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David Boto-García, Alessandro Buccioli

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Climate Change: Personal Responsibility and Energy Saving*

David Boto-García

University of Oviedo

botodavid@uniovi.es

Alessandro Bucciol[†]

University of Verona

alessandro.bucciol@univr.it

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Abstract:

We study at the individual level the connection between actions meant to reduce energy use and beliefs about personal responsibility on climate change mitigation. In addition, we also examine the role of human values and cross-country differences in shaping beliefs and behaviours. Using data from 23 (mostly) European countries, we find large heterogeneity in both beliefs and values, with richer countries being more likely to exhibit more concern about the environment. Personal responsibility and actual energy saving are positively correlated, but the correlation is not high. As regards human values, self-transcendence and openness are positively correlated with responsibility, while self-enhancement and conservation are negatively correlated. Values are instead not as correlated with energy saving, since we find only a positive correlation with conservation and a negative correlation with self-enhancement.

Keywords: Climate change; Energy saving; Personal responsibility; Human values.

JEL Codes: Q54; D91.

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[†] Corresponding author. Address: University of Verona, Dept. of Economics, University of Verona, Department of Economics, Via Cantarane 24, 37129 Verona, Italy.

1. INTRODUCTION

Climate on Earth has changed throughout history, and is changing nowadays as well. Since the advent of the industrial revolution, climate change has been driven not only by natural reasons, but also by human behaviour. Indeed, human responsibility has increased over time. In particular, the current intensive use of stationary energy sources causes an artificial build-up of greenhouse gases in the atmosphere, raising the average surface temperature worldwide in what is commonly called “global warming”. The most severe consequence of this phenomenon is the occurrence of extreme weather events in some geographical areas, but there are further impacts such as melting ice, rising seas, increasing precipitation, and shifting wildlife population. Scientists believe that actions should be taken immediately to limit CO₂ emissions as to alleviate the problem; if we do not intervene sooner than 2030, the climate change will become permanent (Intergovernmental Panel on Climate Change, 2018).

The European Union has become concerned about pursuing actions towards climate targets. Several policies have been undertaken towards the goal of cutting greenhouse emissions by 40% compared to 1990 and increasing energy efficiency by at least 32.5% by 2030 (European Commission, 2019). European countries have been urged to adopt national plans to cope with climate change.

Fuelled by media coverage, concern about climate change is getting more and more popular among individuals. However, consensus on human responsibility, or even the existence of a problem, is not uniform. If people believe their behaviour is irrelevant for the world climate, it is likely that they will not undertake more virtuous actions. Hence, the first step for policy makers is to increase awareness of climate change concern. This is not enough, though. Awareness must induce concrete daily actions meant to mitigate climate change, such as avoiding cars for short journeys, turning off lights when not being used or using appliances with a good energy rating.

In this empirical paper we study beliefs about personal responsibility on fighting climate change in combination with actions meant to reduce energy use at the individual level. The main purpose is to see whether beliefs and actions are widespread, which variables they are correlated with, and if beliefs determine actions. In addition, we aim to investigate two further issues: the role of human values in determining beliefs and behaviour, and a comparison across countries to learn if specific cultural and institutional settings alter beliefs and behaviour. Values are abstract motivations that are supposed to

guide opinions and behaviours, in a similar vein to social and cultural changes across countries.

Connecting beliefs and actual behaviour in the context of climate change is rare but not new in the literature. Some remarkable examples are Dienes (2015) and Nauges and Wheeler (2017). In particular, the latter is the first work that explicitly accounts for potential simultaneity in the link between beliefs (climate change concern) and behaviour (water and energy mitigation). We follow their approach and we also assume that beliefs and actions may suffer from simultaneity. However, we depart from Nauges and Wheeler (2017) in three main directions. First, we consider a Simultaneous Bivariate Ordered Probit model where beliefs and actions are described together as a function of observable variables. This way, we admit that the two dimensions may potentially have common drivers, and we check the support to findings obtained in the literature when studying beliefs and actions separately. Second, we incorporate values in the set of explanatory variables, following some literature pointing to the key role they play in shaping pro-environmental behaviour (e.g., Schultz and Zelezny, 1999; 2003). Third, we exploit the cross-country dimension of the dataset to investigate country-specific differences in beliefs and actions.

We employ the 2016/17 wave of the European Social Survey, which collects data on climate change attitudes and beliefs on a representative sample from 23 (mostly) European countries. We estimate bivariate linear and non-linear models on two categorical variables measuring energy saving behaviour and perceived personal responsibility about climate change. We assume that personal responsibility has an impact on actual saving behaviour, and we correct for the potential endogeneity arising between the two dimensions.

We find large heterogeneity in both beliefs and values, with richer countries being more likely to exhibit more concern about the environment. Personal responsibility and actual energy saving are positively correlated, but the correlation is not high. As regards values, self-transcendence and openness are positively correlated with responsibility, while self-enhancement and conservation are negatively correlated. Values are instead not as correlated with energy saving, since we find only a positive correlation with conservation and a negative correlation with self-enhancement. Part of the cross-country heterogeneity is absorbed in the country-specific fixed effects, which incorporate all social, cultural and institutional characteristics that are not captured in human values and socio-demographic controls.

The remainder of the paper is structured as follows. Section 2 reviews the related literature. Section 3 presents the dataset and the variables to be used in the analysis. Section 4 presents the empirical model. Section 5 reports the estimation results. Section 6 concludes. The Appendix reports details on the construction of the variables.

2. LITERATURE REVIEW

A growing body of literature has tried to unveil the determinants of pro-environmental behaviour and environmental concern attitudes.

2.1. Pro-environmental behaviour

Earlier studies paid attention to the socio-demographic profile of pro-environmental people. Their focus was on both generic behaviour and specific issues such as energy saving, green consumption, waste management, and water saving.

There is large agreement that both the active engagement in pro-environmental behaviour and the perceived seriousness of climate change are higher among females (McCright, 2010) and young people (Tjernström and Tietenberg, 2008). Vicente-Molina et al. (2013) examine students' pro-environmental behaviour in four countries (USA, Spain, Mexico and Brazil); their results indicate that males exhibit a lower "green" behavior, both in the advanced and in the emerging countries. Perceived effectiveness emerges as a relevant motivational factor that pushes students towards recycling and public transport use.

As for education, it has been found that people with higher education are more likely to be aware of the potential damage of global warming, which translates into more pro-environmental behaviour (Lozano, 2006; Olli et al., 2001; Schlegelmilch et al., 1996, Zsóka et al., 2012). Indeed, some scholars indicate that environmental knowledge is crucial for altering individual's lifestyles towards sustainability (e.g., Adomssent, 2012)¹.

Regarding income and wealth, the evidence is instead inconclusive. Domene and Sauri (2006) show that water conservation is unrelated to income. However, Renwick and Archibald (1998) provide evidence that household income is positively related with indoor water-efficient equipment. Berk et al. (1993) explore water conservation in the

¹ Kennedy et al. (2009) report that a large share of people in Canada state that their pro-environmental behavior is constrained by a perceived lack of knowledge.

San Francisco Bay Area. The authors find that home owners and people with gardens or pools are more likely to save water. According to them, some water saving initiatives require people to invest in technological gadgets, an issue that only wealthy people can afford.

Some authors have focused on the effect of incentives in promoting green behaviour. Millock and Nauges (2010) study the determinants of water-efficient equipment adoption using a sample from 10 OECD countries. They find that household size and water consumption being charged a volumetric price exert a positive effect on water-efficient equipment adoption. Buccioli et al. (2015; 2019) study the behaviour of households in terms of solid waste disposal. Buccioli et al. (2015) find a considerable improvement, in terms of waste sorting, after the introduction of a fee proportional to the amount of unsorted waste generated. Buccioli et al. (2019) show that the amount of unsorted waste produced is smaller when two households share the same bin, compared to a situation where each household is endowed with its own bin. Based on this evidence, the authors argue that peer monitoring can promote environment-friendly behaviour.

Another stream of research has been interested in the relationship between personality and pro-environmental behaviour. Psychologists have examined how personality traits affect the probability of an individual to be an environmentalist. For example, Brody et al. (2012) examine to which extent US residents are willing to change their behaviour to mitigate global warming. They find that both contextual characteristics and personality traits are the most relevant factors for explaining willingness to change longstanding behavioural patterns. Hirsch (2010) and Hirsch and Dolderman (2007) show that such traits as agreeableness and openness to experience are positively linked with environmental engagement. Similar findings are found in Milfont and Sibley (2012), who observe a significant role for conscientiousness in addition to the other two personality traits. Using a discrete choice experiment in which respondents have to choose between different forest-management plans, Soliño and Farizo (2014) show that those individuals with high open and extraverted scores exhibit a higher concern about the environment. However, larger scores on neuroticism are associated with less interest in environmental sustainability.

In a similar vein, other scholars have paid attention to the relationship between human values and attitudes about environmental issues. A common finding is that self-transcendence, which makes people feel to be an integral part of the universe, is positively related with concern for environmental problems, whereas the opposite pattern holds for

self-enhancement, which makes people concentrate mostly on themselves (Schultz and Zelezny, 2003; Milfont and Gouveia, 2006). Using data from six different countries all over the world, Schultz et al. (2005) provides evidence for the cross-cultural generalizability of this result.

Another dimension that is frequently studied is religiosity. The idea is that being religious is associated with ethics and altruism, which in turn should be tied with more concern for the environment. However, the evidence on this issue is still mixed. On the one hand, whereas some studies have found that religious people tend to show greater environmental “greenness” (Kanagy and Willits, 1993; Wolkomir et al., 1997), other scholars have indicated that measures of religious commitment such as church attendance and prayer frequency are not associated with pro-environmental behaviour (Konisky et al., 2008). On the other hand, authors like Eckberg and Blocker (1989) or Arbuckle and Konisky (2015) report a negative relationship between being a member of Judeo-Christian traditions and environmental concern.

2.2. Environmental concern

Quite different from pro-environmental behaviour is the degree of environmental concern (i.e., whether people consider global warming to be a problem or not). Stern et al. (1993) indicate that women tend to be more informed and aware of the global warming, whereas men tend to consider environmental risks to be lower (Flynn et al., 1994). Environmental concern has also been found to depend on age, with older people tending to value the environment less (Hersch and Viscusi, 2006) and on the business cycle. With this respect Kahn and Kotchen (2010) show that, in periods of high unemployment rates and lower levels of income, people attach lower importance to the global warming than in economic expansion periods. Similar evidence is found in Dienes (2015) when looking at the consequences of the recent economic crisis.

A common finding in the literature is that climate change beliefs are positively associated with personal experiences with extreme weather events (e.g., Dai et al., 2015)². Attitude towards global warming strongly depends on threat perception (Lam, 2006) and perceived consequences (Krosnick et al., 2008). For example, Zaval et al. (2014) indicate

² However, it appears that the influence of extreme events on environmental concern varies with the type of event experienced. Whitmarsh (2008) show that flood victims differ very little from other people in their climate change concern, whereas those who suffer air pollution consider climate change as a salient risk are more willing to take action.

that both belief and concern about global warming are linked to present temperature abnormalities. Li et al. (2011) conduct an interesting study on the effect of current day's temperature on climate change beliefs in Australia and the United States. The authors find that people who declare that the temperature the day they were interviewed was warmer than usual exhibit greater concern about global warming and donated more money to a global-warming charity.

Media coverage about extreme weather events and global warming also plays a key role on environmental concern (e.g. Yin, 1999). Nevertheless, news tend to be interpreted based on ideological identification about the topic (Lenz, 2009). In fact, perceptions about the seriousness of climate change are more related to elite cues from politicians and mobilization from advocacy groups rather than science-based information (Brulle et al., 2012).

Another strand of the literature looks at the relation between environmental concern and political ideology. This relationship has been examined for different countries around the world such as Australia (e.g., Tranter, 2013), Canada (e.g., Lachapelle et al., 2012), the United States (e.g., Hamilton, 2011) and the United Kingdom (e.g., Clements, 2012a; 2012b), among others. Tranter (2013) shows that supporters to the Labor Party or the Greens in Australia are more likely to believe that global warming constitutes a serious threat to their lives. Therefore, left-handed Australians are more concerned about climate change than their right-handed counterparts. Lachapelle et al. (2012) document that supporters of the Conservative Party in Canada are less likely to consider that global warming is well-founded. Clemens (2012a; 2012b) finds that British right-handed people are more sceptical about climate change. As opposed to Liberal Democrat supporters, Conservative Party supporters attach lower importance to the negative impacts of global warming. Similar findings are reported in the studies by Poortinga et al. (2011) and Whitmarsh (2011). Nevertheless, the largest political divide on climate change is found in the USA, where Liberals and Democrats show greater personal concern about climate change (Hamilton, 2011). This finding has been justified by Conservatives and Republicans exhibiting larger support for the maintenance of the societal status quo (McCright And Dunlap, 2011).

Other studies have explored the connection between political party identification and pro-environmental behaviour using cross-national data from several countries. Using a large dataset for 26 countries, Tjernström and Tietenberg (2008) document that the perceived dangerousness of climate change is strongly associated with a liberal political

view. In a similar way, Kvaløy et al. (2012) find that the attached importance of global warming is higher for extreme left supporters than centre or right voters. McCright et al. (2016) find that left-handed citizens exhibit a stronger belief in climate change than right-handed individuals for a sample of 14 Western European countries. Ziegler (2017) studies climate change beliefs and attitudes in the USA, Germany and China. His results indicate that beliefs and attitudes toward climate change are lower in the USA than in Germany and China. Chinese respondents that belong to the Communist Party and US and German respondents with high green identification are willing to pay a price premium for climate-friendly products. The author concludes that environmental values are more important for explaining climate change beliefs than political orientation. However, environmental values and political views may be intertwined. Campbell and Kay (2014) suggest that both left-wing and right-wing individuals consider that the climate is actually changing, but right-wing people seem to be more averse to the proposed solutions to the problem, which might go against their worldview and threaten system functioning.

2.3. Link between pro-environmental behaviour and environmental concern

Research in social psychology indicates that norms must be activated to influence people in a particular direction. In our study context, for enhancing people to engage in active pro-environmental behaviour, their awareness about their responsibility in global warming plays a crucial role. Mitigation behaviour then depends on environmental concern (e.g., Zaval et al., 2014). In this sense, some recent studies have put emphasis on the existing disparities between stated beliefs and manifested actions regarding the environment. Gilg and Barr (2006) study environmental attitudes in terms of water saving, green consumption and waste management at home. They show that energy saving behaviour is positively associated with the belief that environmental problems can be a serious threat to personal's welfare.

Some scholars have addressed how encouraging people about the importance of energy reduction translates into pro-environmental behaviour. Joireman et al. (2010) conduct three different studies in which they find that priming participants with health-related cognitions and anchoring them about future increases in global temperatures are positively associated with the willingness to pay to reduce global warming. Similarly, Spence et al. (2014) frame people with energy reduction in terms of CO₂. The authors find that doing so increased climate change salience and intentions to undertake environmental behaviour among participants.

The most relevant works for us are Dienes (2015), Hornsey et al. (2016) and Nauges and Wheeler (2017). Dienes (2015) uses household data from a sample of 35 countries to find a positive link between climate change concern and a broad range of actions meant to reduce its effects, such as limiting car use, reducing energy or water consumption, and separating waste for recycling. Hornsey et al. (2016) run a meta-analysis based on polls and academic studies, finding that climate change beliefs have only a small impact on the willingness to act in an environment-friendly way. They also find that ideologies, political views and values correlate with climate change beliefs more than socio-demographic variables and exposure to extreme weather events. Based on this, Nauges and Wheeler (2017) are the first to consider the potential endogeneity between climate change concerns and water and energy mitigating behaviour. Using household data from a sample of 11 countries, they find that concerns generally induce mitigating actions. They also show that higher income households are less likely to undertake energy curtailment behaviour, whereas educated and older people engage more with mitigation behaviour.

In this paper, we aim to extend the analysis in Nauges and Wheeler (2017) and provide a more complete representation of the link between personal responsibility about climate change and actual behaviour regarding energy saving using a large dataset including 23 countries.

3. DATA

Our dataset is drawn from the 2016/17 wave (Round 8) of the European Social Survey (ESS). This is a survey directed to a representative sample of residents over a large number of countries, mostly within the European borders (23 countries in the wave we consider)³. The questionnaire comprises 8 sections and covers behaviour, opinions and attitudes towards several topics such as immigration, politics, life satisfaction, the public sector or the labour market, among others. Respondents are presented with several statements about different issues and asked to indicate their opinion, mostly on a 0-10 Likert scale. To facilitate understanding, after each question respondents are shown a card

³ The 23 countries are: Austria, Belgium, Czech Republic, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Russia, Slovenia, Spain, Sweden, Switzerland and United Kingdom. Israel and Russia are the only countries outside Europe.

with the different possible answers and the coding of the Likert scale whenever necessary. Detailed socioeconomic information is also gathered in the survey.

A total of 44,387 individuals participated in the 2016/17 wave. After having removed missing values on the variables under investigation, our dataset comprises 29,856 valid observations that we use throughout the analysis. We also employ sampling weights provided by ESS to make the sample representative of the European population.

3.1. Dependent variables

The 2016/17 wave is the first to include a module on climate change and energy saving. Its purpose is to assess Europeans' opinions about climate change and their pro-environmental behaviour. To this end, respondents are firstly asked about the frequency by which they take actions to save energy. More specifically, they are asked the following question:

“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?”

Possible answers range from 1 to 6 on a Likert scale, where 1 means “Never” and 6 means “Always”. Since the frequency of the 1-2 answers is small, we combine them and create a new variable (denoted as *saving*) taking five possible values. The distribution of the answers is shown in panel a) of Figure 1. The figure shows that the largest shares of respondents indicate moderate levels of energy saving. In addition, we notice that the distribution of answers is skewed as the fraction of people stating they save more energy is higher than the corresponding fraction of people stating they save less energy.

Respondents are then asked the following question:

“To what extent do you feel a personal responsibility to try to reduce climate change?”

Possible answers range from 0 to 10 on a Likert scale where 0 means “Not at all” and 10 means “A great deal”. Also here, since the frequency of answers for some options is small, we opted for combining them into a new variable (*responsibility*) that also takes

five possible values⁴. Panel b) of Figure 1 shows the distribution of the answers. In this case, it can be seen that answers are more concentrated in categories 3 and 4.

It is important to note that the question about personal responsibility regarding climate change is asked only after individuals answered to their energy saving behaviour. This was intended to avoid framing effects in which individuals become aware of the focus of the section and adjust their answers accordingly.

FIGURE 1 ABOUT HERE

Comparison of the answers provided to the two questions reveals a small positive correlation (0.21). Interestingly, there are some individuals for whom low responsibility is associated with high saving. For some others, the pattern is just the reversal: high personal responsibility but low energy saving.

We also observe large cross-country heterogeneity. Figure 2 shows the country-average values of the two dimensions, in comparison with predictions from a linear regression of *saving* on *responsibility*. The average of *saving* is higher than the prediction in 13 out of 23 countries, almost exclusively from the Centre-South of the continent.

FIGURE 2 ABOUT HERE

In Table 1 we show the average levels of *responsibility* and *saving* separately by country, together with their per capita GDP in USD (Source: World Bank)⁵. Czech Republic and Hungary are the two most remarkable cases of discrepancy, as they report average *saving* above average *responsibility* by no less than 0.7 points. In the table we divide the countries in four groups, depending on their ranking in these two dimensions. Specifically, we check if the country is above or below the median country in each dimension. This way we have Group (1) including (Western) countries with above-median levels of both *responsibility* and *saving*, and Group (4) including (mostly Eastern) countries with below-median levels of both *responsibility* and *saving*. The remaining groups include countries with above-median levels of *saving* (Group 2, made of Central-

⁴ Value 1 combines the original values 0-2; value 2 combines the original values 3-4; value 3 combines the original values 5-6; value 4 combines the original values 7-8; value 5 combines the original values 9-10. Using different combinations of values our findings remain the same; results are available upon request.

⁵ https://data.worldbank.org/indicator/ny.gdp.pcap.cd?year_high_desc=true (accessed March 19 2019).

Southern countries) or *responsibility* (Group 3, mainly made of Northern countries) only. A clear pattern emerges. We notice that countries with a higher GDP level typically feel more responsibility, in line with Franzen and Meyer (2009) who argue that people living in richer societies are more likely to exhibit post-material values including concern for the environment. It is however interesting to note that, although the correlation between GDP and *responsibility* is relatively high (0.60), the correlation between GDP and *saving* is much lower and even negative (-0.26). In fact, countries in Group (3) are generally rich and report high *responsibility*; however, they also indicate relatively low energy saving behaviour.

TABLE 1 ABOUT HERE

3.2. Explanatory variables and summary statistics

In addition to the linkages between personal responsibility and energy saving, we consider three groups of explanatory variables: human values, socio-demographics and further controls. The variables are defined and summarised in Table 2.

Human values

ESS implements a “human values scale” meant to measure the value orientations of the respondent based on agreement to a set of 21 statements describing a hypothetical person. We refer the reader to the Appendix for a description of the scale and the construction of the indexes. We aggregate the measures in the form of higher-order values and consider the following four values in a 1-6 scale: *transcendence*, the attitude to transcend one's concerns and promote the welfare of others; *enhancement*, the attitude to enhance personal interests; *openness*, the attitude to pursue whatever desired intellectual or emotional directions; and *conservation*, the attitude to preserve the current personal environment. These variables are supposed to represent the major different orientations that are recognised across cultures. Interestingly, we found at the country level high correlation of *responsibility* with *transcendence* (0.71) and *enhancement* (-0.56).

Socio-demographics

Several socio-demographic variables are used as controls. More specifically, we consider age (a squared polynomial), gender, marital status, presence of children, high or

low level of income⁶, employment status, self-assessed health condition, and living in a small or big city. All of them are defined as dummy variables except age.

Further controls

To control for further sources of observable heterogeneity, we also include the variable *religiosity*, measured on a 0-10 discrete scale where 0 means “Not at all religious” and 10 means “Very religious”. This variable is added to the analysis because, as argued in Section 2, it is frequently considered a determinant of environmental concern and pro-environmental behaviour. Similarly, we control for political orientation by means of the variable *right-wing*, which is recorded over a 0-10 discrete scale where 0 means “Left” and 10 means “Right”⁷. Finally, we add a dummy variable for whether the respondent declares to spend more than 30 minutes on a typical day to watch, read or listen to news about politics and current affairs (denoted as *news*).

TABLE 2 ABOUT HERE

4. EMPIRICAL MODEL

In this section, we describe the empirical model to be estimated. We first provide a brief discussion of our modelling approach; we then present the model formally.

Our two key variables (*responsibility* and *energy saving*) are assumed to be a function of the value and socio-demographic variables presented in Section 3. Since these two measures of *responsibility* and *energy saving* are discrete ordinal indicators, the natural way to describe them is by means of non-linear models such as an Ordered Probit Model. Hence, we could use two independent univariate models. However, it might be the case that the two variables share some common unobserved factors, so that the error terms are likely to be correlated. Accordingly, the two equations need to be jointly estimated to

⁶ ESS does not record actual income, but asks the following question: “Using this card, please tell me which letter describes your household’s total income, after tax and compulsory deductions, from all sources? If you don’t know the exact figure, please give an estimate. Use the part of the card that you know best: weekly, monthly or annual income.” The respondent then sees a country-specific card, with 10 possible options. We define as “high income” an answer in the top 20% (options 9 and 10) and “low income” an answer in the bottom 20% (options 1 and 2). This way we avoid depending on different currencies and different purchasing powers.

⁷ The exact wording of the question posit by the ESS was: “In political matters people talk of “the left” and “the right”. How would you place your views on this scale?”.

avoid biased parameter estimates. In addition, we assume that personal beliefs on personal responsibility exert an effect on actual energy saving behaviour. In other words, we believe that saving behaviour depends on the individual's self-reported personal responsibility. Hence, *responsibility* enters as a further explanatory variable for *saving*.

By construction, if the error terms of the two equations are allowed to be correlated, the inclusion of *responsibility* as an explanatory variable in the *saving* equation generates endogeneity, as orthogonality between *responsibility* and the error term in the *saving* equation is not fulfilled. As such, a Seemingly Unrelated Bivariate Ordered Probit (SUBOP) model would lead to inconsistent parameter estimates. To account for this, we consider a Simultaneous Bivariate Ordered Probit Model (SBOP) model that explicitly addresses the fact that *responsibility* is not exogenous in the *saving* equation.

4.1. A Simultaneous Bivariate Ordered Probit (SBOP) model

Let us assume that our ordered dependent variables come from two latent unobservable variables, *responsibility*^{*} and *saving*^{*}, so that our model is given by:

$$\begin{cases} \text{responsibility}_i^* = X_{1i}'\beta_1 + \varepsilon_{1i} \\ \text{saving}_i^* = \gamma \text{responsibility}_i^* + X_{2i}'\beta_2 + \varepsilon_{2i} \end{cases} \quad (1)$$

where subscript *i* stands for each individual in the sample, X_1 and X_2 are two vectors of explanatory variables that might share some but not all the covariates, β_1 and β_2 are vectors of parameters to be estimated, γ is the parameter that measures the effect of *responsibility*^{*} on *saving*^{*}, and ε_{1i} and ε_{2i} are two error terms that follow a bivariate standard normal distribution so that $\varepsilon \sim N(0, \Sigma)$ where $\Sigma = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$ and ρ is the correlation between the error terms.

We only observe the categorical variables *responsibility* and *saving*, whose observation mechanism is given by:

$$\begin{cases} \text{responsibility}_i = J \\ \text{saving}_i = K \end{cases} \quad \text{if} \quad \begin{cases} \text{responsibility}_i^* \in (\theta_{1,J-1}, \theta_{1,J}] \\ \text{saving}_i^* \in (\theta_{2,K-1}, \theta_{2,K}] \end{cases}$$

for $J, K \in \{1, 2, 3, 4, 5\}$, with $\theta_{1,J}, \theta_{2,K}$ unknown threshold parameters that need to be estimated and that satisfy the following rules: $\theta_{1,0} \rightarrow -\infty$, $\theta_{1,5} \rightarrow +\infty$, and $\theta_{1,J-1} < \theta_{1,J}$ for the first set of thresholds and identically for the second one.

The joint probability that $responsibility_i = J$ and $saving_i = K$ is then given by:

$$\begin{aligned} & \Pr(responsibility_i = J, saving_i = K) \\ &= \Pr(\theta_{1,J-1} < responsibility_i^* \leq \theta_{1,J}, \theta_{2,K-1} < saving_i^* \leq \theta_{2,K}) \\ &= \Pr(responsibility_i^* \leq \theta_{1,J}, saving_i^* \leq \theta_{2,K}) - \Pr(responsibility_i^* \leq \theta_{1,J-1}, saving_i^* \leq \theta_{2,K}) \\ & \quad - \Pr(responsibility_i^* \leq \theta_{1,J}, saving_i^* \leq \theta_{2,K-1}) - \Pr(responsibility_i^* \leq \theta_{1,J-1}, saving_i^* \leq \theta_{2,K-1}) \end{aligned}$$

Due to the endogeneity of *responsibility*, it is required that X_1 includes at least one variable that is absent from X_2 for parameter identification (Sajaia, 2008). If we do not impose this exclusion restriction, the system in Equation (1) is not identified⁸. This exclusion restriction for the SBOP model needs to fulfil the same characteristics as instrumental variables in a linear setting, namely, the instruments must be highly correlated with the treatment indicator (*responsibility*^{*}) and orthogonal to the error term in the outcome equation (*saving*^{*}). We consider the variables *right-wing* and *news* as two candidate instruments to be included in the *responsibility* equation but excluded in the *saving* equation. We choose these variables as instruments following the vast literature showing a direct link with environmental concern, as discussed in Section 2. In the following section we justify the validity of these two instruments from a statistical point of view.

The model is estimated using Full Information Maximum Likelihood (FIML). This approach has been shown to provide better results than alternative two-stage least squares, independent Ordered Probit regressions or two-steps procedures in Monte Carlo simulations under the assumption of the error terms being bivariate normally distributed (Sajaia, 2008)⁹. A likelihood ratio test for the statistical significance of the correlation

⁸ Although Wilde (2000) shows that identification is achieved even if the set of explanatory variables are the same in the two equations for the Bivariate Probit case, this is not the case in the simultaneous Bivariate Ordered Probit model.

⁹ Rivers and Vuong (1988) originally proposed a two-step method for simultaneous bivariate modelling in which the estimated residuals from the first-stage regression are added as an explanatory variable in the second equation to obtain consistent estimates. However, an adjustment for the variance-covariance matrix is required. Since it directly takes into account the full covariance structure of the error terms, the FIML estimator is more efficient.

parameter between the error terms ρ (i.e., $H_0 : \rho = 0$) is a test of the exogeneity of *responsibility* on *saving*. If we do not reject the null, the log-likelihood function for the system in Equation (1) can be written as the sum of the log-likelihood of two univariate Ordered Probit models. As a result, the two equations could be estimated separately.

5. RESULTS

We first assess the validity of the instruments employed by estimating linear OLS and IV regressions. We then present the results from the non-linear SUBOP and SBOP models. Before doing that, we point out that all the regressions use White robust standard errors and incorporate country fixed effects to capture country-specific aspects such as average climate, institutional and cultural settings. In what follows, we take the convention to comment on coefficients that are significant at least at the 5% level.

Table 3 reports the results from the linear regression. This methodology is in line with Nauges and Wheeler (2017), who studied climate change concerns and mitigation behaviour in a sample of OECD countries. In the bottom of the table, we report the values of two tests (Kleibergen-Paap and Hansen) for assessing the adequacy of the instruments employed. The successful application of our modelling approach depends on the validity of the instruments employed. The two instruments (*right-wing* and *news*) pass these tests so that we have evidence that they are adequate for the treatment of endogeneity.¹⁰ One further test (Hausman test) rejects the null hypothesis at all significance levels, suggesting that indeed there is a problem of endogeneity and instruments should be used. Hence, we consider the instruments to be valid and necessary to correct for endogeneity bias. Based on the IV regression in Column (3), there is evidence of a positive correlation between *responsibility* and *saving*, with a 1-point increase in *responsibility* being associated to a 0.735-point increase in *saving*.

TABLE 3 ABOUT HERE

¹⁰ Specifically, the Kleibergen-Paap test rejects the null hypothesis at all significant levels, finding evidence of relevant instruments; the Hansen test accepts the null hypothesis at the 10% significance level finding evidence of exogenous instruments.

5.1. Main results

Once we have assessed the validity of the instruments, we now turn to discuss the estimates from the SUBOP and SBOP models shown in Table 4. Columns (1) and (2) report the coefficient estimates from the SUBOP model, while Columns (3) and (4) report the coefficient estimates from the SBOP model.

Responsibility

We first discuss the results for the *responsibility* equation in Columns (1) and (3), whose findings are similar. Starting with the instruments, right-wing people are significantly less likely to feel a personal responsibility towards climate change. This finding is consistent with previous studies, which argue that conservative people are less environmentally concerned (among others see Clements, 2012a; 2012b; Lachapelle et al., 2012; Tranter, 2013). Conversely, individuals who spend more than 30 minutes a day watching, reading or listening to news about politics and current affairs perceive themselves to be more responsible for climate change. Accordingly, information about climate change seems to play a key role for enhancing personal responsibility, as argued by Linden et al. (2006) and Yin (1999).

Personal responsibility is positively associated with both Self-Transcendence and Openness and negatively related with Self-Enhancement and Conservation. These findings are plausible, and in line with previous literature (e.g., Schultz and Zelezny, 1999; 2003; Schultz et al., 2005). They indicate that open-minded and (especially) altruistic individuals are more likely to be concerned about the environment. In contrast, selfish individuals and individuals that are more resistant to changes show less concern.

Personal responsibility increases with age, although at a decreasing rate. This result does not necessarily contradict the ones by Hersch and Viscusi (2006), who found that elderly people care less about the environment. The estimates suggest that the relationship between personal responsibility and age is an inverse U-shape so that people in middle ages are the ones who feel more guilt for climate change. Using the coefficients in Column (3), the turning age is around 45 ($100 * 2.271 / (2 * 2.495)$).

Consistent with Stern et al. (1993), females are significantly more concerned about their responsibility in climate change. Highly educated individuals are significantly more likely to be concerned about their role in climate change, in line with Lozano (2006) and Zsóka et al., (2012). One of the most argued reasons for the general low levels of awareness about the importance of the global warming is that people mispredict the utility

consequences, especially low-educated people (Welsch and Kühling, 2010). Hence, education constitutes a valid tool for fostering global warming awareness.

Responsibility is also positively associated with income. However, labour status appears to have no effect on environmental concern. Interestingly, people in good health conditions and religious people feel more responsible for climate change. Something similar holds for people living in small cities, who hold a significantly higher degree of responsibility for the state of the environment than those living in medium and big cities.

Saving

We now turn to the results for the saving equation. Based on the estimates from the SUBOP model in Column (2), which assumes responsibility is exogenously given, it seems that the more responsible you feel about climate change, the less energy you save. Females, married people, people with high levels of education, those in good health conditions and religious individuals save more energy. Energy saving increases up to around age 59 ($100 \cdot 3.023 / (2 \cdot 2.551)$) and falls with high income. As regards human values, the same pattern observed on *responsibility* emerges here, with the exception of Conservation that is no longer significant.

However, when we take into account the endogeneity of responsibility on saving energy behaviour, a different picture emerges from Column (4). As for the role of personal responsibility on energy saving, the effect is just the opposite: a higher degree of personal responsibility translates into higher saving behaviour. This finding makes sense and is consistent with some previous literature (Ek and Söderholm, 2010; Gilg and Barr, 2006; Nauges and Wheeler, 2017). Since we found evidence of the existence of endogeneity, the difference in sign and magnitude between the estimated effect of responsibility on saving between the SUBOP and the SBOP models clearly indicates that the parameter estimate is seriously biased in the SUBOP model. This highlights the importance of controlling for endogeneity when assessing the relationship between environmental attitudes and actual behaviour.

In contrast to the SUBOP model, estimates from the SBOP model indicate that energy saving behaviour is more likely in people who score high in Conservation and low in Self-Enhancement. Results are also in contrast with our findings for *responsibility*, where the effect of Conservation was negative, and where we found effects for such human values as Self-Transcendence and Openness. It is still confirmed that selfish individuals care less

about the environment; however, we now see that people more inclined to preserve cultures, ethics and traditions save energy to a larger extent.

If we look at the effect of socio-demographics on saving in the SBOP model, we now see that gender, marital status and education lose their significance. The same happens with good health status. Hence, contrary to some previous evidence, it seems that basic socio-demographic characteristics are not correlated with actual energy saving conditional on personal responsibility. Gender and education significantly matter for explaining environmental concern and their effect on actual pro-environmental behaviour operates through it. The effect of age continues to be positive, but linear. Accordingly, older people are the ones who mostly engage in energy saving behaviour, as in Nauges and Wheeler (2017). Now it seems that people with children save more energy, possibly as a way of teaching their young kids how to behave.

Interestingly, income continues to exhibit a negative relationship with saving behaviour. This result is also found in Nauges and Wheeler (2017). Accordingly, our results show that whereas high-income people are more concerned about climate change, they then save less energy. This suggests that the existing mixed evidence on the relationship between income and environmental behaviour found in the literature can be due to its different effect on concerns and actions undertaken.

The same striking pattern exists with religious people. Although they declare to feel highly responsible for climate change, they do not translate their concerns into action since they are negatively related with energy saving. As it happens with income, the inconclusive evidence on the effect of religiosity on environmental behaviour discussed in Section 2 might be partially explained by our results. Religious people feel more responsible, but they declare to save less energy.

Correlation between the two equations

The correlation parameter (ρ) between the error terms in the two equations is significantly negative when endogeneity is accounted for. This indicates that common unobserved factors operate in opposite directions. An example of these common unobserved factors is beliefs about what other people (friends, neighbours, relatives) do. There is substantial evidence that points to the important role of social interactions in environmental attitudes and behaviour (Ek and Söderholm, 2010). It might happen that people become more aware about their responsibility on facing climate change due to their exposure to other people feeling concern about the problem. However, if they

perceive other people do not put this into practice, individuals may consider their effort is not worthwhile and behave in the same fashion.

TABLE 4 ABOUT HERE

5.2. Cross-country comparison

One of our purposes was to analyse the differences in environmental responsibility and energy saving behaviour across countries. As argued by several authors, environmental problems are not perceived in the same way in all countries (Diamantopoulos et al., 2003). Differences in social norms (Allcott and Rogers, 2014) and cultural and ideological factors (Ramos et al., 2015) can explain differences in environmental concern at the societal level.

Figure 3 plots a geographical map with the average probability of indicating high responsibility (panel a) and high saving (panel b) based on predictions from the SBOP model in Table 4. Specifically, darker colours denote higher predicted probabilities to report options 4 or 5 in the *saving* or *responsibility* variables. We confirm the view that Western countries generally perform high in both dimensions, in line with the findings of Chaisty and Whitefield (2015). The most striking evidence from the comparison between the two panels is the different behaviour of Northern countries, which rank high in *responsibility* but *low* in saving.

FIGURE 3 ABOUT HERE

Figure 4 plots the same probabilities, computed by setting to zero the country dummies. As a result, the probabilities remove country differences that are not captured by the observed variables, and show the average for a representative country (our baseline is Russia) and its specific values and socio-demographic characteristics. It is interesting to note that, removing country-specific unobserved differences, Northern countries improve their predicted probabilities on energy saving. One possible explanation is that these countries set a higher reference goal, and therefore interpret whatever they do as too little. As regards the other countries, we find mixed evidence but, in general terms, we confirm the ranking provided in the estimates from Figure 3. Countries in Central Europe exhibit high scores for both *responsibility* and *saving*.

As a consequence, it seems that not in all the countries the correlation between concern and energy saving is the same. To further investigate this issue, we replicate the benchmark analysis of Table 4, Columns (3)-(4), in two sub-samples of data, represented by the countries belonging to Groups (1) and (4) defined in Section 3, i.e., countries performing high in both *responsibility* and *saving* (Group (1)) and countries performing low in the same variables (Group (4)). Results are shown in Appendix Table A1.

From the comparison with the benchmark analysis in Table 4 we document two findings in these “extreme” groups of countries. First, fewer socio-demographic control variables are significant in both equations, which indicates that our dependent variables show less heterogeneity. Second, the correlation between the error terms in the two equations is not significant, which suggests that the unobserved factors explaining *responsibility* are different from the ones explaining *saving*. The latter result, in particular, seems to indicate that unobserved drivers of *responsibility* and *saving* tend to be the same in countries that are neither too “naïve” nor too “mature” in their attitude toward the environment.

6. CONCLUDING REMARKS

In this paper, we have examined the linkage between self-assessed personal responsibility in climate change and energy saving behaviour. Based on a large dataset for 23 countries from the European Social Survey, in our analysis we have also paid key attention to human values and cross-country differences to explain the heterogeneity in savings and beliefs.

Once accounting for the existence of endogeneity, our results show that increases in climate change concerns impact positively on energy saving behaviour. Right-wing people exhibit lower levels of climate change concern whereas females and people with high education are more likely to feel responsible for climate change. People with high income are more concerned but save less energy. The same pattern holds for religious people. Responsibility increases with age at a decreasing rate while saving is more widespread among elderly people. Responsibility is positively associated with Self-Transcendence and Openness values whereas saving behaviour is more likely to emerge among people with high scores of Conservation. Unobserved factors that affect both dimensions appear to be positively related.

From an econometric point of view, we have estimated a Simultaneous Bivariate Ordered Probit Model that controls for the correlation between the error terms of the two dependent variables and at the same time addresses the endogeneity of responsibility on the saving equation. We have compared our results with a naïf SUBOP model that ignores the existence of endogeneity and shown how the effect of responsibility on saving would be poorly estimated if endogeneity was not controlled for.

Furthermore, we have assessed cross-country differences in both personal responsibility (beliefs) and energy saving (behaviour). First, we have computed the predicted probability of scoring high values for each variable. Setting the country fixed effects to zero to remove differences in reference goals, we found that Western countries are the ones that perform better in both beliefs and behaviour. Second, we have estimated our model for the two extreme groups of countries. The estimates indicate that the relationship between environmental concern and behaviour is not homogeneous across countries.

Our results have several relevant policy implications. On the one hand, the positive relationship between beliefs and actions seems to suggest that in order to achieve global warming mitigation goals it is essential to increase the level of public awareness about the climate change problem. By increasing the level of personal responsibility, it is likely that people will undertake energy saving actions. However, since beliefs are negatively related to right-wing political orientation, policies should target the relevance of global warming among these individuals. Similarly, the fact the saving behaviour is higher among elderly people suggest that campaigns about the importance of saving energy should be specifically oriented to young people.

Our study presents at least two limitations. First, our analysis is based on self-reported behaviour and beliefs, which not necessarily coincide with actual behaviour. A possible bias might arise because a socially desirable habit is likely to be over-reported. Conversely, actual behaviour could be understated in countries (such as Northern ones) where environmental concern is of widespread and considered of fundamental importance, so that whatever action is taken is never seen as sufficient. Second, our study relies on cross-sectional data, which cannot address the dynamics of beliefs and actions. A possible avenue for future research could then be to explore the linkage between these two variables using longitudinal data, to see how changes in beliefs could drive changes in actions over time. In addition, our study focuses on energy saving behaviour. Extending

our analysis to other types of energy use such as waste management or water consumption could provide a broader picture of attitudes and behaviour towards sustainability.

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APPENDIX

A. Human values scale

The European Social Survey includes a 21-item question meant to determine human value orientations, following the scale originally developed in Schwartz (1992)¹¹. Subjects hear the description of a generic third person, and have to indicate whether they feel to be similar. The question is shown in two gender-specific variants. The one below is presented to males.

«Now I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer.

- A Thinking up new ideas and being creative is important to him. He likes to do things in his own original way.
- B It is important to him to be rich. He wants to have a lot of money and expensive things.
- C He thinks it is important that every person in the world should be treated equally. He believes everyone should have equal opportunities in life.
- D It's important to him to show his abilities. He wants people to admire what he does.
- E It is important to him to live in secure surroundings. He avoids anything that might endanger his safety.
- F He likes surprises and is always looking for new things to do. He thinks it is important to do lots of different things in life.
- G He believes that people should do what they're told. He thinks people should follow rules at all times, even when no-one is watching.
- H It is important to him to listen to people who are different from him. Even when he disagrees with them, he still wants to understand them.
- I It is important to him to be humble and modest. He tries not to draw attention to himself.
- J Having a good time is important to him. He likes to “spoil” himself.
- K It is important to him to make his own decisions about what he does. He likes to be free and not depend on others.
- L It's very important to him to help the people around him. He wants to care for their well-being.

¹¹ Schwartz, S. H. (1992). Universals in the content and structure of values: Theory and empirical tests in 20 countries. In M. Zanna (Ed.), *Advances in experimental social psychology*, Vol. 25, pp. 1-65. New York: Academic Press.

- M Being very successful is important to him. He hopes people will recognise his achievements.
- N It is important to him that the government ensures his safety against all threats. He wants the state to be strong so it can defend its citizens.
- O He looks for adventures and likes to take risks. He wants to have an exciting life.
- P It is important to him always to behave properly. He wants to avoid doing anything people would say is wrong.
- Q It is important to him to get respect from others. He wants people to do what he says.
- R It is important to him to be loyal to his friends. He wants to devote himself to people close to him.
- S He strongly believes that people should care for nature. Looking after the environment is important to him.
- T Tradition is important to him. He tries to follow the customs handed down by his religion or his family.
- U He seeks every chance he can to have fun. It is important to him to do things that give him pleasure.»

Possible answers are presented in a six-point Likert scale: “Very much like me” (1), “Like me” (2), “Somewhat like me” (3), “A little like me” (4), “Not like me” (5), “Not like me at all” (6). In addition, it is allowed to report “Refusal” (7), “Don't know” (8) or “No answer” (9). We consider these answers as missing values.

We assign the reverse code (i.e., 1 becomes 6, 2 becomes 5, etc.) to each item, so that a higher score indicates closer connection to the statement. Answers are then classified in ten basic value orientations, each defined as the mean of two or three items. A short definition of the ten values, with an indication of the underlying items, follows:

- *Achievement* (items D, M): Personal success through demonstrating competence according to social standards.
- *Benevolence* (items L, R): Preservation and enhancement of the welfare of people with whom one is in frequent personal contact.
- *Conformity* (items G, P): Restraints of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms.
- *Hedonism* (items J, U): Pleasure and sensuous gratification for oneself.

- *Power* (items B, Q): Social status and prestige, control or dominance over people and resources.
- *Security* (items E, N): Safety, harmony and stability of society, of relationships, and of self.
- *Self-direction* (items A, K): Independent thought and action-choosing, creating, exploring.
- *Stimulation* (items F, O): Excitement, novelty, and challenge in life.
- *Tradition* (items I, T): Respect, commitment and acceptance of the customs and ideas that traditional culture or religion provide the self.
- *Universalism* (items C, H, S): Understanding, appreciation, tolerance and protection for the welfare of all people and for nature.

It is possible to also consider a structural representation of the values, grouping the ten values into four higher-order values. Each higher-order value is made of the average of the corresponding values:

- *Self-transcendence*: Benevolence, Universalism
- *Self-enhancement*: Achievement, Power
- *Openness to change*: Hedonism, Self-direction, Stimulation
- *Conservation*: Conformity, Security, Tradition

The higher-order values can be summarised with two orthogonal dimensions: *Self-transcendence* vs. *Self-enhancement*, or concern for the welfare and interests of others against self-interests; *Openness to change* vs. *Conservation*, or independent action, thought and feeling and readiness for new experience, against self-restriction, order and resistance to change.

In this analysis, for parsimony we take this approach and refer to the four higher-order values.

B. Analysis by group of countries

In Table A1 we replicate the benchmark analysis of Table 4, Columns (3)-(4), in two sub-samples of data, represented by the countries belonging to Groups (1) and (4) defined in Section 3. To repeat, Group (1) includes countries performing high in both *responsibility* and *saving*, while Group (4) includes countries performing low in the same

variables. We exclude the countries in Groups (2) and (3) whose regression outputs are more similar to the benchmark case of Table 4. However, results are available upon request.

Table A1. Results from SBOP regressions, by country group

Dep. variable Group	(1) Responsibility High Responsibility, High Saving	(2) Saving High Saving	(3) Responsibility Low Responsibility, Low Saving	(4) Saving Low Saving
Responsibility		0.547*** (0.138)		0.515** (0.259)
Right-wing	-0.036*** (0.007)		-0.017*** (0.005)	
News	0.102*** (0.024)		0.066* (0.036)	
Self-Transcendence	0.474*** (0.024)	-0.012 (0.086)	0.180*** (0.024)	0.117 (0.079)
Self-Enhancement	-0.070*** (0.015)	-0.067*** (0.022)	-0.053*** (0.018)	-0.096*** (0.035)
Openness	0.093*** (0.018)	0.048* (0.026)	0.106*** (0.021)	-0.035 (0.036)
Conservation	-0.106*** (0.018)	0.092*** (0.024)	-0.117*** (0.023)	0.150*** (0.029)
Age	2.736*** (0.419)	1.641** (0.687)	0.766 (0.498)	0.895 (0.633)
Age ²	-2.888*** (0.422)	-0.840 (0.672)	-0.800 (0.510)	-0.363 (0.595)
Female	-0.013 (0.024)	0.039 (0.024)	0.046* (0.028)	0.022 (0.033)
Married	0.036 (0.028)	0.033 (0.029)	0.008 (0.031)	0.005 (0.031)
Children	0.002 (0.032)	-0.022 (0.032)	-0.030 (0.037)	0.085** (0.037)
College	0.163*** (0.028)	0.029 (0.040)	0.103*** (0.031)	0.034 (0.050)
High income	0.026 (0.033)	-0.135*** (0.033)	0.094** (0.040)	-0.108*** (0.041)
Low income	-0.120*** (0.037)	0.197*** (0.038)	-0.020 (0.041)	0.016 (0.042)
Employee	0.098*** (0.035)	-0.014 (0.039)	0.080* (0.042)	-0.049 (0.045)
Self-employed	0.137** (0.056)	-0.109* (0.056)	0.013 (0.072)	-0.002 (0.073)
Good health	0.027 (0.026)	0.057** (0.028)	0.052 (0.033)	-0.066* (0.034)
Religiosity	0.030*** (0.004)	-0.009 (0.006)	0.033*** (0.005)	-0.006 (0.010)
Small city	-0.035 (0.048)	-0.021 (0.049)	0.241*** (0.060)	-0.163* (0.085)
Big city	0.086** (0.036)	-0.030 (0.040)	-0.121*** (0.029)	0.034 (0.046)
Country dummies	YES	YES	YES	YES
Correlation	-0.306* (0.151)		-0.411 (0.273)	
Log pseudo-likelihood	-25,462.398		-21,251.195	
Observations	9,378		7,427	

Note. SBOP is a Simultaneous Bivariate Ordered Probit. Robust standard errors in parentheses;

*** p<0.01, ** p<0.05, * p<0.1

Table 1. Saving and responsibility, average by country and country group

Group	Responsibility	Saving	GDP
<i>(1) High Responsibility, High Saving</i>	3.535	3.407	44,698
Belgium	3.307	3.276	43,324
France	3.758	3.455	38,477
Germany	3.634	3.503	44,470
Great Britain	3.357	3.337	39,720
Spain	3.346	3.501	28,157
Switzerland	3.743	3.302	80,190
<i>(2) Low Responsibility, High Saving</i>	3.070	3.336	37,630
Hungary	2.504	3.283	14,225
Ireland	3.218	3.231	69,331
Italy	3.050	3.371	31,953
Portugal	3.300	3.475	21,136
Slovenia	3.034	3.383	23,597
<i>(3) High Responsibility, Low Saving</i>	3.440	3.111	55,209
Austria	3.330	3.089	47,291
Finland	3.569	3.220	45,703
Iceland	3.460	2.858	70,057
Netherlands	3.305	3.180	48,223
Norway	3.411	3.067	75,505
Sweden	3.530	3.101	53,442
<i>(4) Low Responsibility, Low Saving</i>	2.631	2.992	21,265
Czech Republic	2.119	3.023	20,368
Estonia	2.592	3.183	19,705
Israel	2.909	2.915	40,270
Lithuania	2.773	3.118	16,681
Poland	3.185	3.053	13,863
Russia	2.328	2.524	10,743

Note. We group countries based on their ranking in personal responsibility and energy saving. We include in Group 1 the countries that rank above the median in both responsibility and saving. We include in Group 4 the countries that rank below the median in both responsibility and saving. The remaining countries are included in Group 2 if they rank above the median on Saving, and in Group 3 if they rank above the median on Responsibility. The last column reports per capita GDP in USD as of year 2017; the source is the World Bank.

Table 2. Summary statistics (29,856 observations)

Variable	Definition	Mean	Std. Dev.	Min	Max
<i>Dependent variables</i>					
Responsibility	Personal responsibility, scale 1-5	3.205	1.215	1	5
Saving	Energy saving, scale 1-5	3.215	1.126	1	5
<i>Human values</i>					
Self-Transcendence	Self-transcendence score, scale 1-6	4.892	0.693	1	6
Self-Enhancement	Self-enhancement score, scale 1-6	3.492	1.009	1	6
Openness	Openness to change score, scale 1-6	4.091	0.846	1	6
Conservation	Conservation score, scale 1-6	4.286	0.818	1	6
<i>Socio-demographics</i>					
Age	Age /100	0.497	0.172	0.180	0.900
Age ²	(Age /100) squared	0.277	0.176	0.032	0.810
Female	Dummy =1 if female	0.509	0.500	0	1
Married	Dummy =1 if married	0.672	0.470	0	1
Children	Dummy =1 if children	0.328	0.469	0	1
College	Dummy =1 if college degree	0.274	0.446	0	1
High income	Dummy =1 if top 20% income	0.170	0.376	0	1
Low income	Dummy =1 if bottom 20% income	0.167	0.373	0	1
Employee	Dummy =1 if employee	0.621	0.485	0	1
Self-employed	Dummy =1 if self-employed	0.055	0.228	0	1
Good health	Dummy =1 if self-assessed good health	0.669	0.471	0	1
Small city	Dummy =1 if lives in a small city	0.113	0.317	0	1
Big city	Dummy =1 if lives in a big city	0.324	0.468	0	1
<i>Further controls</i>					
Religiosity	Religiosity, scale 0-10	4.440	3.089	0	10
Right-wing	Political orientation, scale 0-10 (0: left-wing, 10: right-wing)	5.116	2.198	0	10
News	Dummy =1 if spends more than 30 minutes listening to the news	0.630	0.483	0	1

Table 3. Results from linear regressions

Dep. variable Model	(1) Responsibility OLS	(2) Saving OLS	(3) Saving IV
Responsibility		0.161*** (0.006)	0.735*** (0.116)
Right-wing	-0.027*** (0.003)		
News	0.081*** (0.015)		
Self-Transcendence	0.313*** (0.013)	0.236*** (0.012)	0.047 (0.041)
Self-Enhancement	-0.049*** (0.009)	-0.098*** (0.009)	-0.068*** (0.012)
Openness	0.087*** (0.010)	0.032*** (0.010)	-0.017 (0.015)
Conservation	-0.098*** (0.011)	0.052*** (0.010)	0.114*** (0.017)
Age	2.293*** (0.245)	2.234*** (0.244)	0.870** (0.392)
Age ²	-2.551*** (0.248)	-1.562*** (0.247)	-0.073 (0.414)
Female	0.051*** (0.014)	0.038*** (0.014)	0.010 (0.017)
Married	0.025 (0.016)	0.042*** (0.016)	0.027 (0.018)
Children	-0.012 (0.019)	0.035** (0.018)	0.042** (0.021)
College	0.164*** (0.016)	0.091*** (0.015)	-0.009 (0.027)
High income	0.077*** (0.019)	-0.104*** (0.019)	-0.143*** (0.023)
Low income	-0.098*** (0.022)	0.095*** (0.021)	0.150*** (0.027)
Employee	0.036* (0.021)	0.001 (0.020)	-0.016 (0.023)
Self-employed	0.040 (0.034)	-0.061* (0.034)	-0.074* (0.039)
Good health	0.054*** (0.016)	0.031* (0.016)	0.002 (0.019)
Religiosity	0.029*** (0.003)	0.003 (0.002)	-0.012*** (0.004)
Small city	0.072*** (0.025)	-0.014 (0.025)	-0.053* (0.030)
Big city	-0.017 (0.018)	0.003 (0.017)	0.009 (0.020)
Constant	0.572*** (0.093)	0.360*** (0.089)	0.098 (0.118)
Country dummies	YES	YES	YES
Kleibergen-Paap test (p-value)			0.000
Hansen test (p-value)			0.273
Hausman-Wu test (p-value)			0.000
R-squared	0.192	0.122	
Observations	29,856	29,856	29,856

Note. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4. Results from SUBOP and SBOP regressions

Dep. variable Model	(1) Responsibility SUBOP	(2) Saving SUBOP	(3) Responsibility SBOP	(4) Saving SBOP
Responsibility		-0.330*** (0.040)		0.650*** (0.073)
Right-wing	-0.015*** (0.004)		-0.026*** (0.003)	
News	0.029** (0.014)		0.083*** (0.013)	
Self-Transcendence	0.331*** (0.013)	0.355*** (0.014)	0.326*** (0.013)	0.031 (0.040)
Self-Enhancement	-0.055*** (0.009)	-0.108*** (0.009)	-0.054*** (0.009)	-0.057*** (0.013)
Openness	0.092*** (0.010)	0.068*** (0.010)	0.092*** (0.010)	-0.018 (0.013)
Conservation	-0.105*** (0.011)	-0.005 (0.011)	-0.102*** (0.011)	0.104*** (0.012)
Age	2.331*** (0.236)	3.023*** (0.240)	2.271*** (0.236)	0.768** (0.374)
Age ²	-2.522*** (0.238)	-2.551*** (0.247)	-2.495*** (0.238)	-0.091 (0.365)
Female	0.045*** (0.014)	0.056*** (0.013)	0.047*** (0.014)	0.011 (0.015)
Married	0.028* (0.016)	0.048*** (0.015)	0.027* (0.016)	0.023 (0.016)
Children	-0.013 (0.018)	0.024 (0.018)	-0.014 (0.018)	0.038** (0.018)
College	0.165*** (0.016)	0.158*** (0.016)	0.160*** (0.016)	-0.007 (0.023)
High income	0.069*** (0.019)	-0.058*** (0.019)	0.073*** (0.019)	-0.125*** (0.018)
Low income	-0.076*** (0.021)	0.038* (0.021)	-0.077*** (0.021)	0.121*** (0.021)
Employee	0.030 (0.020)	0.015 (0.020)	0.034* (0.020)	-0.012 (0.020)
Self-employed	0.030 (0.033)	-0.043 (0.034)	0.040 (0.033)	-0.066* (0.034)
Good health	0.043*** (0.016)	0.048*** (0.015)	0.045*** (0.016)	0.006 (0.017)
Religiosity	0.027*** (0.003)	0.015*** (0.003)	0.028*** (0.003)	-0.010*** (0.003)
Small city	0.059** (0.025)	0.019 (0.024)	0.063** (0.025)	-0.041 (0.026)
Big city	-0.000 (0.017)	-0.001 (0.017)	-0.005 (0.017)	0.001 (0.018)
Country dummies	YES	YES	YES	YES
Correlation		0.551*** (0.042)		-0.477*** (0.082)
Log pseudo-likelihood		-83,584.702		-83,590.243
Observations		29,856		29,856

Note. SUBOP is a Seemingly Unrelated Bivariate Ordered Probit; SBOP is a Simultaneous Bivariate Ordered Probit. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Distribution of saving and responsibility

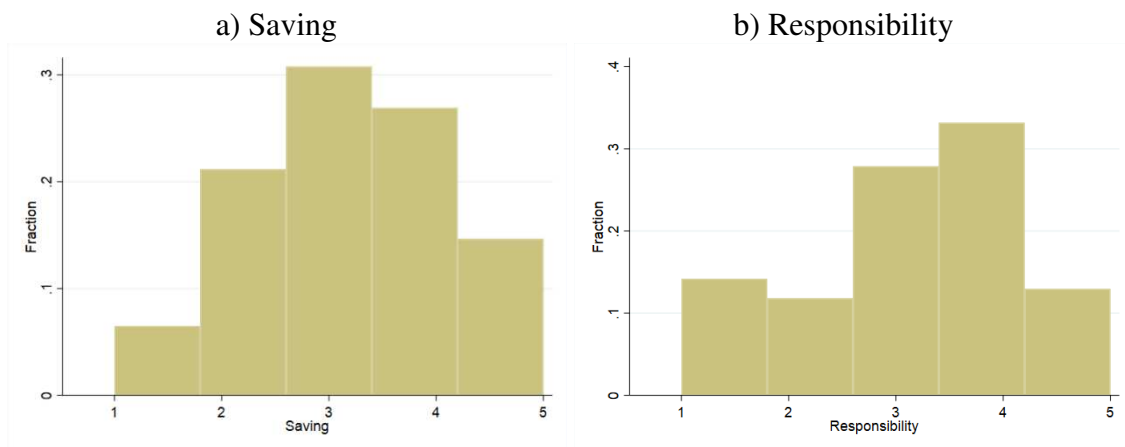


Figure 2. Saving vs. responsibility, country averages

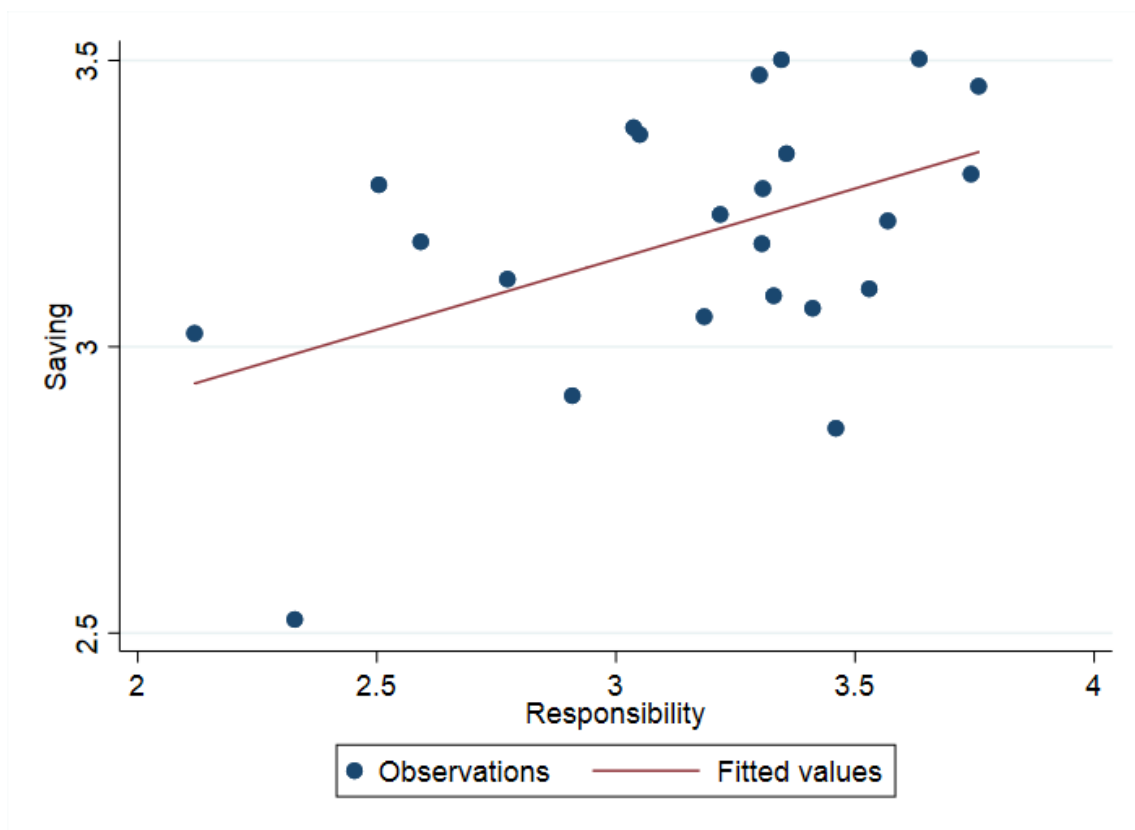
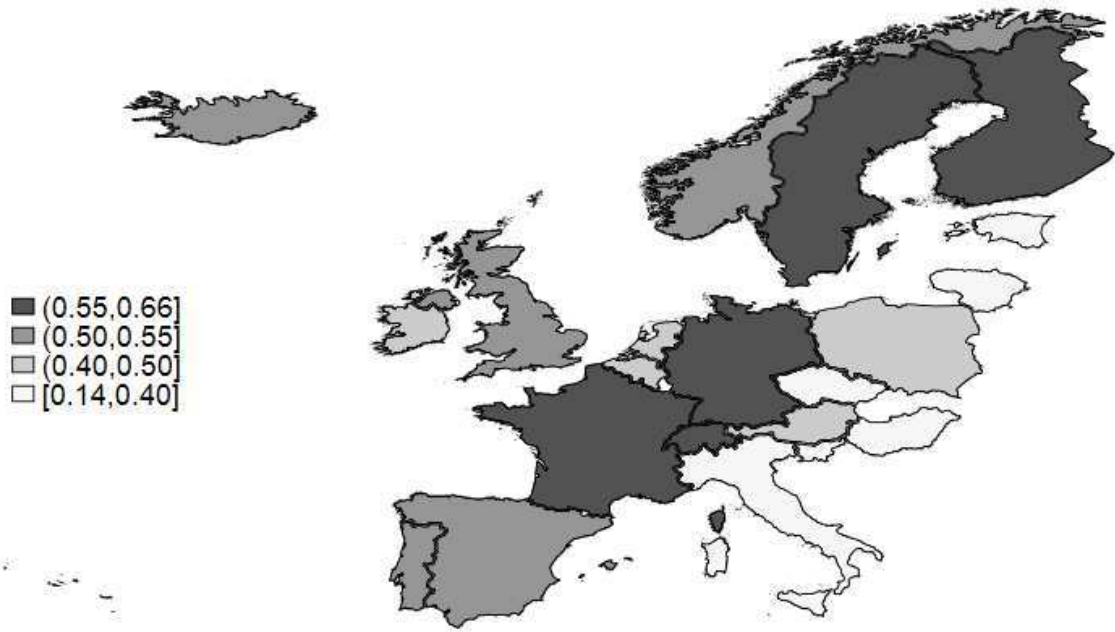
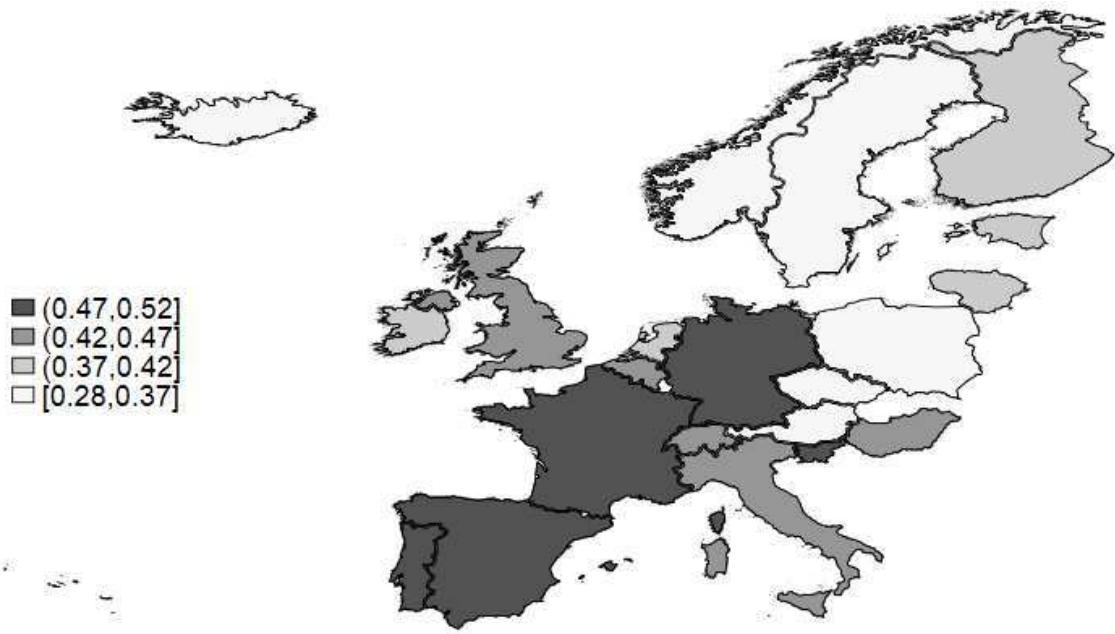


Figure 3. Probability to report options 4-5

a) Responsibility



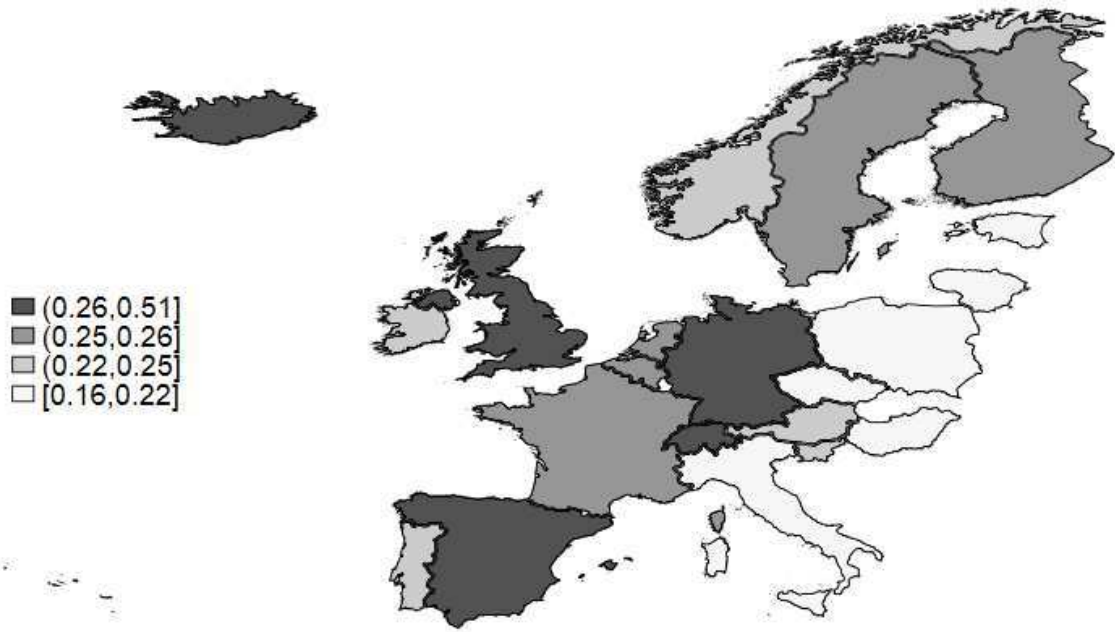
b) Saving



Note. The probabilities are based on the models in Table 4, Columns 3-4. Israel and Russia are excluded to make the figure readable.

Figure 4. Probability to report options 4-5, removing country effects

a) Responsibility



b) Saving



Note. The probabilities are based on the models in Table 4, Columns 3-4. Probabilities set to 0 the country fixed effects. Israel and Russia are excluded to make the figure readable.