://doi.org/10.1108/JCM-10-2014-1179

Mostafa, M. M. (2007). A hierarchical analysis of the green consciousness of the Egyptian consumer. *Psychology and Marketing*, *24*(5), 445–473. https://doi.org/10.1002/mar.20168

Onwezen, M. C., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology*, *39*, 141–153. https://doi.org/10.1016/j.joep.2013.07.005

Pagiaslis, A., & Krontalis, A. K. (2014). Green Consumption Behavior Antecedents: Environmental Concern, Knowledge, and Beliefs: ANTECEDENTS OF GREEN CONSUMER BEHAVIOR. *Psychology & Marketing*, *31*(5), 335–348. https://doi.org/10.1002/mar.20698

Palomo-Vélez, G., & van Vugt, M. (2021). The evolutionary psychology of climate change behaviors: Insights and applications. *Current Opinion in Psychology*, *42*, 54–59. https://doi.org/10.1016/j.copsyc.2021.03.006

Park, H., Russell, C., & Lee, J. (2007). National culture and environmental sustainability: A cross-national analysis. *Journal of Economics and Finance*, *31*(1), 104–121. https://doi.org/10.1007/BF02751516

Pavot, W., & Diener, E. (1993). The affective and cognitive context of self-reported measures of subjective well-being. *Social Indicators Research*, *28*(1), 1–20. https://doi.org/10.1007/BF01086714

Phillips, D. L. (1967). Mental Health Status, Social Participation, and Happiness. *Journal of Health and Social Behavior*, *8*(4), 285. https://doi.org/10.2307/2948422

Prinzing, M. (2023). Going green is good for you: why we need to change the way we think about pro-environmental behavior. *Ethics, Policy & Environment*, *26*(1), 1-18. https://doi.org/10.1080/21550085.2020.1848192

Redondo, I., & Puelles, M. (2017). The connection between environmental attitude–behavior gap and other individual inconsistencies: A call for strengthening self-control. *International Research in Geographical and Environmental Education*, *26*(2), Article 2. https://doi.org/10.1080/10382046.2016.1235361

Rehdanz, K., Welsch, H., Narita, D., & Okubo, T. (2015). Well-being effects of a major natural disaster: The case of Fukushima. *Journal of Economic Behavior & Organization*, *116*, 500–517. https://doi.org/10.1016/j.jebo.2015.05.014

Ringov, D., & Zollo, M. (2007). The impact of national culture on corporate social performance. *Corporate Governance: The International Journal of Business in Society*, *7*(4), 476–485. https://doi.org/10.1108/14720700710820551

Sacks, D. W., Stevenson, B., & Wolfers, J. (2012). The new stylized facts about income and subjective well-being. *Emotion*, *12*(6), 1181–1187. https://doi.org/10.1037/a0029873

Schimmack, U., Schupp, J., & Wagner, G. G. (2008). The Influence of Environment and Personality on the Affective and Cognitive Component of Subjective Well-being. *Social Indicators Research*, *89*(1), 41–60. https://doi.org/10.1007/s11205-007-9230-3

Schmitt, M. T., Aknin, L. B., Axsen, J., & Shwom, R. L. (2018). Unpacking the relationships between pro-environmental behavior, life satisfaction, and perceived ecological threat. *Ecological economics*, *143*, 130-140. https://doi.org/10.1016/j.ecolecon.2017.07.007

Schumacher, I. (2015). The endogenous formation of an environmental culture. *European Economic Review*, *76*, 200–221. https://doi.org/10.1016/j.euroecorev.2015.03.002

Sheeran, P., & Webb, T. L. (2016). The Intention-Behavior Gap: The Intention-Behavior Gap. *Social and Personality Psychology Compass*, *10*(9), 503–518. https://doi.org/10.1111/spc3.12265

Shrestha, N. (2020). Detecting Multicollinearity in Regression Analysis. *American Journal of Applied Mathematics and Statistics*, *8*(2), 39–42. https://doi.org/10.12691/ajams-8-2-1

Suárez-Varela, M., Guardiola, J., & González-Gómez, F. (2016). Do Pro-environmental Behaviors and Awareness Contribute to Improve Subjective Well-being? *Applied Research in Quality of Life*, *11*(2), Article 2. https://doi.org/10.1007/s11482-014-9372-9

Tam, K.-P., & Chan, H.-W. (2017). Environmental concern has a weaker association with pro-environmental behavior in some societies than others: A cross-cultural psychology perspective. *Journal of Environmental Psychology*, *53*, 213–223. https://doi.org/10.1016/j.jenvp.2017.09.001

Tam, K.-P., & Chan, H.-W. (2018). Generalized trust narrows the gap between environmental concern and pro-environmental behavior: Multilevel evidence. *Global Environmental Change*, *48*, 182–194. https://doi.org/10.1016/j.gloenvcha.2017.12.001

Tan, J. J. X., Kraus, M. W., Carpenter, N. C., & Adler, N. E. (2020). The association between objective and subjective socioeconomic status and subjective well-being: A meta-analytic review. *Psychological Bulletin*, *146*(11), 970–1020. https://doi.org/10.1037/bul0000258

Tao, H.-L. (2019). Marriage and Happiness: Evidence from Taiwan. *Journal of Happiness Studies*, *20*(6), 1843–1861. https://doi.org/10.1007/s10902-018-0029-5

Videras, J. R., & Owen, A. L. (2006). Public Goods Provision and Well-Being: Empirical Evidence Consistent with the Warm Glow Theory. *Contributions in Economic Analysis & Policy*, *5*(1). https://doi.org/10.2202/1538-0645.1531

Wang, T., Shen, B., Han Springer, C., & Hou, J. (2021). What prevents us from taking low-carbon actions? A comprehensive review of influencing factors affecting low-carbon behaviors. *Energy Research & Social Science*, *71*, 101844. https://doi.org/10.1016/j.erss.2020.101844

Weinhold, D. (2013). THE HAPPINESS-REDUCING COSTS OF NOISE POLLUTION*. *Journal of Regional Science*, *53*(2), 292–303. https://doi.org/10.1111/jors.12001

Welsch, H. (2020). Happiness and green lifestyle. In D. Maddison, K. Rehdanz, & H. Welsch, *Handbook on Wellbeing, Happiness and the Environment* (pp. 349–366). Edward Elgar Publishing. https://doi.org/10.4337/9781788119344.00027

Welsch, H., Binder, M., & Blankenberg, A.-K. (2021). Green behavior, green self-image, and subjective well-being: Separating affective and cognitive relationships. *Ecological Economics*, *179*, 106854. https://doi.org/10.1016/j.ecolecon.2020.106854

Welsch, H., & Kühling, J. (2010). Pro-environmental behavior and rational consumer choice: Evidence from surveys of life satisfaction. *Journal of Economic Psychology*, *31*(3), Article 3. https://doi.org/10.1016/j.joep.2010.01.009

Welsch, H., & Kühling, J. (2011). Are pro-environmental consumption choices utility-maximizing? Evidence from subjective well-being data. *Ecological Economics*, *72*, 75–87. https://doi.org/10.1016/j.ecolecon.2011.04.015

Welsch, H., & Kühling, J. (2018). How Green Self Image is Related to Subjective Well-Being: Pro-Environmental Values as a Social Norm. *Ecological Economics*, *149*, 105–119. https://doi.org/10.1016/j.ecolecon.2018.03.002

Wintschnig, B. A. (2021). *The Attitude-Behavior Gap – Drivers and Barriers of Sustainable Consumption*. 23.

Yang, S., Zhang, Y., & Zhao, D. (2016). Who exhibits more energy-saving behavior in direct and indirect ways in china? The role of psychological factors and socio-demographics. *Energy Policy*, *93*, 196–205. https://doi.org/10.1016/j.enpol.2016.02.018

Zawadzki, S. J., Steg, L., & Bouman, T. (2020). Meta-analytic evidence for a robust and positive association between individuals' pro-environmental behaviors and their subjective wellbeing. *Environmental Research Letters*, *15*(12), 123007. https://doi.org/10.1088/1748-9326/abc4ae

Zhu, Y., & Yu, D. (2022). Education and happiness: Does education expenditure undermine households' subjective well-being? Evidence from China. *Applied Economics*, 1–14. https://doi.org/10.1080/00036846.2022.2140772

Zweig, J. S. (2015). Are Women Happier than Men? Evidence from the Gallup World Poll. *Journal of Happiness Studies*, *16*(2), 515–541. https://doi.org/10.1007/s10902-014-9521-8

Table 3.1. Descriptive Statistics

Variables	Mean	Std. Dev.	Min	Max
Life satisfaction	7.23	2.02	0	10
Happiness	7.53	1.79	0	10
Environmental belief-action gap	0.21	0.41	0	1
Green self-image	3.86	1.02	0	5
Energy-conscious	3.21	1.17	0	5
Green consumption	7.84	2.21	0	10
Income	48.23	27.15	5	95
Health status	2.81	0.90	0	4
Age	49.53	17.87	15	98
Female	0.52	0.50	0	1
Social activities	3.86	1.51	0	6
Legal marital status:				
Legally married	0.51	0.50	0	1
In a legally registered civil union	0.01	0.10	0	1
Legally separated	0.01	0.12	0	1
Legally divorced/civil union dissolved	0.09	0.29	0	1
Widowed/civil partner died	0.08	0.27	0	1
None of these	0.29	0.45	0	1
Activities doing last 7 days:				
Unemployed, actively looking for a job	0.04	0.19	0	1
Unemployed, not actively looking for a job	0.02	0.13	0	1
Permanently sick	0.03	0.18	0	1
Retired	0.26	0.44	0	1
Paid work	0.57	0.50	0	1
Education	0.08	0.27	0	1
Housework	0.15	0.36	0	1
Community or military service	0	0.04	0	1
Observations number	31,844			

Notes: Descriptive statistics of variables employed in the empirical analysis The variables listed in the table come from ESS8, conducted across 23 countries in 2016.

Table 3.2. Correlation coefficients

Variables	(1) Life satisfaction	(2) Happiness	(3) Environmental belief-action gap	(4) Green self-image	(5) Green consumption	(6) Utility saver	(7) Income decile
(1) Life satisfaction	1.00						
(2) Happiness	0.70*	1.00					
(3) Environmental belief-action gap	-0.04*	-0.05*	1.00				
(4) Green self-image	0.04*	0.05*	-0.09*	1.00			
(5) Green consumption	0.10*	0.12*	-0.48*	0.23*	1.00		
(6) Energy-conscious	0.02*	0.04*	-0.42*	0.26*	0.32*	1.00	
(7) Income decile	0.24*	0.22*	0.01*	-0.03*	0.06*	-0.04*	1.00

Note: This table represents Pearson correlation coefficients between the core explanatory variables and dependent variables. *** *p<0.01, *** *p<0.05, * p<0.1*

Table 3.3. OLS Regression Results

VARIABLES	Life satisfaction		Happiness	
Environmental belief-action gap	-0.18***	(0.07)	-0.14**	(0.06)
Green self-image	0.05**	(0.02)	0.04*	(0.02)
Energy-conscious behaviors	-0.05**	(0.03)	-0.02	(0.02)
Green consumption	0.06***	(0.01)	0.07***	(0.02)
Income	0.01***	(0.00)	0.01***	(0.00)
Health status	0.58***	(0.03)	0.52***	(0.03)
Age	-0.06***	(0.01)	-0.04***	(0.01)
Age square/100	0.06***	(0.01)	0.04***	(0.01)
Female	0.01	(0.04)	0.09**	(0.04)
Education level	0.03**	(0.01)	-0.01	(0.01)
Social activity	0.17***	(0.02)	0.15***	(0.02)
Marriage status: (default legally married)				
In a legally registered civil union	-0.00	(0.16)	-0.10	(0.13)
Legally separated	-0.65***	(0.17)	-0.77***	(0.15)
Legally divorced/civil union dissolved	-0.53***	(0.08)	-0.51***	(0.08)
Widowed/civil partner died	-0.37***	(0.11)	-0.48***	(0.10)
None of these	-0.42***	(0.06)	-0.52***	(0.06)
Activities doing in the last 7 days:				
Unemployed, actively looking for a job	-0.93***	(0.14)	-0.55***	(0.12)
Unemployed, inactively looking for a job	-0.50***	(0.18)	-0.60***	(0.18)
Permanently sick or disabled	-0.43***	(0.17)	-0.18	(0.14)
Retired	0.29***	(0.10)	0.20**	(0.09)
Paid word	-0.04	(0.07)	-0.01	(0.07)
Education	0.14	(0.10)	0.09	(0.10)
Housework	0.09	(0.06)	0.07	(0.06)
Community or military service	0.31	(0.27)	-0.02	(0.32)
Constant	5.78***	(0.27)	5.64***	(0.24)
Observations	31,844		31,844	
R-squared	0.28		0.25	
Country dummy variable	YES		YES	

Notes: Survey weights are included in this regression. Coefficients in column (1) correspond to Equation (1), and coefficients in column (2) correspond to Equation (2). Table list coefficients with standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

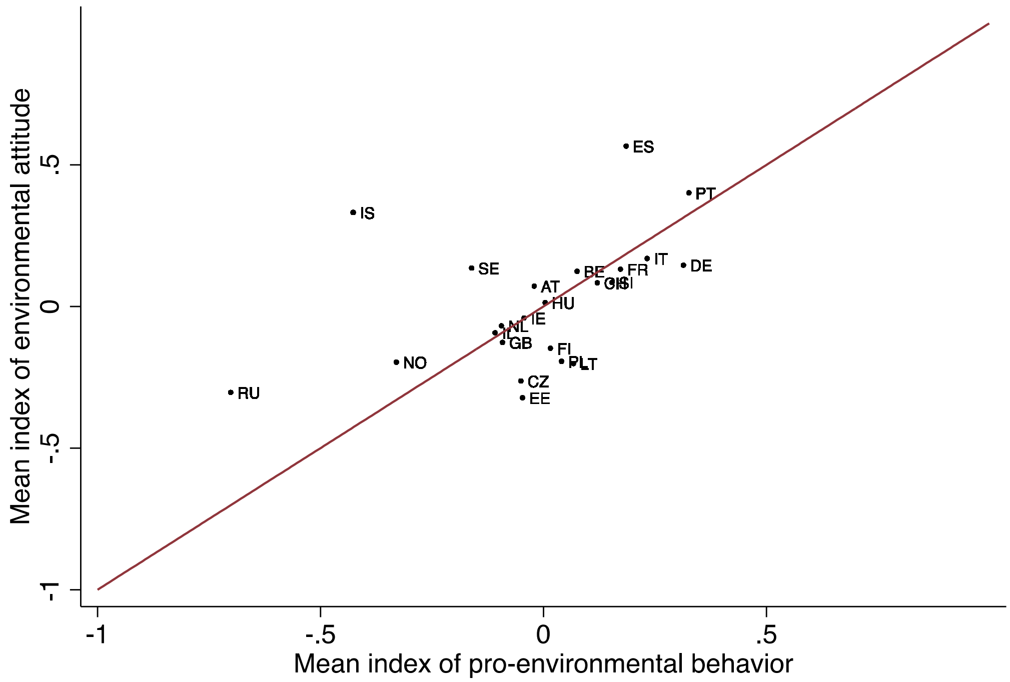


Figure 3.1. National mean levels of PEB (Pro-environmental Behavior Index) and Environmental Attitude Index

Notes: This table represents the mean levels of PEB and environmental attitude for each country. The red line is a 45-degree reference line. The abbreviations of the countries are AT Austria, BE Belgium, CZ Czech Republic, EE Estonia, ES Spain, FI Finland, FR France, GB United Kingdom, DE Germany, HU Hungary, IE Ireland, SI Slovenia, IL Israel, IT Italy, IS Iceland, LT Lithuania, NL Netherlands, NO Norway, PL Poland, PT Portugal, RU Russia, SE Sweden, SI Slovenia. The red line in the graph is a 45-degree reference line.

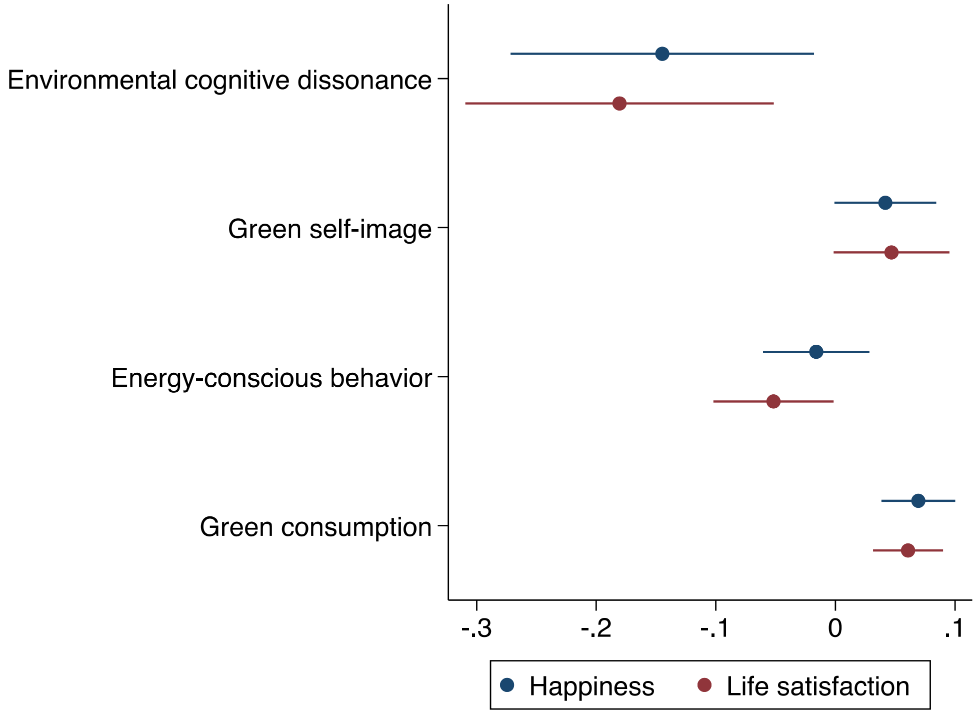


Figure 3.2. The coefficients of core explanatory variables with 95% confidence interval
Notes: This figure represents the 95% confidence interval of the core explanatory variable coefficients for happiness and life satisfaction, respectively, based on the estimation results from Table 3.3 (which correspond to Equations (1) and (2)).

Appendix B

Table B.1 Regression results with alternative environmental belief-action gap

VARIABLES	Life satisfaction		Happiness	
Environmental belief-action gap	-0.18*	(0.08)	-0.16	(0.08)
Green self-image	0.04	(0.03)	0.04	(0.02)
Energy-conscious behaviors	-0.05	(0.03)	-0.01	(0.02)
Green consumption	0.06***	(0.02)	0.07***	(0.02)
Constant	5.57***	(0.27)	5.57***	(0.27)
Individual-level controls	YES		YES	
Observations	31,844		31,844	
R-squared	0.27		0.24	
Country dummy variable	YES		YES	

Notes: This table represents the results of regression corresponding to Equation (1) & (2), where the environmental belief-action gap is calculated using the average sum index. We take simple average values as an alternative way to construct the indicators of environmental belief and pro-environmental behavior. The dummy variable indicating the environmental belief-action gap is equal to 1 when the sum index of environmental belief is at least one point larger than pro-environmental behaviors. Table list coefficients with standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table B.2 Regression results controlling for climate change worries

VARIABLES	Life satisfaction		Happiness	
Environmental belief-action gap	-0.16*	(0.07)	-0.12	(0.07)
Green self-image	0.05*	(0.03)	0.05*	(0.02)
Energy-conscious behaviors	-0.05	(0.03)	-0.01	(0.02)
Green consumption	0.06***	(0.02)	0.07***	(0.02)
Climate change worries	-0.04	(0.03)	-0.04	(0.03)
......				
Constant	5.64***	(0.27)	5.51***	(0.25)
Observations	31,793		31,793	
R-squared	0.27		0.24	
Country dummy variable	YES		YES	

Notes: This table represents the results of the regression corresponding to Equations (1) and (2), where additional climate change worries are controlled for. The extent of climate change worries is measured by the question "How worried are you about climate change?" on a 0–4 point scale. Table list coefficients with standard errors in parentheses: *** p 0.01, ** p 0.05, * p 0.1

CHAPTER 4

AMERICANS’ WILLINGNESS TO PAY FOR CLIMATE CHANGE MITIGATION: EVIDENCE FROM A CHOICE EXPERIMENT[11]

[11] Zhang, S., Colson, G., Ferreira, S., & Karali, B. To be submitted to *Energy Economics*.

4.1 Abstract

The Inflation Reduction Act of 2022 represents a significant milestone in the United States' efforts towards climate change mitigation. Under the context of this Act, this study investigates Americans' willingness to pay for climate change mitigation, with a specific focus on the policy attributes associated with environmental effectiveness, labor market outcomes, and revenue distribution options. By analyzing these factors, the study aims to provide insights into public preferences and attitudes towards climate change policies, contributing to a deeper understanding of the challenges and opportunities in achieving global carbon neutrality.

Key words: Choice experiment; Willingness to pay; Climate policy; Climate change mitigation.

4.2 Introduction

Limiting global warming to 2 degrees Celsius above the pre-industrial level by this century under the Paris Agreement requires urgent actions to reduce greenhouse gas emissions and combat climate change. As a quintessential public good, climate change mitigation has become a collective action problem with global collective benefits (Hammitt & Adams, 1996).

Unsurprisingly, the current climate policies across countries are not on track to achieve climate ambition (Georgieva, 2021). Bridging the gap between global climate goals and national climate efforts is crucial to achieving global net-zero greenhouse gas emissions (Nascimento et al., 2022). In fact, community and citizen support provide the potential to fill the gap. An illustrative example is the potential of citizen-led finance, which is estimated by the choice experiment survey to effectively bridge the €179 billion investment gap between the EU's ambitious climate targets and the actual amount invested in the energy transition in 2018 (Pons-Seres de Brauwer & Cohen, 2020). This demonstrates the promising potential for increasing public engagement in climate change mitigation to attain carbon neutrality.

Furthermore, public support serves as the foundation for the national government to develop and implement effective climate policies (Drews & van den Bergh, 2016). Among the available public policy approaches, carbon pricing has been widely supported by economists for its cost-effectiveness in cutting carbon emissions, but public opposition is still the main obstacle to its implementation (Carattini et al., 2019). In the United States, citizens' awareness of climate change has increased during the past decade but remains low (Ballew et al., 2019). Carbon tax policy has failed in referendum twice in Washington State (Reed et al., 2019; Karceski et al., 2020), and carbon pricing is conspicuously absent from the Inflation Reduction Act of 2022. This landmark U.S. federal law is expected to reduce 2030 U.S. greenhouse gas emissions to

40% below 2005 level, through a $437 billion investment in climate change mitigation, mainly in tax incentives for renewable energy and improvements to energy efficiency (Newburger, 2022; Taylor, 2022). In contrast, several studies have documented a positive willingness-to-pay to mitigate carbon emissions among the American public. Kotchen et al. (2013) estimated that Americans were willing to pay $79–$89 each year to reduce 17% of their carbon emissions by 2020, regardless of the policy instrument. Kotchen et al. (2017) reported that Americans are willing to pay an additional $177 on the annual household energy bill for a carbon tax scheme. Hammerle et al. (2021) used a discrete choice experiment to estimate WTP for carbon tax schemes and stated that a policy scheme with financial rebates to low-income households is favored. This suggests that public attitudes towards carbon mitigation policies are nuanced and that understanding people's preferences for allocating public funding to combat climate change requires a deeper analysis of the policies put forward.

This study examines the acceptability of alternative climate policies in the United States through a discrete choice experiment. We survey 314 households in the United States about their willingness to pay for the climate change mitigation with different policy alternatives. People are asked to make choices among scenarios with a wide range of attributes. These attributes are the total increase in the monthly electricity bill, additional green jobs increased by 2035[12], additional fossil fuel jobs lost by 2035, the global warming target, the expected date to be domestic carbon neutral, and revenue distribution options. Respondents are also asked to present their environmental attitudes by answering questions such as "Do you think the world's climate is changing?" "How important is the issue of global warming to you personally?" and "How worried are you about global warming?" These results help us understand more about people's

[12] As President Biden announced 2035 as the target year of achieving a carbon pollution-free power sector.

policy choices given different environmental attitudes. The demographic information of respondents is collected for further discussion about public preferences in different groups.

Unlike previous studies that primarily concentrate on revenue distribution options, we shed light on the crucial role of economic consequences and environmental effectiveness associated with climate policies. Our findings indicate that individuals value job opportunities and are averse to job losses, regardless of whether they are in green or brown industries. On average, people are willing to pay an additional $4.77 per month on their electricity bill for one million green jobs increase by 2035. However, they need compensation of $5.02 per month for one million fossil fuel jobs lost by the same year. Besides, individuals are willing to pay approximately $4.55 to limit a one-degree Celsius increase in global temperature. They are also willing to pay approximately $0.61 per year to expedite the transition to a net-zero carbon economy.

This study represents the first attempt to evaluate how the perceived effects of climate policies on employment impact public support. Additionally, we find that people are willing to pay for both achieving a global warming target and advancing the domestic expected date for carbon neutrality. Financial rebates provided to all households emerge as the most preferred revenue use distribution option compared to other alternatives.

4.3 Literature Review

Understanding public acceptability of climate policy

According to the past studies of public opinion about climate change, there is a rising trends of climate change beliefs across the world (Ballew et al., 2019). However, public awareness of environmental problems is different with public acceptability of climate policy. While the public concerns regarding climate change are relatively high, it is important to acknowledge that opposition to climate policies can still be substantial. To better understand what factors influence public opinion, Ščasný et al. (2017) divided drivers of public acceptability of policies into two categories: individual characteristics and policy design characteristics.

Extensive studies have discussed the influence of individual characteristics on people's votes or willingness to pay for a climate policy. Public support to climate policies hinges on individuals' climate change awareness (Dietz et al., 2007), citizen trust (Hammar & Jagers, 2006; Kitt et al., 2021), environmental values (Dietz et al., 2007; Attari et al., 2009; Joireman et al., 2010; Unsworth & Fielding, 2014), climate change knowledge (Rhodes et al., 2014; Douenne & Fabre, 2020), political ideology (Ziegler, 2017; Fairbrother, 2022), and etc. The social-demographic factors, including age, gender, income, and living in rural or urban areas, also matter in predicting individuals' preferences to climate policies. Previous study shows that women are more supportive of carbon taxation (Douenne & Fabre, 2020), while urban people are more likely to support carbon taxation compared to rural people (Rhodes et al., 2017; Douenne & Fabre, 2020). Besides, high-income people or elder groups are considered to have stronger support for most climate policies (Dietz et al., 2007).

Turning to the characteristics of policy design, policy effectiveness has been flagged as a main driver of people's willingness to contribute (Krosnick et al., 2006; Kallbekken & Sælen, 2011). In fact, communicating the information that a policy is effective can be one of the strongest predictors to public support (Reynolds et al., 2020). The climate policy's effectiveness is measured by the perceived reduction of carbon emissions by implementing the policy. People care about whether the designed climate policy has the capacity to achieve the desired target (Drews & van den Bergh, 2016).

However, even carbon pricing has been widely supported by economists because of its effectiveness in cutting carbon emissions, public opposition is still the main obstacle to its implementation (Carattini et al., 2019). The opposed public opinion regarding carbon taxation has been well documented (Davidovic & Harring, 2020). Carattini et al. (2017) summarized five main reasons of public opposition to carbon tax policy as perceived high cost, perceived low efficiency, potential regressivity, fear of negative economic effects, and low political trust. In addition, Odland et al. (2023) explained this counter-intuitive resistance to the carbon tax by self-serving bias, which can be explained as whether individuals perceive the policy or action as beneficial to themselves. The carbon tax is a prominent policy with a visible high cost to households and is perceived to be unevenly distributed in society.

In despite of effectiveness and cost, the perceived justice is a significant predictor of the acceptability of environmental policies (Carson et al., 2010; Brannlund & Persson, 2012; Dreyer & Walker, 2013). Vona (2019) found that the "job-killing" effect of a climate policy could make the affected workers resistant to this policy. Although the benefits of a climate policy, including co-benefits in health and labor outcomes, are larger than the cost of possible job opportunity loss, the negative effect on employment might be concentrated in specific areas or groups, leading to strong opposition by affected people. Common beliefs about the adverse effects of climate policies on the economy or employment are obstacles to their implementation (Shwom et al., 2010).

As we stated above, previous literature tried to explore public support to climate change mitigation from various perspective, including policy characteristics and individual factors. Drawing upon the previous literature, our research goal focuses on how the perceived environmental effectiveness and economic consequences of climate policy affect individual's willingness to pay. By emphasizing these key aspects, we aim to dig deeper in understanding public preferences for climate change mitigation by designing the corresponding survey experiment.

Stated preference approach

Even though a growing body of literature has discussed people's willingness to pay for various carbon mitigation approaches, consumers' perspectives remain ambiguous in the context of willingness to pay for climate change mitigation, especially in the households' energy sector in the United States.

Two methods are commonly used to elicit public preferences towards climate policies: contingent valuation (CV) and discrete choice experiment (DCE), CV is regarded as a direct way to elicit public WTP, while DCE is an indirect approach (Bijlenga et al., 2011). During the past decades, a growing body of studies have applied DCE, which is well-known as a popular stated preference method, in the environmental economic area. DCE has some advantages compared to CV (Hammerle et al., 2021): (1) DCE allows for the identification of trade-offs between attributes in the policy scheme, specifically evaluates the trade-off between the cost attribute and other attributes we designed for climate policies in our paper; (2) Respondents are asked to reveal their preferences in multiple questions, which provide more information compared to the simplest CV method; (3) DCE is an indirect way to reveal respondents preferences, which avoids hypothetical bias in the experiment. In this approach, we could gather more information about public preferences toward climate policies and therefore make a more accurate evaluation.

According to the previous applications of stated preference method in public acceptance of climate change mitigation, Kotchen et al. (2013) estimated that Americans are willing to pay \$79–\$89 each year to reduce 17% of their carbon emissions by 2020, regardless of the policy instrument. Kotchen et al. (2017) found that Americans are willing to pay an additional $177 on the annual household energy bill for a carbon tax scheme. Both studies were estimated based on contingent valuation, which reports the average citizens' WTP in the context of a designed climate policy scheme. Although they didn't illustrate what dimensions of a policy increase people's WTP, these initial contributions to evaluating Americans' WTP for climate policy provided accurate references for us to set a priori in our experiment.

While both stated preference methods could be used to evaluate the WTP for climate change mitigation, we focus on the DCE application for analyzing public preferences towards climate policy. Hammerle et al. (2021) used a discrete choice experiment (DCE) to estimate willingness to pay for carbon tax schemes and stated that a policy scheme with financial rebates to low-income households is favored. Svenningsen (2019) investigated whether individuals exhibit social preferences for the distributive outcomes of climate policy when donating to such policies. Our study extended the literature above by asking respondents to choose from a combination of policy alternatives with a wider range of attributes.

4.4 Survey Design

We conducted online survey using the online survey platform Qualtrics and collected 314 responses in June 2022. In the survey design, each respondent was asked to complete 6 choice tasks, with two policy alternatives and a *status quo* option in each choice task. The policies presented to respondents vary in terms of the total increase in monthly electricity expenditure, additional jobs *created* in the U.S. green energy industry by 2035, additional jobs *lost* in the U.S. fossil fuel industry by 2035, environmental effectiveness (measured as a cap in the temperature increase), expected date to be carbon neutral in the U.S., and the use of revenue collected by the government. The attributes levels are shown in the Table 4.1.

[Table 4.1]

Following previous WTP studies (Kotchen et al., 2013, 2017; Hammerle et al., 2021), we designed the levels of cost attribute as $0, $15, $30, and $45. As Kotchen et al. (2017) estimated for Americans willingness to pay for a carbon tax scheme, the average value is around $177, which can be transformed into a monthly extra cost of $15. Considering the enormous inflation (over 20%) between 2016 and 2022, we use $15 as a baseline and set the cost attribute range between $0 and $45.

We integrated additional employment creation in the U.S. renewable energy industry by 2035 and job losses in the U.S. fossil fuel industry by 2035 as labor market outcomes of climate change mitigation policies. The selection of 2035 as the target year is significant due to President Biden's ambitious aim of achieving a carbon-free power sector by that year, which is anticipated to result in significant structural changes to the economy. As highlighted by Malik et al.(2021), climate policies are likely to accelerate the transformation of employment structures, resulting in an increase in jobs associated with solar and wind construction, installation, and manufacturing, while long-term employment in the fossil fuel sector decreases. According to the Inflation Reduction Act (Saha et al., 2022), the projected decline in fossil fuel employment is estimated to exceed one million. To capture the asymmetry in the energy transition process triggered by climate policies, we categorized job gains and losses as 0, 1, 2, and 3 million.

The measurement of global warming targets and the anticipated date of carbon neutrality are crucial indicators of environmental effectiveness and policy success in carbon reduction efforts. Most investigations imply a limit between 1.5 and 6 degrees Celsius (Houghton, 1996). Within this range, 1.5 degrees Celsius is the most ambitious climate objective that has been established to date, reflecting the desirable maximum limit to minimize the negative effects of climate change. On the opposite end of the spectrum, 6 degrees Celsius represents a projection of extreme global warming associated with the maximum emission scenario considered in existing literature (Lynas, 2008). Considering the expected date of achieving carbon neutrality in the United States, we have chosen 2050 as the baseline and designed levels below and above it. In accordance with climate goals set by countries worldwide, such as the Maldives targeting 2030, the United States aiming for 2050, and China setting a goal of 2060, we have established the levels of expected dates to reach carbon neutrality as 2035, 2045, 2055, and 2065.

In order to garner public support for the climate policy, previous research highlighted the vital role of the revenue distribution options. Bristow et al. (2010) found that specific revenue allocation purposes are typically preferred to general tax budgets. As estimated by the Congressional Budget Office, the Inflation Reduction Act of 2022 projects to reduce federal deficit by $238 billion over a decade and plans to invest $391 billion in energy and climate-related initiatives. Moreover, this act authorizes $8.8 billion in rebates for residential energy efficiency initiatives. Taking into consideration the fiscal plan in the Inflation Reduction Act of 2022 and various options for revenue recycling, we developed four alternative revenue use scenarios: general government spending, deficit reduction, renewable energy subsidies, and financial rebates for all U.S. households. Table 4.2 below provides a specific illustration of the choice task.

[Table 4.2]

Environmental attitudes play a vital role in understanding people's acceptance of climate policy. To better illustrate public opinion regarding climate change in our sample, we collected views on climate change using the "Six Americas Short Survey" and compared our results with the national estimate (Chryst et al., 2018). They asked respondents four questions regarding the climate change topic and divided respondents into six groups with scores of responses. These questions are "How important is the issue of global warming to you personally?" "How worried are you about global warming?" "How much do you think global warming will harm you personally?" "How much do you think global warming will harm future generations of people?". Based on the overall scores of answers to these four questions, the sample are divided into six groups with various climate change perception.

Referring to the questions in the 8th round of European Social Survey, we measure the belief in climate change belief by asking, "You may have heard the idea that the world's climate is changing due to increases in temperature over the past 100 years. What is your personal opinion on this? Do you think the world's climate is changing?". The answer is coded in five points: 0=definitely not changing; 1=probably not changing; 2=not sure; 3=probably changing; 4=definitely changing. We recoded answers above 2 as believing climate change is due to global warming. They are also required to pick the most important energy issue for themselves among 7 alternatives: (1) keeping energy costs as low as possible; (2) maintaining energy jobs; (3) reducing U.S. dependence on foreign sources; (4) preventing accidents at energy facilities; (5) using energy sources that protect the environment; (6) avoiding energy shortages or blackouts; and (7) other. Respondents are also asked to report their monthly electricity, gasoline, and natural gas bills and current gasoline prices. These results help us understand more about people's policy choices in light of their daily energy use habits. The demographic information (age, income, education, gender, ethnicity, political parties, etc.) of respondents that is assumed to be correlated with an individual's climate policy preference is collected for further discussion about heterogeneity in different groups.

As discussed in the literature review, the willingness of individuals to pay for climate change mitigation is influenced by both policy and individual factors. In the latent class model, we selected several observed individual characteristics which are expected to affect people's choices for different climate policy alternative. First of all, we included a dummy variable indicating whether respondents are members of an environmental organization to identify those with strong environmental values. Secondly, we examined whether respondents have a higher-than-average household electricity bill, which can indicate their actual utility usage patterns and influence their sensitivity to cost attributes. In addition, we considered rural or urban residence, political affiliation (Republican or Democrats), high-than-average income and demographic factors such as gender and age (over 60) as socio-demographic predictors known to be associated with individual preferences. These variables were included in the latent class model as membership characteristics to identify individuals with similar preferences for climate policies. By taking these factors into consideration, we intended to identify distinct subgroups within the population with comparable preferences and to understand the factors that influence their decisions regarding climate policies.

4.5 Methodology

Mixed Logit Model

The econometric model for discrete choice analysis is based on the random utility theory developed by McFadden et al. (1973). The individual's utility is assumed to include an observed deterministic component and a random component representing uncertainty. The utility equation is structured as below.

$$U_{njt} = X_{njt}\beta + \epsilon_{njt} \quad (1)$$

U_{njt} represents the utility of individual n when he/she chooses alternative j in the choice task t. According to the utility maximization, individual n will always choose the alternative j among all alternatives J to achieve highest utility, which can be represented as $U_{nj} \geq U_{nJ}$. X_{njt} represents the observed characteristics for the alternatives. In the multinomial logit model, ϵ_{njt} represents random term which is identically and independently distributed with an extreme value type 1 distribution. It follows the independence of irrelevant alternatives (IIA) assumption (Greene & Hensher, 2003), which states that the probability of selecting one option over another is unaffected by the presence or absence of other options. Under this assumption, all parameters to be fixed for all individuals. The probability of individual n choosing alternative j at choice task t is given as following.

$$P_{njt} = \frac{e^{X_{njt}\beta}}{\sum_J e^{X_{njt}\beta}} \quad (2)$$

However, the multinomial logit model has some limitations that restrict its ability to examine the heterogeneity of individuals' preferences (Hoyos, 2010; Train, 2009). The restriction applied in the multinomial logit model assumes all individuals share the same preferences for each attribute. The random variation of individuals' preferences cannot be detected in the multinomial logit model. To allow for the individual variation of taste (Timmermans & Golledge, 1990), we applied mixed multinomial logit model (MXL) in this paper. Following application by Kruse & Atkinson (2022), the utility function is therefore as following.

$$U_{njt} = X_{njt}\beta_k + X_{njt}\eta_{nk} + \epsilon_{njt} \quad (3)$$

where X_{njt} is a vector including variables associated with alternative-specific attributes. We assume β_k (estimated coefficient of attribute k) varied across respondents. η_{nk} is the random deviation from mean value of coefficient β_k. The mixed logit model allows for variation in tastes of individuals. β_n and α_n are therefore coefficients of an individual's tastes. The random coefficients in this model are normally distributed. Then the probability of individual n choosing alternative j at choice task t is given by:

$$P_{njt} = \int \frac{e^{X_{njt}\beta}}{\sum_J e^{X_{njt}\beta}} f(\beta_n|\Theta) d\beta_n \tag{4}$$

where $f(\beta_n|\Theta)$ is the density function for the coefficient vector β. As we have discussed before, we assume the coefficient of the cost attribute to be fixed and the rest of the attributes to be random.

The estimated parameters are used to calculate average WTP values for different attribute. We calculate the trade-off between cost attribute and the other policy attribute by this following equation:

$$WTP_k = -\frac{\beta_k}{\beta_{price}} \tag{5}$$

where β_k is the estimated random coefficient for non-monetary attribute k, β_{price} is the estimated fix coefficient for the monetary attribute (cost attribute of the alternatives).

Latent Class Model

The latent class model could serve as an alternative to discrete choice analysis, according to the method by Greene & Hensher (2003). Similar with mixed logit model, the latent class model also relaxes the IIA assumption. We apply the latent class model to examine the heterogeneity in several groups of respondents. In this way, the respondents in the whole sample are divided into several classes and assumed to have homogeneous preferences within the same group. The utility function used in latent class model is as below.

$$U_{njt|q} = X_{njt|q}\beta_q + \epsilon_{njt|q} \tag{6}$$

where $U_{njt|q}$ represents the utility of individual n of group q when he/she chooses alternative j in the choice task t. β_q is the vector of the coefficients in the group q. The unconditional probability of individual n choosing alternative j in choice task t can be expressed as a weighted average function of β_q (Strazzera et al., 2012; Kruse & Atkinson, 2022).

$$Pr_{nj} = \sum_{q=1}^{Q} h_q Pr_{nj|q} \tag{7}$$

where $Pr_{j|q}$ is the conditional probability of individual n choosing alternative j in the group q. There are Q groups in total. The $Pr_{nj|q}$ is expressed as:

$$Pr_{nj|q} = \frac{e^{\beta_{n1|q}X_{n1j}+\beta_{n2|q}X_{n2j}+\cdots+\beta_{nk|q}X_{nkj}}}{\sum_{q=1}^{Q} e^{\beta_{n1|q}X_{n1j}+\beta_{n2|q}X_{n2j}+\cdots+\beta_{nk|q}X_{nkj}}} \tag{8}$$

h_q is the class probability estimated by the multinomial logit model according to the individual characteristics of the respondent. Z_l is the vector of individual characteristics to divide the group among individuals. α_q is the vector of the corresponding coefficients in group q.

$$h_q = \frac{\mathrm{e}^{Z_l \alpha_q}}{\sum_{q=1}^{Q} \mathrm{e}^{Z_l \alpha_q}} \tag{9}$$

We estimate the latent class model using the maximum likelihood approach. As we discussed above, the trade-off is calculated by the negative ratio of the coefficients of non-monetary attributes and the monetary attribute.

$$WTP_{k|q} = -\frac{\beta_{k|q}}{\beta_{price|q}} \tag{10}$$

4.7 Empirical Results

Descriptive results

We surveyed 314 individuals, representative of the population of the United States in 2022. The demographic information (age, income, gender, etc.) is shown in Table 3, which represents the comparison of our sample and the American population in 2022. The socio-demographic information on the population of the United States is derived from the U.S. Census Bureau. In our sample, 50.16% are female, 75.43% are white, 15.36% are black or African American, 6.48% are Asian, 2.05% are American Indian and Alaska Native, and 0.68% are Native Hawaiian or Other Pacific Islander. The average age of the respondents is about 42.76. The average household annual income is approximately $76,111, which is estimated by the median of each range of income categories provided in our survey. While our survey sample is slightly higher in age and income compared to the average American population, these differences are relatively small. Therefore, the sample can still be considered representative of the general population.

[Table 4.3]

Figure 4.1 depicts the group scoring results of "Global Warming’s Six Americas" and the comparison of shares in each group between our survey sample and national estimates. The respondents in our survey are divided into six groups (Chryst et al., 2018): 36% of respondents are in the alarmed group with the strongest support of climate policies; 24.8% of respondents are in the concerned group who believe global warming is happening and support climate policies; 23% of respondents are in the cautious group with undecided minds about global warming issues; 2% of respondents are in the disengaged group who rarely hear about climate change issues; 8.9% of respondents are in the doubtful group who don’t believe global warming or regard it as a natural cycle; and the rest of respondents are in the dismiss group who hold the least beliefs about climate change issues. It provides persuasive evidence for the representativeness of our survey in comprehending climate change issues.

[Figure 4.1]

The average reported monthly electricity expenses are about $182, and the average monthly gasoline expenses are $189. The mean value of reported gasoline prices is about $5.06. Regarding the importance of energy issues, 40.00% of respondents think keeping energy costs as low as possible is of the utmost importance. 7.62% of respondents think that the priority is to maintain energy jobs; 19.37% of respondents think reducing U.S. dependence on foreign sources is the most important thing; 5.40% of respondents think preventing accidents at energy facilities plays the most vital role; 20.63% of respondents believe using energy sources that protect the environment is of the utmost importance; 4.13% of respondents think the most important issue is avoiding energy shortages or blackouts.

Mixed logit regression results and WTP estimates

Based on over 10,000 choices from 314 respondents surveyed in the first round, our study investigates attributes of climate policy that increase public acceptability in the United States. According to the estimated results from the mixed logit model in Table 4.4, the most significant attribute of the climate change policy identified is the use of revenue. The *status quo* policy uses government general spending as the revenue distribution option. Compared to the base option, the coefficient of financial rebates to households is the only statistically significant parameter among the four options of revenue distribution (general government spending, reducing the federal deficit, investment in renewable energy subsidies, and financial rebates to U.S. households). It's significant at the 0.1 percent level. Referring to the WTP estimates in Table 4.5, Americans are willing to pay an additional $18.98 per month, which is about 10% of their average monthly electricity bill, if the revenue is used for rebates. These results suggest the dominant importance of financial rebates for households.

Our estimation results also suggest that perceived policy effectiveness is important for people to increase their support for climate policy. According to results in Table 4.4, the coefficients of the global warming target, expected date to be carbon neutral in the United States, monthly household electricity cost, additional green jobs created by 2035, and additional fossil fuel jobs lost by 2035 are all statistically significant at different levels. The cost attribute is the most important and statistically significant at the 0.1 percent level. The results comply with the intuition that policies with less personal cost are favored by households. The coefficients of green job gain and fossil fuel job loss are statistically significant at the 5 percent level. There is a distinguished preference for options that provide more ecological job gains or fewer fossil fuel job losses. The difference between the coefficients for green job gains and fossil fuel job losses is not statistically significant within the confidence interval.

[Table 4.4]

To limit each degree Celsius increase in global temperature, people's WTP is approximately $4.55. Individuals are willing to pay an additional $0.61 to expedite the achievement of a net-zero carbon economy in the United States by one year ahead of 2065. As for the policy outcome in the labor market, people are willing to pay, on average, an additional $4.77 per month for one million green jobs increased by 2035, while they need to be compensated $5.02 on their monthly electricity bill for one million fossil fuel jobs lost by 2035.

[Table 4.5]

Based on the results discussed in the preceding section, we concluded that our findings differ from previous research that suggests people favor investing in environmental initiatives as a revenue recycling option (Dresner et al., 2006; Baranzini & Carattini, 2017). In fact, we only discovered evidence that Americans prefer financial rebates; they have no preference for the other three options. Nonetheless, it is noteworthy that Americans are willing to pay for differences in climate goals. In terms of monetary WTP, Ščasný et al., (2017) found that people do not care whether the goal is to reduce carbon emissions by 40% or 80%. In our study, we provide convincing evidence that people are willing to pay more to attain carbon neutrality faster and limit global warming as low as possible.

Latent class model results

The first step in the latent class analysis is to identify the optimal number of classes in the latent class model. Following similar applications of latent class model (Gevrek & Uyduranoglu, 2015; Carattini et al., 2017; Kruse & Atkinson, 2022), the Akaike information criterion (AIC), consistent Akaike information criterion (CAIC), and the Bayesian information criterion (BIC) are usually used as indicators to determine the optimal number of classes in the model. Compared to CAIC and BIC, AIC often tends to select a model with a greater number of latent classes than the true underlying structure, indicating that AIC may overestimate the complexity of the model (Yang, 2006). On the other hand, CAIC and BIC tend to prefer models with fewer latent classes, suggesting a tendency to select simpler models. AIC, BIC, CAIC values are represented in Table 6. The CAIC and BIC values are lowest when there are three classes. AIC value is lowest when there are four classes. We determined to estimate the latent class model with three classes because of the lowest BIC and CAIC values among different number of classes.

[Table 4.6]

The coefficients of the latent class model are presented in three classes in Table 4.7. Panel A of the table depicts the preferences of individuals for policy attributes, whereas Panel B describes key membership characteristics used to identify heterogeneous groups. The coefficients for urban residence, and being a Democrat are all statistically significant and positive for the first latent class, which consists of 31.5 percent of survey respondents. The coefficient of high-electricity-bill is statistically significant with a negative sign. These results suggest that members of this class are more likely to identify as Democrats, to reside in urban areas, and to have lower-than-average electricity expenditures. Notably, this group exhibits a negative and statistically significant utility coefficient for global temperature change, indicating a strong opposition to global temperature increase. In addition, they display a statistically significant and positive coefficient for financial rebates, indicating a preference for this revenue distribution option.

[Table 4.7]

The coefficients of rural residence, higher household incomes, high beliefs in climate change, and Democratic party affiliation are statistically significant within class 2. This second latent class comprises the majority of respondents, accounting for 51.9% of the survey sample. These respondents exhibit distinct characteristics, such as being members of environmental organizations, residing in rural areas, having higher household incomes, expressing strong beliefs in climate change, and aligning with the Democratic party. Compared to Class 1, this class shares similar preferences for global warming and financial rebates as a method of revenue distribution to households. In addition, this class of respondents exhibits positive and statistically significant utility coefficients for two specific factors: an increase in green employment opportunities by 2035 and an earlier expected date for achieving carbon neutrality in the United States. Notably, the Alternative Specific Constant (ASC) for the *status quo* policy is statistically negative, indicating that this class of respondents tends to support more ambitious climate policy and oppose the current situation described as a *status quo* that government take no action to combat climate change. In the *status quo* scenario, government collects revenue for general spending, makes minimum efforts to limit global warming, and does not strive to achieve national carbon neutrality in the country. Furthermore, there is no significant shift in the labor market.

The third latent class, comprising 16.6% of the survey respondents, serves as the reference class in our analysis. Within this class, the most vital attribute is the perceived loss of fossil fuel jobs by 2035. The negative sign associated with this coefficient indicates a strong opposition among individuals in this class towards job losses resulting from climate policies targeting the fossil fuel industry. The magnitude of the coefficient is notably large, underscoring the public adverse attitude towards the “job-killing” effect of climate policy (Vona, 2019).

[Table 4.8]

Table 4.8 presents the willingness-to-pay results across different classes. More than half of respondents (Class 2) are willing to pay to accelerate domestic efforts to achieve carbon neutrality and contribute to meeting the Paris Agreement's global warming limitation. Furthermore, a majority of respondents are willing to pay an average monthly amount of $9 to support 1 million green jobs increased by 2035. This group is also strongly opposed to the status quo policy in which government did nothing to combat climate change. To accept the status quo in climate policy, people in this group need to get compensation of about $495. Approximately 16.6% of respondents (Class 3) require compensation to accept the projected job losses in the fossil fuel industry by 2035. In this way, we can distinguish that people who are in favor of gaining green jobs are not the group that posed a strong opposition to the potential job losses in the fossil fuel industry. This phenomenon can be explained by the previous study that even though the energy transition might bring opportunities to fossil fuel-based communities, representatives there are still angry about such a transition because of the perceived threat to local economic development (Olson-Hazboun, 2018). Additionally, around 83.4% of respondents (both Class 1 and Class 2) demonstrate a clear preference for financial rebates as the preferred method of revenue distribution. These findings highlight the substantial support for climate change mitigation initiatives and the corresponding individuals' financial contributions.

4.7 Conclusion

The U.S. climate plan announced by President Biden includes ambitious goals such as reaching carbon neutrality in the United States before 2050 and reducing domestic carbon emissions significantly by 2035. Recent implementation of the Inflation Reduction Act (IRA) of 2022 represents a significant milestone taken by the U.S. government to combat climate change through substantial investments in the renewable energy area. In our study, we incorporated the Inflation Reduction Act and existing literature as a framework for designing a discrete choice experiment examining public preferences for climate policies in the United States. This experiment is designed to evaluate how people perceive the effectiveness, labor market outcomes, as well as the revenue recycling method of the climate policy alter their policy choices.

This study is expected to provide policy implications for climate change mitigation in the United States. Firstly, government should prioritize climate policies with relatively low costs for citizens and convince the public that the policies are both effective and advantageous (Lam, 2015). In our results, the perceived cost of climate change mitigation is the most important attribute identified, and financial rebates is the most popular option for revenue use.

Secondly, the impact of climate change mitigation on labor outcomes poses a significant challenge to garnering public support. In general, people hate policies with perceived job losses and prefer policies that are expected to increase employment, despite the potential environmental cost of brown industries. However, as we discussed in the previous part, our results indicate that those who are in favor of increased green job opportunities are not necessarily the same group that strongly opposes job losses in the fossil fuel sector. This finding is not surprising and comply with previous literature. Despite the potential for economic growth in these communities, Olson-Hazboun (2018) found negative perceptions of the renewable energy industry in energy-dependent regions of Utah due to perceived threats to local economies. This strong opposition can be explained by loss aversion, the psychological phenomenon in which the negative psychological impact of losing something outweighs the positive psychological impact given that the measurements of events are equal (Cason, 1930; Baumeister et al., 2001; Rozin & Royzman). However, this finding highlights the significance of the "just transition" approach to climate policies, especially in communities that are highly dependent on the fossil fuel industry. It is crucial to consider how to design climate policies that provide compensation and support for the affected workers and areas by the energy transition. Future research should delve deeper into the design of such policies to ensure a seamless transition for these communities and to resolve their concerns and requirements.

Thirdly, even though people might not have enough knowledge or information about how much effort is needed to achieve ambitious climate goals, they are willing to pay for achieving both the global climate target for limiting global warming as well as the domestic goal to reduce carbon emissions and achieve carbon neutrality. This finding is in contrast with a previous study showing that people are indifferent to the effectiveness of policy in reducing carbon emissions in different proportions (Ščasný et al., 2017). We concluded that people who are members of environmental organizations or identified as Democratic are more likely to distinguish the differences among the climate goals and are willing to pay more for these ambitious targets.

Overall, this study contributes to a more nuanced comprehension of how climate policies can be acceptable to achieve desired results. In addition, it is also crucial to continually evaluate existing policies and seek to gain the public support through the implementation of innovative and effective climate strategies. We enable policymakers and stakeholders to evaluate the public acceptability of the current policy attributes and make informed decisions regarding future actions.

4.8 References:

Akter, S., Bennett, J., & Ward, M. B. (2012). Climate change scepticism and public support for mitigation: Evidence from an Australian choice experiment. *Global Environmental Change*, *22*(3), 736–745. https://doi.org/10.1016/j.gloenvcha.2012.05.004

Attari, S. Z., Schoen, M., Davidson, C. I., DeKay, M. L., Bruine de Bruin, W., Dawes, R., & Small, M. J. (2009). Preferences for change: Do individuals prefer voluntary actions, soft regulations, or hard regulations to decrease fossil fuel consumption? *Ecological Economics*, *68*(6), 1701–1710. https://doi.org/10.1016/j.ecolecon.2008.10.007

Ballew, M. T., Leiserowitz, A., Roser-Renouf, C., Rosenthal, S. A., Kotcher, J. E., Marlon, J. R., Lyon, E., Goldberg, M. H., & Maibach, E. W. (2019). Climate Change in the American Mind: Data, Tools, and Trends. *Environment: Science and Policy for Sustainable Development*, *61*(3), 4–18. https://doi.org/10.1080/00139157.2019.1589300

Baranzini, A., & Carattini, S. (2017). Effectiveness, earmarking and labeling: Testing the acceptability of carbon taxes with survey data. *Environmental Economics and Policy Studies*, 19(1), 197–227. https://doi.org/10.1007/s10018-016-0144-7

Baumeister, R. F., Bratslavsky, E., Finkenauer, C., & Vohs, K. D. (2001). Bad is stronger than good. *Review of General Psychology*, *5*(4), 323–370.

Bergquist, P., Mildenberger, M., & Stokes, L. C. (2020). Combining climate, economic, and social policy builds public support for climate action in the US. *Environmental Research Letters*, *15*(5), 054019. https://doi.org/10.1088/1748-9326/ab81c1

Bijlenga, D., Bonsel, G. J., & Birnie, E. (2011). Eliciting willingness to pay in obstetrics: Comparing a direct and an indirect valuation method for complex health outcomes. *Health Economics*, *20*(11), 1392–1406. https://doi.org/10.1002/hec.1678

Brannlund, R., & Persson, L. (2012). To tax, or not to tax: Preferences for climate policy attributes. *Climate Policy*, *12*(6), 704–721. https://doi.org/10.1080/14693062.2012.675732

Bristow, A. L., Wardman, M., Zanni, A. M., & Chintakayala, P. K. (2010). Public acceptability of personal carbon trading and carbon tax. *Ecological Economics*, *69*(9), Article 9. https://doi.org/10.1016/j.ecolecon.2010.04.021

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., & Vöhringer, F. (2017). Green Taxes in a Post-Paris World: Are Millions of Nays Inevitable? *Environmental and Resource Economics*, *68*(1), 97–128. https://doi.org/10.1007/s10640-017-0133-8

Carattini, S., Carvalho, M., & Fankhauser, S. (2017). *How to make carbon taxes more acceptable*. 58.

Carattini, S., Kallbekken, S., & Orlov, A. (2019). How to win public support for a global carbon tax. *Nature*, *565*(7739), 289–291. https://doi.org/10.1038/d41586-019-00124-x

Carson, R. T., Louviere, J. J., & Wei, E. (2010). Alternative Australian climate change plans: The public's views. *Energy Policy*, *38*(2), 902–911. https://doi.org/10.1016/j.enpol.2009.10.041

Cason, H. (1930). Pleasant and unpleasant feelings. *Psychological Review*, *37*, 228–240. https://doi.org/10.1037/h0074761

Chryst, B., Marlon, J., Van Der Linden, S., Leiserowitz, A., Maibach, E., & Roser-Renouf, C. (2018). Global warming's "Six Americas Short Survey": Audience segmentation of climate change views using a four question instrument. *Environmental Communication*, *12*(8), 1109–1122.

Davidovic, D., & Harring, N. (2020). Exploring the cross-national variation in public support for climate policies in Europe: The role of quality of government and trust. *Energy Research & Social Science*, *70*, 101785. https://doi.org/10.1016/j.erss.2020.101785

Dietz, T., Dan, A., & Shwom, R. (2007). Support for Climate Change Policy: Social Psychological and Social Structural Influences*. *Rural Sociology*, *72*(2), 185–214. https://doi.org/10.1526/003601107781170026

Douenne, T., & Fabre, A. (2020). French attitudes on climate change, carbon taxation and other climate policies. *Ecological Economics*, *169*, 106496. https://doi.org/10.1016/j.ecolecon.2019.106496

Drews, S., & van den Bergh, J. C. J. M. (2016). What explains public support for climate policies? A review of empirical and experimental studies. *Climate Policy*, *16*(7), Article 7. https://doi.org/10.1080/14693062.2015.1058240

Dresner, S., Jackson, T., & Gilbert, N. (2006). History and social responses to environmental tax reform in the United Kingdom. *Energy Policy*, *34*(8), Article 8. https://doi.org/10.1016/j.enpol.2004.08.04

Dreyer, S. J., & Walker, I. (2013). Acceptance and Support of the Australian Carbon Policy. *Social Justice Research*, *26*(3), 343–362. https://doi.org/10.1007/s11211-013-0191-1

ESS Round 8: European Social Survey Round 8 Data (2016). Data file edition 2.2. Sikt - Norwegian Agency for Shared Services in Education and Research, Norway – Data Archive and distributor of ESS data for ESS ERIC. doi:10.21338/NSD-ESS8-2016.

Fairbrother, M. (2022). Public opinion about climate policies: A review and call for more studies of what people want. *PLOS Climate*, *1*(5), e0000030. https://doi.org/10.1371/journal.pclm.0000030

Georgieva, K. (2021, October 31). Not Yet on Track: Climate Threat Demands More Ambitious Global Action. *IMF Blog*.

Gevrek, Z. E., & Uyduranoglu, A. (2015). Public preferences for carbon tax attributes. *Ecological Economics*, *118*, 186–197. https://doi.org/10.1016/j.ecolecon.2015.07.020

Greene, W. H., & Hensher, D. A. (2003). A latent class model for discrete choice analysis: Contrasts with mixed logit. *Transportation Research Part B: Methodological*, *37*(8), 681–698. https://doi.org/10.1016/S0191-2615(02)00046-2

Hammar, H., & Jagers, S. C. (2006). Can trust in politicians explain individuals' support for climate policy? The case of CO2 tax. *Climate Policy*, *5*(6), 613–625. https://doi.org/10.1080/14693062.2006.9685582

Hammerle, M., Best, R., & Crosby, P. (2021). Public acceptance of carbon taxes in Australia. *Energy Economics*, *101*, 105420. https://doi.org/10.1016/j.eneco.2021.105420

Hammitt, J. K., & Adams, J. L. (1996). The value of international cooperation for abating global climate change. *Resource and Energy Economics*, *18*(3), 219–241. https://doi.org/10.1016/S0928-7655(96)00008-5

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecological Economics*, *69*(8), 1595–1603. https://doi.org/10.1016/j.ecolecon.2010.04.011

Joireman, J., Barnes Truelove, H., & Duell, B. (2010). Effect of outdoor temperature, heat primes and anchoring on belief in global warming. *Journal of Environmental Psychology*, *30*(4), 358–367. https://doi.org/10.1016/j.jenvp.2010.03.004

Kallbekken, S., & Sælen, H. (2011). Public acceptance for environmental taxes: Self-interest, environmental and distributional concerns. *Energy Policy*, *39*(5), 2966–2973. https://doi.org/10.1016/j.enpol.2011.03.006

Karceski, S. M., Dolšak, N., Prakash, A., & Ridout, T. N. (2020). Did TV ads funded by fossil fuel industry defeat the Washington carbon tax? *Climatic Change*, *158*(3–4), Article 3–4. https://doi.org/10.1007/s10584-019-02626-z

Kitt, S., Axsen, J., Long, Z., & Rhodes, E. (2021). The role of trust in citizen acceptance of climate policy: Comparing perceptions of government competence, integrity and value similarity. *Ecological Economics*, *183*, 106958. https://doi.org/10.1016/j.ecolecon.2021.106958

Kotchen, M. J., Boyle, K. J., & Leiserowitz, A. A. (2013). Willingness-to-pay and policy-instrument choice for climate-change policy in the United States. *Energy Policy*, *55*, 617–625. https://doi.org/10.1016/j.enpol.2012.12.058

Kotchen, M. J., Turk, Z. M., & Leiserowitz, A. A. (2017). Public willingness to pay for a US carbon tax and preferences for spending the revenue. *Environmental Research Letters*, *12*(9), Article 9. https://doi.org/10.1088/1748-9326/aa822a

Krosnick, J. A., Holbrook, A. L., Lowe, L., & Visser, P. S. (2006). The Origins and Consequences of democratic citizens' Policy Agendas: A Study of Popular Concern about Global Warming. *Climatic Change*, *77*(1), 7–43. https://doi.org/10.1007/s10584-006-9068-8

Kruse, T., & Atkinson, G. (2022). Understanding public support for international climate adaptation payments: Evidence from a choice experiment. *Ecological Economics*, *194*, 107321. https://doi.org/10.1016/j.ecolecon.2021.107321

Lam, S.-P. (2015). Predicting support of climate policies by using a protection motivation model. *Climate Policy*, *15*(3), 321–338. https://doi.org/10.1080/14693062.2014.916599

Lynas, M. (2008). *Six Degrees: Our Future on a Hotter Planet*. National Geographic Books.

Malik, A., Bertram, C., Kriegler, E., & Luderer, G. (2021). Climate policy accelerates structural changes in energy employment. *Energy Policy*, *159*, 112642. https://doi.org/10.1016/j.enpol.2021.112642

McFadden, D. & others. (1973). *Conditional logit analysis of qualitative choice behavior*.

Nascimento, L., Kuramochi, T., Iacobuta, G., den Elzen, M., Fekete, H., Weishaupt, M., van Soest, H. L., Roelfsema, M., Vivero-Serrano, G. D., Lui, S., Hans, F., Jose de Villafranca Casas, M., & Höhne, N. (2022). Twenty years of climate policy: G20 coverage and gaps. *Climate Policy*, *22*(2), 158–174. https://doi.org/10.1080/14693062.2021.1993776

Odland, S., Rhodes, E., Corbett, M., & Pardy, A. (2023). What policies do homeowners prefer for building decarbonization and why? An exploration of climate policy support in Canada. *Energy Policy*, *173*, 113368. https://doi.org/10.1016/j.enpol.2022.113368

Olson-Hazboun, S. K. (2018). "Why are we being punished and they are being rewarded?" views on renewable energy in fossil fuels-based communities of the U.S. west. *The Extractive Industries and Society*, *5*(3), 366–374. https://doi.org/10.1016/j.exis.2018.05.001

Pons-Seres de Brauwer, C., & Cohen, J. J. (2020). Analysing the potential of citizen-financed community renewable energy to drive Europe's low-carbon energy transition. *Renewable and Sustainable Energy Reviews*, *133*, 110300. https://doi.org/10.1016/j.rser.2020.110300

Reed, M., O'Reilly, P., & Hall, J. (2019). The Economics and Politics of Carbon Taxes and Regulations: Evidence from Voting on Washington State's Initiative 732. *Sustainability*, *11*(13), Article 13. https://doi.org/10.3390/su11133667

Reynolds, J. P., Stautz, K., Pilling, M., van der Linden, S., & Marteau, T. M. (2020). Communicating the effectiveness and ineffectiveness of government policies and their impact on public support: A systematic review with meta-analysis. *Royal Society Open Science*, *7*(1), 190522. https://doi.org/10.1098/rsos.190522

Rhodes, E., Axsen, J., & Jaccard, M. (2014). Does effective climate policy require well-informed citizen support? *Global Environmental Change*, *29*, 92–104. https://doi.org/10.1016/j.gloenvcha.2014.09.001

Rhodes, E., Axsen, J., & Jaccard, M. (2017). Exploring Citizen Support for Different Types of Climate Policy. *Ecological Economics*, *137*, 56–69. https://doi.org/10.1016/j.ecolecon.2017.02.027

Rozin, P., & Royzman, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review*, *5*(4), 296–320.

Saha, D., Shrestha, R., & Jordan, P. (2022). How a Clean Energy Economy Can Create Millions of Jobs in the US. Retrieved from https://www.wri.org/insights/us-jobs-clean-energy-growth

Ščasný, M., Zvěřinová, I., Czajkowski, M., Kyselá, E., & Zagórska, K. (2017). Public acceptability of climate change mitigation policies: A discrete choice experiment. *Climate Policy*, *17*(sup1), S111–S130. https://doi.org/10.1080/14693062.2016.1248888

Shwom, R., Bidwell, D., Dan, A., & Dietz, T. (2010). Understanding U.S. public support for domestic climate change policies. *Global Environmental Change*, *20*(3), 472–482. https://doi.org/10.1016/j.gloenvcha.2010.02.003

Strazzera, E., Mura, M., & Contu, D. (2012). Combining choice experiments with psychometric scales to assess the social acceptability of wind energy projects: A latent class approach. *Energy Policy*, *48*, 334–347. https://doi.org/10.1016/j.enpol.2012.05.037

Svenningsen, L. S. (2019). Social preferences for distributive outcomes of climate policy. *Climatic Change*, *157*(2), 319–336. https://doi.org/10.1007/s10584-019-02546-y

Timmermans, H., & Golledge, R. G. (1990). Applications of behavioural research on spatial problems II: preference and choice. *Progress in Human Geography*, *14*(3), 311–354.

Train, K. E. (2009). *Discrete choice methods with simulation*. Cambridge university press.

Unsworth, K. L., & Fielding, K. S. (2014). It's political: How the salience of one's political identity changes climate change beliefs and policy support. *Global Environmental Change*, *27*, 131–137. https://doi.org/10.1016/j.gloenvcha.2014.05.002

Vona, F. (2019). Job losses and political acceptability of climate policies: Why the 'job-killing' argument is so persistent and how to overturn it. *Climate Policy*, *19*(4), Article 4. https://doi.org/10.1080/14693062.2018.1532871

Weller, B. E., Bowen, N. K., & Faubert, S. J. (2020). Latent Class Analysis: A Guide to Best Practice. *Journal of Black Psychology*, *46*(4), 287–311. https://doi.org/10.1177/0095798420930932

Yang, C. C. (2006). Evaluating latent class analysis models in qualitative phenotype identification. *Computational Statistics & Data Analysis*, *50*(4), 1090–1104. https://doi.org/10.1016/j.csda.2004.11.004

Ziegler, A. (2017). Political orientation, environmental values, and climate change beliefs and attitudes: An empirical cross country analysis. *Energy Economics*, *63*, 144–153. https://doi.org/10.1016/j.eneco.2017.01.022

Table 4.1. Attributes and levels in the discrete choice experiment

Attributes	Levels
Total increase in the monthly electricity expenditure:	$0, $15, $30, $45
Additional green jobs created by 2035	0, 1, 2, 3 (millions)
Additional fossil fuel jobs lost by 2035	0, 1, 2, 3 (millions)
Limit global warming by this century	1.5, 3, 4.5, 6 (degree Celsius)
Expected date to be carbon neutral in the United States:	2035, 2045, 2055, 2065
Revenue distribution:	General government spending Reducing the federal deficit Renewable energy subsidy Financial rebates to the U.S. households.

Notes: This table describes the designed attributes and their levels in our survey.

Table 4.2. Choice task example

	Policy Option A	**Policy Option B**	***Status Quo Policy***
Total increase in your monthly household expenses for electricity	$0	$45	$0
Additional Jobs created in the U.S. green energy industry by 2035	2 million	1 million	0
Additional Jobs lost in the U.S. fossil fuel industry by 2035	1 million	2 million	0
Limit global warming to	1.5°C	3°C	6°C
Expected date to be carbon neutral in the U.S.	2045	2055	2065
If revenue is collected from this program, it will be used for	General government spending	Financial rebates back to U.S. households	General government spending

Notes: This table is an example of the choice task presented to respondents in the survey.

Table 4.3. Descriptive statistic

Variables	Statistic	Overall sample	American Population
Gender	% Female	50.16%	50.5%
Age	Mean	42.76	38.5
	S.D.	16.52	/
Income	Mean	76,111	69,021
	S.D.	50,375	/
Race	White	75.43%	75.8%
	Black or African American	15.36%	13.6%
	American Indian and Alaska Native	2.05%	1.3%
	Asian	6.48%	6.1%
	Native Hawaiian or Other Pacific Islander	0.68%	0.3%
Monthly electricity expenses	Mean	182.16	/
	S.D.	106.30	/
Monthly gasoline expenses	Mean	188.74	/
	S.D.	115.04	/
Monthly natural gas expenses	Mean	113.10	/
	S.D.	124.54	/
Current gasoline price	Mean	5.07	/
	S.D.	1.31	/
Importance of energy issue	Keep energy costs as low as possible	40.00%	/
	Maintain energy jobs	7.62%	/
	Reduce U.S. dependence on foreign sources	19.37%	/
	Prevent accidents at energy facilities	5.40%	/
	Use energy sources that protect the environment	20.63%	/
	Avoid energy shortages or blackouts	4.13%	/
	Other	2.86%	/

Notes: The second column represents descriptive statistics based on our sample, while the third column represents the national estimates according to the U.S. Census Bureau.

Table 4.4. Mixed logit regression results

	Overall Sample
Cost	-0.013***
	(0.001)
GreenJobs	0.053*
	(0.025)
FossilJobs	-0.066*
	(0.027)
Global warming target	-0.054**
	(0.019)
Expected date for domestic carbon neutral	0.007**
	(0.002)
Revenue used for reducing the federal deficit	0.059
	(0.123)
Revenue used for renewable energy subsidies	0.125
	(0.125)
Revenue used for financial rebates back to U.S. households	0.234***
	(0.068)
SQ	-1.514***
	(0.222)
Observations	11340
AIC	6,666.767
BIC	6,791.480

Notes: This table provide mixed logit regression results corresponding to Equation (4). Table list coefficients with standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.5. WTP estimates

	WTP	95% Confidence Interval
1 million of green jobs increased by 2035	4.27*	(0.29, 8.25)
1 million of fossil jobs decreased by 2035	-5.24*	(-9.54, -0.95)
Global warming target (1 degree Celsius)	-4.34**	(-7.41, -1.27)
Expected date for domestic carbon neutral	0.59**	(0.18, 0.99)
Revenue used for reducing the federal deficit	4.70	(-14.61, 24.00)
Revenue used for renewable energy subsidies	10.03	(-9.80, 29.85)
Revenue used for financial rebates back to U.S. households	18.70***	(7.70, 29.72)
ASC *status quo*	-121.04***	(-163.55, -78.53)
Observations	11340	
AIC	6,666.767	
BIC	6,791.480	

Notes: The WTP estimates are calculated based on the results from Table 4.4 using the Delta method. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.6. Criteria for selecting preferred number of classes.

Number of classes	AIC	BIC	CAIC
2	6868.562	6973.6341	7001.6341
3	6690.4099	6866.7808	6913.7808
4	6624.5753	6872.2451	6938.2451

Notes: Table showing the AIC, BIC and CAIC for alternative number of classes in the latent class analysis. Compared to CAIC and BIC, AIC often tends to select a model with a greater number of latent classes than the true underlying structure, indicating that AIC may overestimate the complexity of the model (Yang, 2006). On the other hand, CAIC and BIC tend to prefer models with fewer latent classes, suggesting a tendency to select simpler models. The CAIC and BIC values are lowest when there are three classes. AIC value is lowest when there are four classes. Based on the BIC and CAIC criteria, we choose 3 as the optimal class number.

Table 4.7. Latent class regression results

	Class1	Class2	Class3
Panel A:			
Cost	-0.008**	-0.007***	-0.108***
	(0.002)	(0.001)	(0.012)
GreenJobs	0.06	0.060**	-0.110
	(0.035)	(0.022)	(0.100)
FossilJobs	-0.05	-0.029	-0.201*
	(0.036)	(0.022)	(0.100)
Global warming target	-0.048*	-0.059***	0.005
	(0.003)	(0.015)	(0.070)
Expected date for domestic carbon neutral	0.004	0.008***	0.0129
	(0.003)	(0.002)	(0.009)
Revenue used for reducing the federal deficit	0.255	-0.059	-0.614
	(0.160)	(0.46)	(0.347)
......for renewable energy subsidies	0.193	0.016	-0.228
	(0.158)	(0.461)	(0.273)
......for financial rebates back to U.S. households	0.268*	0.204**	-0.434
	(0.112)	(0.069)	(0.294)
SQ	-0.0528	-3.295***	0.196
	(0.173)	(0.374)	(0.334)
Panel B: class membership			
Environmental organization	2.002	2.286*	
	(1.081)	(1.059)	
Rural	0.787	1.326**	
	(0.542)	(0.484)	
Urban	0.873*	0.622	
	(0.458)	(0.439)	
High-income households	0.148	0.920*	
	(0.419)	(0.382)	
High electricity bill	-0.873*	-0.681	
	(0.408)	(0.378)	
Climate change belief	0.209	1.144**	
	(0.403)	(0.391)	
Republican	-0.274	-0.039	
	(0.448)	(0.410)	
Democrat	1.381*	1.572**	
	(0.578)	(0.550)	
Old	-1.098	-0.628	
	(0.509)	(0.437)	
Female	0.469	0.405	
	(0.403)	(0.377)	
Constant	-1.972	-3.108**	
	(1.230)	(1.218)	
Class share	31.5%	51.9%	16.6%
AIC	6690.4099		
BIC	6866.7808		

Notes: This table provide latent class model results corresponding to Equation (8). Table list coefficients with standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.8. WTP estimates for Latent Class Model

	Class 1		Class 2		Class 3	
	WTP estimates	Confidence Interval	WTP estimates	Confidence Interval	WTP estimates	Confidence Interval
1 million of green jobs increased by 2035	7.79	(-1.80, 17.38)	9.08*	(1.55, 16.62)	-1.00	(-2.84, 0.83)
	(4.89)		(3.84)		(0.93)	
1 million of fossil jobs decreased by 2035	-6.07	(-15.62, 3.48)	-4.42	(-11.26, 2.43)	-1.92*	(-3.73, -0.11)
	(4.87)		(3.49)		(0.92)	
Global warming target (1 degree Celsius)	-5.99	(-12.59, 0.61)	-8.85**	(-14.53, -3.18)	0.01	(-1.26, -1.27)
	(3.37)		(2.89)		(0.65)	
Expected date for domestic carbon neutral	0.51	(-0.37, 1.39)	1.24**	(0.43, 2.06)	0.12	(-0.05, 0.29)
	(0.45)		(0.42)		(0.09)	
Revenue used for reducing the federal deficit	32.01	(-10.16, 74.18)	-8.04	(-144.82, 128.74)	-5.60	(-12.04, 0.84)
	(21.52)		(69.79)		(3.29)	
......for renewable energy subsidies	24.15	(-17.21, 65.52)	3.34	(-132.95, 139.62)	-2.12	(-7.19, 2.94)
	(21.10)		(69.54)		(2.59)	
......for financial rebates back to U.S. households	33.82*	(7.70, 29.72)	30.38***	(7.08, 53.67)	-4.17	(-9.64, 1.31)
	(17.01)		(11.89)		(2.79)	
ASC *status quo*	-6.26	(-47.40, 34.89)	-495.05***	(-733.99, -256.67)	1.72	(-4.43, 7.87)
	(20.99)		(121.91)		(3.14)	
Class share	31.5%		51.9%		16.6%	
AIC	6690.4099					
BIC	6866.7808					

Notes: The WTP estimates are calculated based on the results from Table 4.7 using the Delta method. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

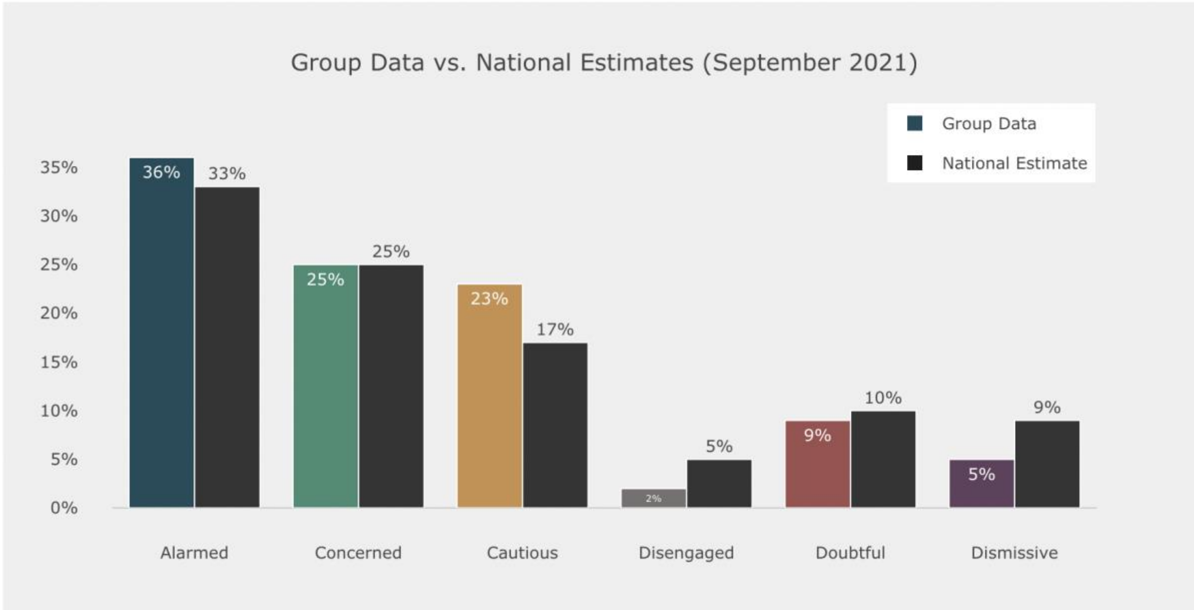


Figure 4.1. Global Warming's Six Americas distribution comparison

Notes: This figure depicts the group scoring results of "Global Warming's Six Americas" and the comparison of shares in each group between our survey sample and national estimates. The black bar represents the national estimates in September 2021.

CHAPTER 5

CONCLUSION

Overall, this dissertation investigates public opinion towards climate change mitigation from different perspectives. Two chapters of this dissertation (Chapter 1 & Chapter 3) focus on examining the determinants of public attitudes towards climate policy in Europe and the United States. Chapter 1 utilizes secondary data from the eighth round of the European Social Survey to explore how spatial and individual characteristics affect people's support for different climate policies in Europe. In Chapter 3, we employ a discrete choice experiment to estimate the willingness to pay for various climate policy attributes among Americans. In the second chapter, we observe the gap between climate change belief and corresponding pro-environmental behaviors and evaluate its relationship with individuals' subjective well-being.

Throughout this dissertation, we have extensively examined the various factors that contribute to public acceptability of climate policies, including individual characteristics, contextual factors, and policy attributes. Our research enriches the existing literature on public acceptability of climate policy and implementation of pro-environmental behaviors. However, there are several limitations in our study. The first two chapters rely on secondary survey data (ESS8), which restricts our ability to control for individual effects over time and establish causal relationships. To overcome this limitation, future research could incorporate longitudinal surveys, allowing for more accurate estimations. Additionally, the measurement of pro-environmental behavior in ESS8 is limited to only two types, which hinders a comprehensive understanding of environmental cognitive dissonance across various behaviors. Future studies should expand the range of behaviors examined to shed more light on this relationship.