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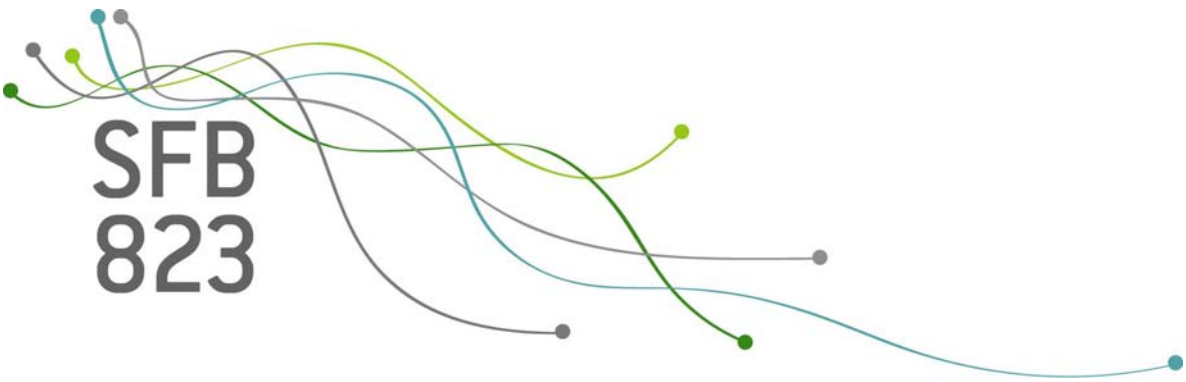

Climate Change, Population Ageing and Public Spending: Evidence on Individual Preferences

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Abstract. Economic theory, as well as empirical research, suggest that elderly people prefer public spending on policies yielding short-term benefits. This might be bad news for policies aimed at combating climate change: while the unavoidable costs of these policies arise today, the expected benefits occur in the distant future. Drawing on data from over 12,000 households and using the ordered logit and the generalized ordered logit model, we analyze whether attitudes towards climate change and climate policies, as well as public spending preferences, differ with respect to age. Our estimates show that elderly people are less concerned about climate change, but more concerned about other global challenges. Furthermore, they are less likely to support climate-friendly policies, such as the subsidization of renewables, and allocate less public resources to environmental policies. Thus, our results suggest that the ongoing demographic change in industrialized countries may undermine climate policies.

Keywords: Demographics, Attitudes, Survey, Generalized Ordered Logit Analysis

JEL codes: H41, J14, Q54

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1 Introduction

During the next decades, demographic change will dramatically alter the structure of the world's population. While population growth in developing countries is expected to continue, most industrialized countries will be faced with a declining number of inhabitants. Europe's population, for instance, is expected to decrease from 738 in 2015 to 707 million in 2050 (UN, 2015). This trend comes along with the tendency of an ageing population, which is due to lower birth rates and increased longevity. For Europe, the median age is projected to rise from 41.7 years in 2015 to 46.2 in 2050, and to be substantially higher in Portugal (52.5), Italy (51.7), and Germany (51.4), for instance (UN, 2015).

At the same time, the world is faced with the challenging problem of climate change that is induced by rising greenhouse gas emissions. Notwithstanding an intense controversy over the best way to respond to the threat of global warming, there is widespread consensus about the general need for political action. In fact, policy-makers all around the world have started to enact programs to mitigate climate change and to improve their economies' ability to adapt to it.

To ascertain sufficient support for enacting such policies, policy-makers face severe obstacles. After all, the costs of these measures are known and arise today, while the benefits are uncertain and might only emerge in the distant future. Moreover, whether there will be any benefits at all crucially depends on the policy measures in other countries, since a global alliance against climate change has yet to form. This combination of short-term costs and uncertain long-term benefits might find particularly weak support from older people, as their individual horizons may be rather short. Given these facts, the question arises whether ageing societies tend to spend less resources on climate policies.

There is ample reason to suspect that ageing societies reduce their spending on policies that yield benefits only in the distant future. In an ageing society, the steadily growing share of elderly people in the electorate increases the age of the median

voter who, according to theoretical reasoning from political economics, determines the amount of public good provision (Downs, 1957). Presumably, an older median voter tends to favor the provision of those public goods that generate the highest utility for elderly voters, such as pensions and health care. Simultaneously, the declining share of the electorate directly benefiting from current climate policies in the distant future will diminish the part of the public budget allocated to climate policies. But this presumption might be wrong as, for instance, not all people are purely self-interested and empirical evidence shows that fairness motives can influence the behavior of people (see, among others, Kahneman et al., 1986, and Fehr and Schmidt, 1999). In fact, the findings of Carpenter et al. (2008), List (2004), and Popp (2001) suggest that people may exhibit (intergenerational) altruism and, thus, appreciate the preservation of the environment for subsequent generations.

There are mixed results as to whether an ageing population leads to higher (or lower) public spending in general (see, for instance, Disney, 2007; Jäger and Schmidt, 2016; Razin et al., 2002; Shelton, 2008). The results for education expenditures, which entail similar characteristics as climate policies – short-term costs and long-term benefits –, seem to be rather clear, though. For instance, Cattaneo and Wolter (2009), Rattsø and Sørensen (2010), as well as Sørensen (2013) uniformly show that elderly people express a lower willingness to dedicate funds to education rather prefering health- and pension-related public expenditures. To our knowledge, the empirical literature on the consequences of population ageing for public goods provision has not addressed the issue of public spending on climate policy.[1]

Employing data that is gathered in four waves between the fall of 2012 and the summer of 2015 among more than 12,000 German households, this paper probes the relationship between individual age and attitudes towards climate change, climate policies, and preferences for public spending, using the ordered logit model (OLM) and the less-restrictive generalized ordered logit model (GOLM).

[1] Based on a different methodology, this topic has been analyzed theoretically in overlapping generation models (see, among others, Balestra and Dottori, 2012; John and Pecchenino, 1994; Rangel, 2003).

Our results demonstrate that elderly people show less concern for the abatement of climate change, while they are more concerned about other challenges the world is faced with. In addition, elderly people are less likely to support climate-friendly policies, such as the subsidization of renewables, and allocate less public resources to environmental policies. In sum, our results suggest that the demographic change taking place in many industrial countries leads to decreasing public funds for climate protection policies in the future.

The remainder of the article is as follows. The next two sections describe the data and the methodology used. In Section 4, the estimation results are presented. Section 5 discusses the findings. The final section summarizes and concludes.

2 Data

To elicit the respondents' attitudes towards climate change, other global challenges, climate policies, and public spending preferences, four surveys were conducted among the household panel of the professional German survey institute *forsa*.[2] Data is collected via a tool that allows participants to complete the questionnaire at home using either a television or the internet. Respondents can interrupt and continue the survey at any time. A large set of socio-economic and demographic background information on all household members is available from *forsa's* household selection procedure and updated regularly. We draw on data from all four survey waves, the first of which took place during October 4 and November 4, 2012 and was retrieved from 6,404 households. Three subsequent surveys were conducted between May 10 and June 17, 2013 (6,522 households), between June 13 and July 30, 2014 (6,602 households), and between March 3 and April 28, 2015 (7,077 households). Altogether, we rely on 26,605 observations originating from 12,472 households.

Respondents' age ranges from 18 to 91 with an average of 53.3 years (Table 1). The share of women in the sample accounts to 33.1%, which is due to the fact that the

[2]Further information on forsa and its household panel is available at www.forsa.com.

Table 1: Descriptive Statistics

Variable name	Variable definition	Mean
Age	Age of respondent	53.3
Female	Dummy: 1 if respondent is female	0.331
East	Dummy: 1 if respondent resides in East Germany	0.391
Children	Dummy: 1 if respondent has at least one child	0.670
Grandchildren	Dummy: 1 if respondent has at least one grandchild	0.264
College degree	Dummy: 1 if respondent has a college degree	0.256
City	Dummy: 1 if household lives in an urban area	0.374
High income	Dummy: 1 if monthly household income exceeds €4,000	0.126
Green attitude	Dummy: 1 if respondent tends to vote for the green party	0.110
Environmental group	Dummy: 1 if respondent is member of an environmentally active group	0.128

household head – defined as the person that normally makes the financial decisions at the household level – was asked to fill out the questionnaire. Furthermore, about two thirds of the respondents have at least one child, whereas about every fourth has at least one grandchild. More than a quarter of the participants indicate to have a college degree. Moreover, around 37% of the households live in urban areas that are defined as regions with a population density of more than 500 inhabitants per km^2 and an overall population of at least 50,000 people. We create a dichotomous high income variable that equals unity for about 13% of the households with monthly net household incomes above 4,000 €. To capture environmental attitudes, two binary variables are used to indicate the inclination to Germany's green party and the membership of an environmental organization, which is the case for 11% and around 13% of the respondents, respectively.

To inquire on concerns about climate change, we asked the following question: "There are plenty of challenges that people all around the world are faced with. Please indicate how important combating climate change is to you.", with response options ranging from (1) "very unimportant" to (5) "very important". Table 2 shows that more than half of the respondents state that combating climate change is "very important". An additional 30% think that it is "important", while only a minority of less than 5% think that combating climate change is unimportant. In the following, the focus of our analysis is the relationship between age and several dependent variables (attitudes towards global challenges, climate policies and public spending preferences), of which

the attitudes towards the importance to combat climate change is the first.

Table 2: Households' Opinion about the Importance of Combating Climate Change

Category	j	Frequency	Percent	Cumulative
Very unimportant	$(j = 1)$	403	1.6%	1.6%
Rather unimportant	$(j = 2)$	806	3.1%	4.7%
Moderately important	$(j = 3)$	2,937	11.3%	16.0%
Rather important	$(j = 4)$	7,787	30.1%	46.1%
Very important	$(j = 5)$	13,980	54.0%	100.0%
Total		25,913	100.0%	

3 Methodology

For the purpose of our analysis, we pool the data from the four surveys and, as the dependent variables are recorded on ordinal scales, apply an ordered logit model (OLM) using the following specification:

$$y_i^* = \delta_1 age_i + \delta_2 age_i^2 + \boldsymbol{\beta}^T \mathbf{x}_i + \epsilon_i, \tag{1}$$

where y_i^* is a latent dependent variable, in our first analysis the attitudes towards the importance of combating climate change, age_i is the age of respondent i, and $\mathbf{x}_i$ contains a set of control variables. δ_1, δ_2, and $\boldsymbol{\beta}$ are the parameters to be estimated, and ϵ_i denotes the error term. Given Specification (1), we assume a quadratic relationship between the dependent variable and age, but we also test further functional forms, either omitting the quadratic term or including several dummy variables for age. We account for repeated observations from the same respondents by clustering standard errors at the individual level.

In terms of probability, the OLM can be written as (Williams, 2006):

$$P(Y_i > j) = \frac{\exp(\alpha_j + \boldsymbol{\theta}^T \mathbf{z}_i)}{1 + \exp(\alpha_j + \boldsymbol{\theta}^T \mathbf{z}_i)}, \; j = 1, 2, ..., M - 1, \tag{2}$$

where M is the number of categories of the ordinal dependent variable and $\boldsymbol{\theta}$ is the vector of parameters to be estimated, comprising $\boldsymbol{\beta}$, δ_1 and δ_2. Vector $\mathbf{z}$ is the compound of the *age* variables and the remaining covariates, while α_j represent the thresholds for the latent dependent variable.

The OLM assumes uniform coefficients across categories, which is commonly referred to as the proportional odds assumption (McCullagh, 1980).[3] If this assumption is violated, estimating an OLM will lead to inconsistent results. Several scholars (e.g. McCullagh and Nelder, 1989; Peterson and Harrell, 1990; Terza, 1985) have questioned the proportional odds assumption and developed ordered choice models that are based on non-proportional odds. In addition to the OLM, in what follows, we employ the so-called generalized ordered logit model (GOLM). Using the GOLM with the relaxed proportional odds assumption, the probability of exceeding category j can be written as (Williams, 2006):

$$P(Y_i > j) = \frac{\exp(\alpha_j + \boldsymbol{\theta}_j^T \mathbf{z}_i)}{1 + \exp(\alpha_j + \boldsymbol{\theta}_j^T \mathbf{z}_i)}, \; j = 1, 2, ..., M-1, \tag{3}$$

where $\boldsymbol{\theta}_j$ is a vector of parameters that may vary across categories j.

In practice, the GOLM is estimated by running a series of $M-1$ binary logit regressions (Williams, 2006, p. 63). For example, in our first analysis of the attitudes towards the importance of combating climate change, where $M = 5$ (Table 2), four binary logit regressions that sequentially combine the categories of the dependent variable are to be estimated. For the first regression (indicated in the results tables by $Y > 1$), category $j = 1$ is recoded as zero, whereas all other categories $j = 2, ..., 5$ are recoded as unity. For the second binary regression ($Y > 2$), the first two categories, $j = 1$ and $j = 2$, are recoded as 0, with the remaining categories being recoded as 1. In a similar vein, for the third regression ($Y > 3$), categories 1 to 3 and for the fourth regression ($Y > 4$), categories 1 to 4 are recoded as zero, respectively.

[3] In the literature, this assumption is also called parallel lines assumption (e.g. Long and Freese, 2006) as well as parallel regressions assumption (e.g. Leon-Novelo et al., 2010). To avoid confusion, we stick with the terminology proportional odds assumption throughout the paper.

For all questions raised in this analysis, we estimate both the OLM and the less-restrictive GOLM. In general, the OLM results lead to the same qualitative conclusions. As the illustration of the OLM results is more intuitive, we only discuss the results of GOLM where additional insights can be gained.

4 Empirical Results

4.1 Attitudes towards Climate Change

Estimating Equation (1) without any controls reveals a non-linear inverted U-shaped correlation between the respondents' age and the probability of stating that combating climate change is important (Panel (1) in Table 3). The coefficients are significant and yield a turning point age, where the expression of concern peaks, at $\tau = \frac{\theta_{Age}}{|2*\theta_{Age^2}|} = 58$ years.

In Panel (2), a large set of covariates is included, several showing statistically significant effects, while the coefficients on age remain similar in magnitude. Among the remaining results, it is worth noting that women tend to assign a higher importance to combating climate change, whereas respondents residing in East Germany and wealthier respondents are less concerned. Holding a college degree turns out to correlate positively with the concern about climate change. However, elderly college graduates tend to report lower levels of concern than younger graduates. The null hypothesis of joint insignificance of having college degree and the interaction term is rejected at conventional significance levels. Surprisingly, having offspring in terms of children or grandchildren does not significantly correlate with higher concern about climate change.[4] The positive and significant coefficient on the second survey dummy indicates that in the second survey period, the concern about climate change was con-

[4]We also applied the International Standard Classification of Education (ISCED) scale for the education variable and included income as a continuous variable as well as several dummy variables. Further, we estimated the models with different measures for having children (log of number of children, a dummy indicating at least two children etc.). All these variations have no influence on the results in qualitative terms.

Table 3: OLM Results for Combating Climate Change

	(1)		(2)		(3)	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	0.057**	(0.008)	0.081**	(0.012)	0.073**	(0.012)
Age × Age	-0.0005**	(0.000)	-0.0007**	(0.000)	-0.0006**	(0.000)
Female	–	–	0.503**	(0.041)	0.462**	(0.043)
East	–	–	-0.370**	(0.052)	-0.285**	(0.054)
Children	–	–	-0.033	(0.182)	-0.066	(0.189)
Grandchildren	–	–	-0.363	(0.385)	-0.227	(0.406)
College degree	–	–	0.439**	(0.155)	0.412*	(0.161)
City	–	–	0.073	(0.041)	0.040	(0.043)
High income	–	–	-0.155**	(0.056)	-0.168**	(0.058)
Age × Children	–	–	0.002	(0.004)	0.003	(0.004)
Age × Grandchildren	–	–	0.005	(0.006)	0.003	(0.007)
Age × College degree	–	–	-0.011**	(0.003)	-0.013**	(0.003)
Green attitude	–	–	–	–	1.024**	(0.067)
Environmental group	–	–	–	–	0.526**	(0.060)
Second survey	–	–	0.513**	(0.054)	0.427**	(0.060)
Third survey	–	–	-0.053	(0.030)	-0.063*	(0.032)
Fourth survey	–	–	0.057	(0.035)	0.043	(0.036)
α_1	-2.594**	(0.207)	-1.752**	(0.286)	-1.832**	(0.302)
α_2	-1.463**	(0.201)	-0.648*	(0.282)	-0.696*	(0.298)
α_3	-0.102	(0.199)	0.725*	(0.282)	0.674*	(0.298)
α_4	1.404**	(0.200)	2.254**	(0.283)	2.231**	(0.299)
No. of observations	25,913		20,064		17,624	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1 % and 5 %level, respectively.*

siderably higher, possibly due to tremendous rainfalls within the survey period in East and South Germany that resulted in disastrous floods and high media attention.

Panel (3) in Table 3 includes the respondents' environmental attitudes. In accordance with the empirical literature (see e.g. Liu et al., 2014, for an overview), these variables are highly significant and show positive signs. As expected, individuals that sympathize with the green party, as well as individuals that are member of an environmental organization, are more concerned about climate change. Although these variables are frequently employed in the literature to explain the variation of concern about environmental issues, we discard them in the subsequent analysis due to the fact that they are most likely highly endogenous. Instead, in the following, we stick

with the specification as shown in Panel (2). However, given the results of all three models, we conclude that the results are robust over model specifications and suggest that elderly people are less concerned about climate change – even if we control for environmental attitudes.

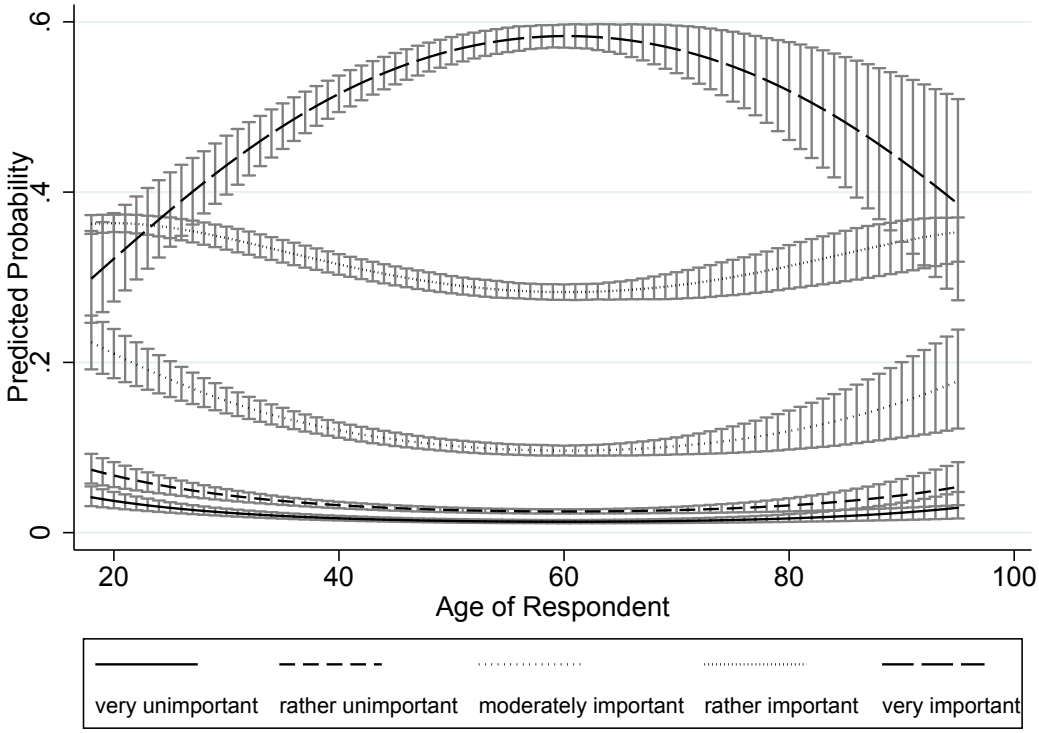
To determine the effect size of an additional year of age on climate concern, it would be necessary to calculate marginal effects. However, we do not display marginal effects since it would be a tedious undertaking for our analysis. It requires computing the marginal effects of an additional year at different ages for each category of the dependent variable separately. For instance, an additional year of age increases the probability of stating that combating climate change is "very important" ($Pr(Y = 5)$) by 1.1 percentage points at the age of 20, and decreases it by 0.6 percentage points at the age of 80, respectively. To deal with this variability of marginal effects, Figure 1 illustrates the predicted probabilities for each category by age and underlines the findings from our estimations. To obtain the marginal effects of the covariates interacted with *age*, we need to plug in values for *age*. For instance, the probability to state that combating climate change is "very important" declines by about 5 percentage points for college graduates aged 60, whereas it increases by about 3 percentage points for college graduates aged 30 years.

To examine the proportional odds assumption of the OLM, we conduct the so-called Brant (1990) test, which involves comparing the estimates across the $M - 1$ binary logit models and testing the null hypothesis that the coefficients do not differ: $H_0 : \boldsymbol{\theta}_j = \boldsymbol{\theta}$. We obtain a chi-square statistic of $\chi^2(45)$ =126.92 (p<0.01), indicating that the proportional odds assumption is violated for the model as a whole. Thus, the OLM results might be inconsistent and the GOLM seems to be preferable to the OLM. Since the OLM is nested in the GOLM, we conduct likelihood ratio tests in order to determine which model fits our data best. The test result ($\chi^2(45)$ =134.15, p<0.01) indicates that the GOLM is the preferable model.[5]

From the GOLM estimates, some additional insights emerge: Most variables only

[5]We estimate all GOLMs using Williams' 2006 Stata program `gologit2`.

Figure 1: Concern about Climate Change by Age



appear significant at the higher categories of the dependent variable (Table 4). Furthermore, the coefficients on *age* and age^2 only show the same signs as in the OLM for the two highest categories. Thus, the effect of age is manifesting itself through the effect on the highest categories. In addition, the GOLM confirms that respondents residing in East Germany are less concerned about climate change, while women tend to be more concerned than men. The declining magnitude of the estimates indicates that women are particularly unlikely to report low levels of concern. Similarly, college graduates have a lower propensity to state that combating climate change is unimportant. Yet, as in the OLM, older respondents with a college degree tend to report a lower level of concern than younger graduates. For an average college graduate aged 30, the marginal effect of an additional year on the probability to state that combating climate change is "rather important" or "very important" amounts to around 2 percentage points, whereas the probability declines by about 5 percentage points for an average graduate of 60 years.

Table 4: GOLM Results for Combating Climate Change

	Y>1		Y>2		Y>3		Y>4	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	-0.020	(0.049)	0.020	(0.027)	0.075**	(0.016)	0.085**	(0.012)
Age × Age	0.0004	(0.001)	0.0000	(0.000)	-0.0006**	(0.000)	-0.0007**	(0.000)
Female	1.078**	(0.201)	1.045**	(0.120)	0.672**	(0.062)	0.456**	(0.042)
East	-0.099	(0.193)	-0.313**	(0.117)	-0.416**	(0.069)	-0.360**	(0.054)
Children	0.403	(0.664)	0.213	(0.424)	-0.005	(0.248)	-0.063	(0.190)
Grandchildren	1.749	(1.609)	0.747	(0.972)	-0.227	(0.535)	-0.438	(0.393)
College degree	0.636	(0.622)	0.976**	(0.361)	0.626**	(0.206)	0.342*	(0.161)
City	-0.108	(0.158)	0.044	(0.100)	0.075	(0.057)	0.075	(0.041)
High income	0.100	(0.205)	-0.296*	(0.124)	-0.201**	(0.073)	-0.134*	(0.056)
Age × Children	-0.003	(0.013)	0.000	(0.008)	0.003	(0.005)	0.002	(0.004)
Age × Grandchildren	-0.030	(0.026)	-0.016	(0.016)	0.002	(0.009)	0.006	(0.006)
Age × College degree	-0.016	(0.012)	-0.023**	(0.007)	-0.014**	(0.004)	-0.009**	(0.003)
Second survey	-0.017	(0.208)	0.457**	(0.124)	0.547**	(0.073)	0.504**	(0.057)
Third survey	0.020	(0.130)	-0.025	(0.074)	-0.061	(0.043)	-0.052	(0.033)
Fourth survey	0.101	(0.155)	0.178*	(0.088)	0.192**	(0.051)	0.017	(0.038)
Constant	3.763**	(1.126)	1.665**	(0.639)	-0.683	(0.371)	-2.310**	(0.294)
No. of observations	20,064							

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1 % and 5 %level, respectively.*

4.2 Attitudes towards Global Challenges Other than Climate Change

Given the result that elderly people are less concerned about climate change, it is interesting to test whether they are less concerned about global challenges in general. To investigate this hypothesis, we extend our analysis to other global challenges that the world is faced with, namely fighting social injustice, hunger and poverty, overcoming diseases, stabilizing financial systems, stopping terrorism and preventing or ending wars. The underlying questionnaire codes the importance of these challenges according to the same five-point scale ($1 = \textit{very unimportant}$ to $5 = \textit{very important}$) that we applied above. In general, the respondents show a high concern for all six challenges (Table 5). The highest level of concern is expressed for ending wars (93.1% of the respondents state that ending wars is either "rather important" or "very important"), followed by fighting social injustice (92.1%) and overcoming diseases (91.6%).

As a first approach to analyze whether the respondents' level of concern is generally high, we compute Spearman's rank correlation coefficients between the six global challenges. The correlation across the different challenges is significantly positive and

Table 5: Households' Opinions about the Importance of Global Challenges

	Very unimportant	Rather unimportant	Moderately important	Rather important	Very important	Total
Climate change	1.6%	3.1%	11.3%	30.1%	54.0%	100.0%
Social injustice	0.5%	1.2%	6.3%	26.3%	65.8%	100.0%
Diseases	0.3%	0.9%	7.3%	32.7%	58.9%	100.0%
Financial system	1.3%	3.1%	13.3%	35.6%	46.7%	100.0%
Terror	0.8%	2.7%	9.8%	24.8%	61.9%	100.0%
Wars	0.5%	1.3%	5.2%	19.6%	73.5%	100.0%

moderately high (Table A1 in the appendix). Furthermore, we find that there is a significant relationship between age and each global challenge (the null hypothesis of joint insignificance of the coefficients on age is rejected at all conventional significance levels for all five models). Both the concern about social injustice and diseases follow the same pattern that we observe for the concern about climate change (Table 6). However, as the turning points are very high and likelihood ratio tests prove that a linear functional form is preferable, we infer that concern is actually increasing with age. For all other global challenges, we also find that concern rises with age. In addition, it bears highlighting that women are more concerned about all global challenges than men.

Table 6: OLM Results for Global Challenges Other than Climate Change

	Social Injustice		Diseases		Financial System		Terrorism		Wars	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	0.055**	(0.012)	0.031**	(0.012)	-0.035**	(0.011)	0.031*	(0.013)	0.015	(0.013)
Age × Age	-0.0003**	(0.000)	-0.0000	(0.000)	0.0007**	(0.000)	0.0001	(0.000)	0.0003*	(0.000)
Female	0.671**	(0.045)	0.350**	(0.040)	0.288**	(0.037)	0.514**	(0.043)	0.704**	(0.047)
East	-0.059	(0.055)	0.104*	(0.052)	-0.036	(0.050)	-0.034	(0.057)	0.156*	(0.063)
Children	-0.309	(0.191)	0.218	(0.178)	0.125	(0.172)	0.482*	(0.187)	0.172	(0.199)
Grandchildren	0.591	(0.420)	0.778*	(0.384)	0.730	(0.374)	0.176	(0.430)	-0.021	(0.476)
College degree	0.046	(0.160)	-0.071	(0.144)	-0.257	(0.136)	-0.417**	(0.148)	-0.014	(0.164)
City	0.147**	(0.043)	-0.087*	(0.039)	-0.104**	(0.037)	-0.140**	(0.041)	0.031	(0.045)
High income	-0.361**	(0.058)	-0.065	(0.053)	0.131**	(0.050)	0.029	(0.055)	-0.117*	(0.059)
Age × Children	0.007	(0.004)	-0.003	(0.004)	-0.003	(0.003)	-0.006	(0.004)	0.001	(0.004)
Age × Grandchildren	-0.008	(0.007)	-0.010	(0.006)	-0.012	(0.006)	-0.002	(0.007)	0.003	(0.008)
Age × College degree	-0.001	(0.003)	-0.007*	(0.003)	0.001	(0.003)	-0.004	(0.003)	-0.002	(0.003)
No. of observations	20,088		20,095		20,046		20,076		20,087	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively. For the sake of compactness, we omit the coefficients on the survey wave dummies as well as on α_j and display the complete models in Table A2 in the appendix.*

To sum up, the results show that elderly people are less concerned about climate change compared to their younger counterparts, but concern about other contemporary problems is positively correlated with age.

4.3 Public Spending Preferences

The previous questions allowed the respondents to assign the highest value of importance to each of the six global challenges. However, in reality, people are confronted with even more challenges and need to trade them off against each other, e.g. for electoral purposes. To check whether the results are consistent when trade-offs are taken into account, we included further questions in the third and fourth survey waves.

Respondents were asked to split a hypothetical governmental budget as according to their spending preferences into the following services: environment, security, education, health, traffic, and other services. Table 7 shows that only around 5% of the respondents assign the highest priority to the environment, but more than every fifth respondent ranks it last. Education is most frequently considered to be of highest priority (25.2%), followed by health (10.4%).

Table 7: Priorities for Public Spending Preferences

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Total
Environment	4.6%	9.7%	19.9%	21.5%	21.6%	22.7%	100.0%
Education	25.2%	20.8%	19.6%	16.6%	10.0%	7.4%	100.0%
Health	10.4%	19.4%	25.2%	21.4%	13.2%	10.4%	100.0%
Security	6.9%	8.4%	14.8%	20.7%	23.6%	25.6%	100.0%
Traffic	2.0%	4.0%	10.4%	17.7%	32.5%	33.4%	100.0%
Other	9.1%	2.6%	4.2%	5.3%	5.3%	73.6%	100.0%

Table 8 displays the results for six OLMs, in which the dependent variable is coded as the rank of the corresponding service within the set of governmental services. For instance, $Y_{is} = 1$ if household i assigns the highest share of the budget to service s, and $Y_{is} = 6$ if the lowest share is assigned.

Again, we observe a non-linear correlation between age and environmental expen-

Table 8: OLM Results for Public Spending Priority

	Environment		Education		Health		Security		Traffic		Other	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	-0.035*	(0.014)	0.074**	(0.014)	0.010	(0.013)	0.028	(0.014)	0.032*	(0.015)	0.005	(0.017)
Age × Age	0.0003*	(0.000)	-0.0006**	(0.000)	-0.0001	(0.000)	-0.0004**	(0.000)	-0.0003	(0.000)	0.0000	(0.000)
Female	-0.434**	(0.044)	-0.246**	(0.044)	-0.221**	(0.042)	-0.088*	(0.043)	0.488**	(0.042)	0.739**	(0.060)
Eastern Germany	0.333**	(0.053)	-0.245**	(0.053)	-0.289**	(0.052)	-0.061	(0.053)	0.089	(0.052)	0.048	(0.065)
Children	0.311	(0.220)	0.063	(0.218)	0.022	(0.203)	-0.270	(0.214)	0.437*	(0.222)	0.356	(0.263)
Grandchildren	0.012	(0.409)	0.083	(0.422)	-0.491	(0.413)	0.137	(0.433)	-0.028	(0.427)	-0.915	(0.536)
College degree	0.043	(0.182)	-0.393*	(0.182)	-0.016	(0.168)	0.113	(0.183)	0.006	(0.183)	-0.113	(0.212)
City	-0.099*	(0.044)	-0.182**	(0.045)	0.088*	(0.042)	-0.008	(0.044)	0.064	(0.043)	-0.023	(0.055)
High income	0.085	(0.060)	-0.062	(0.060)	0.266**	(0.058)	0.054	(0.061)	-0.080	(0.061)	-0.227**	(0.073)
Age × Children	-0.005	(0.004)	-0.005	(0.004)	-0.001	(0.004)	0.003	(0.004)	-0.006	(0.004)	-0.005	(0.005)
Age × Grandchildren	0.001	(0.007)	-0.002	(0.007)	0.006	(0.007)	-0.001	(0.007)	-0.000	(0.007)	0.015	(0.009)
Age × College degree	-0.002	(0.003)	-0.002	(0.003)	0.006	(0.003)	0.002	(0.003)	0.003	(0.003)	-0.005	(0.004)
No. of observations						9,141						

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively. For the sake of compactness we omit the coefficients on the survey wave dummies as well as on α_j and display the complete models in Table A3 in the appendix.*

ditures. The signs indicate that older respondents tend to dedicate smaller shares of the budget to environmental purposes. Conversely, we find that elderly people tend to prioritize education, which is in contrast to Cattaneo and Wolter (2009), for instance.

However, compared to Cattaneo and Wolter (2009), our respondents have to trade-off, among others, environmental against educational expenditures – both policies possess the same characteristic: expenditures accrue in the short-term, while benefits arise in the long-term. Hence, our results indicate that when trading-off expenditures for environmental purposes against educational purposes, elderly respondents tend to opt for the latter.

In addition, we detect a negative age effect on budget shares for security (χ^2 =16.2, p<0.01) and traffic (χ^2 =6.8, p<0.05), while in the case of health expenditures, the null hypothesis of joint insignificance of the age coefficients cannot be rejected at conventional significance levels. Finally, it bears noting that women tend to assign higher budget shares to environmental, educational, and health-related purposes, while expenditures on traffic are significantly lower among women. Furthermore, people in Eastern Germany are less likely to assign high budget shares to environmental purposes, but have a higher propensity to dedicate funds to education and health.

4.4 Support for Specific Climate-Related Policies

To test the robustness of our results, in the following, we analyze the support for specific climate-related policies. In the four surveys, individuals were asked to state to what extent they would support the subsidization of renewable energy sources (RES) as well as the construction of new coal power plants. Due to the specific characteristics of the two policies, we can categorize them as follows: The subsidization of RES is considered as climate-friendly, whereas the construction of new coal power plants is interpreted as the opposite. The dependent variables are measured on an ordered five-point scale ranging from "strongly disagree" to "strongly agree". Table 9 shows that slightly more than half of the respondents agree to the subsidization of RES, while about two thirds disagree with the construction of new coal power plants.

Table 9: Agreement to Certain Climate Policies

	Totally disagree	Disagree	Indifferent	Agree	Totally agree	Total
Subsidies for RES	9.8%	19.0%	18.1%	39.7%	13.4%	100.0%
New coal power plants	25.8%	39.3%	22.1%	11.3%	1.5%	100.0%

Table 10: OLM Results for Climate-Related Measures

	Subsidies for Renewable Energies		New Carbon Power Plants	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	-0.014	(0.011)	-0.007	(0.011)
Age × Age	-0.0003	(0.000)	0.0000	(0.000)
Female	0.684**	(0.038)	-0.146**	(0.038)
East	-0.209**	(0.048)	0.412**	(0.051)
Children	-0.230	(0.171)	0.423*	(0.179)
Grandchildren	-0.811*	(0.351)	0.829*	(0.358)
College degree	0.077	(0.145)	-0.403**	(0.149)
City	0.155**	(0.038)	0.022	(0.039)
High income	-0.062	(0.055)	0.007	(0.055)
Age × Children	0.005	(0.003)	-0.007*	(0.004)
Age × Grandchildren	0.011	(0.006)	-0.012*	(0.006)
Age × College degree	0.001	(0.003)	0.005	(0.003)
No. of observations	19,923		19,835	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively. For the sake of compactness we omit the coefficients on the survey wave dummies as well as on α_j and display the complete models in Table A4 in the appendix.*

The results from the OLM suggest that elderly respondents are less likely to support the subsidization of RES, but more likely to agree with the construction of new coal power plants (Table 10). The null hypotheses of joint insignificance of the age coefficients are rejected for both regressions, i.e. $\chi^2(2)$=38.3 ($p<0.01$) and $\chi^2(2)$ =20.1 ($p<0.01$), respectively. Moreover, women and college graduates show climate-friendly attitudes: They support RES, but oppose to the construction of new coal power plants. In contrast, people residing in Eastern Germany and grandparents have opposing attitudes towards these policies and rather reject the subsidization of RES, while supporting new coal power plants.

Summarizing, the results of this section show that elderly people are less inclined to combating climate change and allocating less public resources to environmental purposes. In addition, they are less likely to support climate-friendly policies such as the subsidization of RES.

5 Discussion

5.1 Skepticism about climate change

One possible explanation for our findings is that elderly people may be more skeptical about the existence of climate change. To test this hypothesis, we analyze the question of whether the respondents believe in the existence of global climate change. The majority of the respondents believe that (1) climate change is already taking place (81.5%) or (2) will take place in the future (14.0%), while only 4.5% think that (3) climate change is not existent. Owed to the ordinal character of the dependent variable, we estimate an OLM, including the same covariates as before.

Our results suggest that the likelihood to be more skeptical about the existence of climate change increases with age (Table 11). Thus, elderly respondents have a significantly higher propensity to state that climate change will not take place. This result is in line with Poortinga et al. (2011) and Whitmarsh (2011). Similarly, Akter et al.

Table 11: OLM Results for the Non-Existence of Climate Change

	Coeff.	Std. Err.
Age	-0.058**	(0.015)
Age × Age	0.0007**	(0.000)
Female	-0.248**	(0.055)
East	0.449**	(0.071)
Children	0.412	(0.250)
Grandchildren	0.010	(0.512)
College degree	-0.544*	(0.225)
City	-0.111*	(0.054)
High income	0.109	(0.079)
Age × Children	-0.009	(0.005)
Age × Grandchildren	0.003	(0.008)
Age × College degree	0.004	(0.004)
No. of observations	19,603	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively. For the sake of compactness we omit the coefficients on the survey wave dummies as well as on the α_j and display the complete models in Table A5 in the appendix.*

(2012) detect a significant negative correlation between age and the agreement on the question whether "we are already experiencing climate change", and McCright and Dunlap (2011) detect that elderly people are less likely to state that "global warming effects have already begun".

5.2 Perceived Reasons of Climate Change

Another explanation for our results may be that elderly people are less likely to believe that climate change is mainly caused by humanity. If people think that global warming is not mainly induced by human activity, they may believe that political measures cannot mitigate it and, thus, show a lower support for these policies. Respondents of all four surveys were asked about the perceived reasons of climate change, given they believe in it. The answers are coded as unity if respondents state that climate change is at least partially caused by humanity and zero otherwise.

In our sample, 96% of the respondents believe that climate change is caused by human action. The logit results reported in Table 12 show that there is a non-linear inverted U-shaped pattern between the respondents' age and the probability of stating

that climate change is at least partially caused by humanity. College graduates are more likely to agree that humans are responsible for global warming. Yet, elderly graduates are more likely to believe in a naturally caused climate change.

Table 12: Logit Results for the Belief that Climate Change Is Caused by Humanity

	Coeff.	Std. Err.
Age	0.077**	(0.029)
Age × Age	-0.0006*	(0.000)
Female	0.635**	(0.118)
East	-0.024	(0.137)
Children	0.214	(0.456)
Grandchildren	-0.651	(0.937)
College degree	0.935*	(0.392)
City	0.079	(0.109)
High income	-0.201	(0.137)
Age × Children	-0.005	(0.009)
Age × Grandchildren	0.008	(0.015)
Age × College degree	-0.022**	(0.007)
No. of observations	18,726	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively. For the sake of compactness we omit the coefficients on the survey wave dummies and display the complete models in Table A6 in the appendix.*

5.3 Age or Cohort Effect?

In contexts dealing with differences in behavior among age groups, typically, the question arises whether the observed correlation is an age or cohort effect. Based on our survey data, we attempt to roughly analyze this question by investigating the relationship between the concern about climate change and age separately for each survey wave. In the absence of a cohort effect, the level of the turning point is hypothesized to be the same across the different waves (or at least does not increase). Although the computed turning points differ across regressions (τ lies between 55 and 65 years), it has no tendency to rise, and the coefficients on age do not differ significantly from each other ($\chi^2(3)$ =3.4, $p = .332$ in the case of Age and $\chi^2(3)$ =4.2, $p = .240$ for Age^2). Hence, one might interpret these results as a tentative evidence for a genuine age effect. Yet, to conclusively answer the question of whether there is a cohort or an age

effect, long-term data on the attitudes toward climate change is required.

6 Conclusion

The demographic changes taking place in most industrial countries are leading to a higher share of elderly people in the population, thereby causing the age of the median voter to rise. At the same time, political measures are required to combat climate change. While the costs of climate protection policies accrue today, the corresponding benefits occur in the future. These characteristics of climate protection policies – (uncertain) long-term benefits but short-term costs – raise the question of whether an ageing society will lead to a decreasing support for such policies.

Using the ordered logit and the less-restrictive generalized ordered logit model, we analyze data of more than 12,000 households. We find that elderly people express a significantly lower concern about combating climate change and are less likely to support climate-friendly policy measures. In contrast, they appear to be more concerned about other global challenges, such as stabilizing the financial system and fighting terrorism. Finally, we show that older people allocate less public resources to climate policies. Surprisingly, we find no evidence that the existence of children or grandchildren alters this outcome.

In accordance with, for instance, Cattaneo and Wolter (2009) and List (2004), we interpret our results as a genuine age effect, rather than a cohort effect. These results suggest that the demographic change taking place in industrial countries will decrease public funds for climate protection policies in the future. Complementing the existing literature that analyzes the influence of an ageing population on public spending in general, as well as with respect to education, our results provide further evidence that an ageing population likely reduces public spending on political measures with a long time horizon.

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A Appendix

Table A1: Spearman's Rank Correlation Coefficients Between Different Global Challenges

	Climate Change	Social Injustice	Diseases	Financial System	Terror	Wars
Climate change	1.0000					
Social injustice	0.3169	1.0000				
Diseases	0.1914	0.3399	1.0000			
Financial system	0.1605	0.1698	0.2778	1.0000		
Terror	0.2102	0.1489	0.3291	0.3140	1.0000	
Wars	0.2581	0.3675	0.2991	0.1867	0.4070	1.0000

B Appendix (Intended for Online Publication)

Table A2: OLM Results for Global Challenges Other than Climate Change

	Social Injustice		Diseases		Financial System		Terrorism		Wars	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	0.055**	(0.012)	0.031**	(0.012)	-0.035**	(0.011)	0.031*	(0.013)	0.015	(0.013)
Age × Age	-0.0003**	(0.000)	-0.0000	(0.000)	0.0007**	(0.000)	0.0001	(0.000)	0.0003*	(0.000)
Female	0.671**	(0.045)	0.350**	(0.040)	0.288**	(0.037)	0.514**	(0.043)	0.704**	(0.047)
East	-0.059	(0.055)	0.104*	(0.052)	-0.036	(0.050)	-0.034	(0.057)	0.156*	(0.063)
Children	-0.309	(0.191)	0.218	(0.178)	0.125	(0.172)	0.482*	(0.187)	0.172	(0.199)
Grandchildren	0.591	(0.420)	0.778*	(0.384)	0.730	(0.374)	0.176	(0.430)	-0.021	(0.476)
College degree	0.046	(0.160)	-0.071	(0.144)	-0.257	(0.136)	-0.417**	(0.148)	-0.014	(0.164)
City	0.147**	(0.043)	-0.087*	(0.039)	-0.104**	(0.037)	-0.140**	(0.041)	0.031	(0.045)
High income	-0.361**	(0.058)	-0.065	(0.053)	0.131**	(0.050)	0.029	(0.055)	-0.117*	(0.059)
Age × Children	0.007	(0.004)	-0.003	(0.004)	-0.003	(0.003)	-0.006	(0.004)	0.001	(0.004)
Age × Grandchildren	-0.008	(0.007)	-0.010	(0.006)	-0.012	(0.006)	-0.002	(0.007)	0.003	(0.008)
Age × College degree	-0.001	(0.003)	-0.007*	(0.003)	0.001	(0.003)	-0.004	(0.003)	-0.002	(0.003)
Second wave	0.250**	(0.059)	-0.044	(0.056)	-0.108*	(0.054)	-0.047	(0.058)	-0.139*	(0.066)
Third wave	-0.198**	(0.034)	-0.068*	(0.034)	-0.553**	(0.032)	0.047	(0.033)	-0.002	(0.038)
Fourth wave	-0.038	(0.040)	-0.064	(0.038)	-0.496**	(0.037)	0.552**	(0.041)	0.363**	(0.046)
α_1	-3.335**	(0.319)	-4.409**	(0.302)	-4.464**	(0.267)	-2.815**	(0.300)	-3.544**	(0.314)
α_2	-1.988**	(0.300)	-2.938**	(0.279)	-3.224**	(0.263)	-1.238**	(0.294)	-2.149**	(0.304)
α_3	-0.352	(0.291)	-0.811**	(0.274)	-1.652**	(0.261)	0.264	(0.293)	-0.692*	(0.298)
α_4	1.518**	(0.291)	1.298**	(0.273)	0.113	(0.261)	1.799**	(0.294)	0.983**	(0.298)
No. of observations	20,088		20,095		20,046		20,076		20,087	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively.*

Table A3: OLM Results for Public Spending Priority

	Environment		Education		Health		Security		Traffic		Other	
	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	-0.035*	(0.014)	0.074**	(0.014)	0.010	(0.013)	0.028	(0.014)	0.032*	(0.015)	0.005	(0.017)
Age × Age	0.0003*	(0.000)	-0.0006**	(0.000)	-0.0001	(0.000)	-0.0004**	(0.000)	-0.0003	(0.000)	0.0000	(0.000)
Female	-0.434**	(0.044)	-0.246**	(0.044)	-0.221**	(0.042)	-0.088*	(0.043)	0.488**	(0.042)	0.739**	(0.060)
Eastern Germany	0.333**	(0.053)	-0.245**	(0.053)	-0.289**	(0.052)	-0.061	(0.053)	0.089	(0.052)	0.048	(0.065)
Children	0.311	(0.220)	0.063	(0.218)	0.022	(0.203)	-0.270	(0.214)	0.437*	(0.222)	0.356	(0.263)
Grandchildren	0.012	(0.409)	0.083	(0.422)	-0.491	(0.413)	0.137	(0.433)	-0.028	(0.427)	-0.915	(0.536)
College degree	0.043	(0.182)	-0.393*	(0.182)	-0.016	(0.168)	0.113	(0.183)	0.006	(0.183)	-0.113	(0.212)
City	-0.099*	(0.044)	-0.182**	(0.045)	0.088*	(0.042)	-0.008	(0.044)	0.064	(0.043)	-0.023	(0.055)
High income	0.085	(0.060)	-0.062	(0.060)	0.266**	(0.058)	0.054	(0.061)	-0.080	(0.061)	-0.227**	(0.073)
Age × Children	-0.005	(0.004)	-0.005	(0.004)	-0.001	(0.004)	0.003	(0.004)	-0.006	(0.004)	-0.005	(0.005)
Age × Grandchildren	0.001	(0.007)	-0.002	(0.007)	0.006	(0.007)	-0.001	(0.007)	-0.000	(0.007)	0.015	(0.009)
Age × College degree	-0.002	(0.003)	-0.002	(0.003)	0.006	(0.003)	0.002	(0.003)	0.003	(0.003)	-0.005	(0.004)
Fourth survey	-0.069*	(0.034)	0.012	(0.034)	0.236**	(0.035)	-0.151**	(0.034)	-0.013	(0.036)	-0.032	(0.043)
α_1	-3.981**	(0.338)	0.490	(0.337)	-1.906**	(0.326)	-2.404**	(0.362)	-2.788**	(0.378)	-1.714**	(0.420)
α_2	-2.743**	(0.337)	1.450**	(0.337)	-0.584	(0.326)	-1.511**	(0.360)	-1.623**	(0.370)	-1.430**	(0.420)
α_3	-1.597**	(0.336)	2.278**	(0.337)	0.492	(0.326)	-0.628	(0.360)	-0.470	(0.368)	-1.057*	(0.420)
α_4	-0.695*	(0.336)	3.230**	(0.339)	1.495**	(0.327)	0.265	(0.360)	0.526	(0.368)	-0.684	(0.420)
α_5	0.315	(0.336)	4.244**	(0.340)	2.506**	(0.328)	1.311**	(0.360)	1.882**	(0.369)	-0.378	(0.420)
No. of observations	9,141											

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively.*

Table A4: OLM Results for Climate-Related Measures

	Subsidies for Renewable Energies		New Carbon Power Plants	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Age	-0.014	(0.011)	-0.007	(0.011)
Age × Age	-0.0003	(0.000)	0.0000	(0.000)
Female	0.684**	(0.038)	-0.146**	(0.038)
East	-0.209**	(0.048)	0.412**	(0.051)
Children	-0.230	(0.171)	0.423*	(0.179)
Grandchildren	-0.811*	(0.351)	0.829*	(0.358)
College degree	0.077	(0.145)	-0.403**	(0.149)
City	0.155**	(0.038)	0.022	(0.039)
High income	-0.062	(0.055)	0.007	(0.055)
Age × Children	0.005	(0.003)	-0.007*	(0.004)
Age × Grandchildren	0.011	(0.006)	-0.012*	(0.006)
Age × College degree	0.001	(0.003)	0.005	(0.003)
Second survey	0.388**	(0.051)	-0.655**	(0.052)
Third survey	0.071*	(0.030)	-0.723**	(0.030)
Fourth survey	0.332**	(0.033)	-0.784**	(0.034)
α_1	-2.648**	(0.264)	-1.314**	(0.269)
α_2	-1.300**	(0.264)	0.437	(0.269)
α_3	-0.503	(0.263)	1.740**	(0.269)
α_4	1.558**	(0.263)	4.054**	(0.277)
No. of observations	19,923		19,835	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively.*

Table A5: OLM Results for the Non-Existence of Climate Change

	Coeff.	Std. Err.
Age	-0.058**	(0.015)
Age × Age	0.0007**	(0.000)
Female	-0.248**	(0.055)
East	0.449**	(0.071)
Children	0.412	(0.250)
Grandchildren	0.010	(0.512)
College degree	-0.544*	(0.225)
City	-0.111*	(0.054)
High income	0.109	(0.079)
Age × Children	-0.009	(0.005)
Age × Grandchildren	0.003	(0.008)
Age × College degree	0.004	(0.004)
Second survey	0.027	(0.071)
Third survey	-0.363**	(0.048)
Fourth survey	-0.042	(0.050)
α_1	0.518	(0.365)
α_2	2.123**	(0.367)
No. of observations	19,603	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively.*

Table A6: Logit Results for the Belief that Climate Change Is Caused by Humanity

	Coeff.	Std. Err.
Age	0.077**	(0.029)
Age × Age	-0.0006*	(0.000)
Female	0.635**	(0.118)
East	-0.024	(0.137)
Children	0.214	(0.456)
Grandchildren	-0.651	(0.937)
College degree	0.935*	(0.392)
City	0.079	(0.109)
High income	-0.201	(0.137)
Age × Children	-0.005	(0.009)
Age × Grandchildren	0.008	(0.015)
Age × College degree	-0.022**	(0.007)
Second survey	-0.112	(0.143)
Third survey	0.111	(0.094)
Fourth survey	-0.012	(0.101)
Constant	0.958	(0.671)
No. of observations	18,726	

*Note: Standard errors are clustered at the household level. **,* denote statistical significance at the 1% and 5% level, respectively.*