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Determinants of Climate Change Perception and Behaviour of European Households

Imprint

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Abstract

The success of climate change measures is highly dependent on household behaviour as one of the most important emission sources of carbon dioxide. Private heating, electricity consumption or private transport are important key levers to reduce households´ impacts on climate change. The paper analyses the determinants of climate change related attitudes and activities based on econometric estimations of European survey data. The results show that personal factors such as female gender, qualification and a high income are positively correlated to green behaviour. Persons having difficulties to pay their bills show a lower probability of buying local, climate-friendly products, but a bad economic situation is not a barrier for green attitudes. The results for the political orientation show that politically left and middle oriented persons are more likely for supporting climate change related actions.

JEL-Codes: C25, D12, D91, Q01

Keywords: Climate change; green household behaviour; European data; multivariate probit model

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1. Introduction

The success of climate change measures depends heavily on changes of household behaviour, which is one of the most important sources of carbon dioxide emissions. In Germany in 2019, for example, the household share of final energy consumption amounted to 26.5% (Umwelt-bundesamt, 2021). Household heating, electricity consumption and private transport are important levers in reducing households' impacts on the environment and particularly on CO_2 emissions. The environmental behaviour of households is strongly related to factors such as personal characteristics of household members (e. g. gender, education level), their social and political environment, or their income and employment situation.

This paper examines the climate change affectedness and behaviour of households at European level. It comprises a short summary of the respective literature, together with econometric analyses of European-wide household data. The analysis uses survey indicators for the description of households´ climate change perception and behaviour. These indicators represent respondents' subjective perceptions of their personal responsibility and affectedness concerning climate change, as well as revealed preferences, such as the use of renewable energy for heating, insulation of houses and flats, waste, recycling, and tourism. Among others, the determinants of green household behaviour comprise housing situation, type of region (town or countryside) and social milieu. Household characteristics such as age profile, number of household members, and working conditions are also considered.

The literature on individuals' and households' green behaviour is extensive. However, there is a lack of comparative country analyses at European level, and joint analyses of different indicators of climate change affectedness and behaviour of households – this paper aims to close these gaps. Its main focus is an econometric analysis of the determinants of climate change related household attitudes and activities at European level for different countries and indicators. The analysis uses two recent European data sources. The first is the European Social Survey (ESS 10) in 2020, which is a comprehensive data source for a large sample of European households, including variables on the greening of households, such as the self-perceived affectedness of climate change. The database contains an extensive range of determinants and control variables, such as income, education level, establishment size, and working conditions of those interviewed. Factors such as the political orientation of a region are also included. The second data source is the recent Eurobarometer 92.4 of 2020, which captures European citizens' attitudes towards the environment. It allows a detailed and comparative analysis of six different climate change related activities in 28 countries.

The econometric analysis of the determinants of green household behaviour sheds light on factors such as the role of income, education, working conditions and regional social environment. A broad range of control variables is also considered. A deeper understanding of these

factors and determinants is necessary for the design and fine-tuning of household-oriented environmental and climate change measures. For example, the planning and shaping of subsidies for renewable energy in households might require knowledge of household characteristics, such as income or education level. The analysis also examines the relevance of measures to improve households' environmental awareness of sustainable or 'green' behaviour.

The paper is structured as follows: Section 2 describes the driving factors of climate change affectedness of households from a theoretical perspective. Section 3 contains a short summary of main empirical results from the respective literature. Section 4 presents econometric analyses of the determinants of perceived and revealed climate change related behaviour. Finally, Section 5 draws some conclusions and discusses the implications for European policy measures.

2. Driving factors of green household behaviour

Green or pro-environmental behaviour describes a "… behaviour that consciously seeks to minimise the negative impact of one's actions on the natural and built world (e. g. minimise resource and energy consumption, use of non-toxic substances, reduce waste production)" (Kollmuss and Agyeman, 2002, p. 240). Such a behaviour thus leads to a reduction of climate-damaging factors. Mere green attitudes and environmental awareness among individuals do not necessarily result in real activities to reduce households' environmental impacts. Kollmuss and Agyeman (2002) explain the reasons underpinning this discrepancy between attitude and behaviour: Attitudes can change quickly but there are barriers to changing habits. Social norms such as family or cultural traditions shape individual behaviour, but these norms are often persistent and slow to change. External barriers and sunk costs may also act as a barrier. E.g., it is expensive to replace an existing heating system with one that consumes less energy or uses renewable energy. Furthermore, in most cases, individuals are typically not directly affected by environmental problems, thus the thresholds for behavioural change are higher than those where individuals are directly concerned. There are also temporal discrepancies. E.g., the German decision to phase-out nuclear energy came just after the Fukushima catastrophe, a few years later, it would have been difficult to realise this political decision.

Up to now, there is no overall theory explaining green behaviour but the extensive literature on green (consumption) behaviour contains many approaches that can be used to draw a comprehensive picture. Figure 1 summarises the main determinants of green attitudes and behaviour that will be empirically tested in Section 4.
The theory of planned behaviour (Ajzen, 1991; Bamberg and Möser, 2007) assumes rational behaviour of individuals, i.e. that people always evaluate the consequences of their behaviour. This theory is closely related to the theory of social norms and customs (Akerlof, 1980; Videras

et al., 2012; Keizer and Schultz, 2018; Vögele et al., 2021). Rational individuals comply with social norms because they fear punishment or social exclusion, feel guilty about disobedience, or, conversely, expect rewards for following social norms. Overall, individuals anticipate and assess positive and negative consequences of different behavioural options and decide their actions accordingly (Bamberg and Möser, 2007). Social norms and customs depend on regionally relevant political framework conditions, but also on the living and housing environment (see Figure 1).

Figure 1: Determinants of green household behaviour

Political and country-specific conditions		Regional living and housing conditions

Social norms

Personal characteristics (age, gender, marital status, education, qualification)	**Greening of households, climate change related behaviour**	Individual values, political orientation, caring for others, etc.

Economic situation (income, poverty, occupational status, etc.)
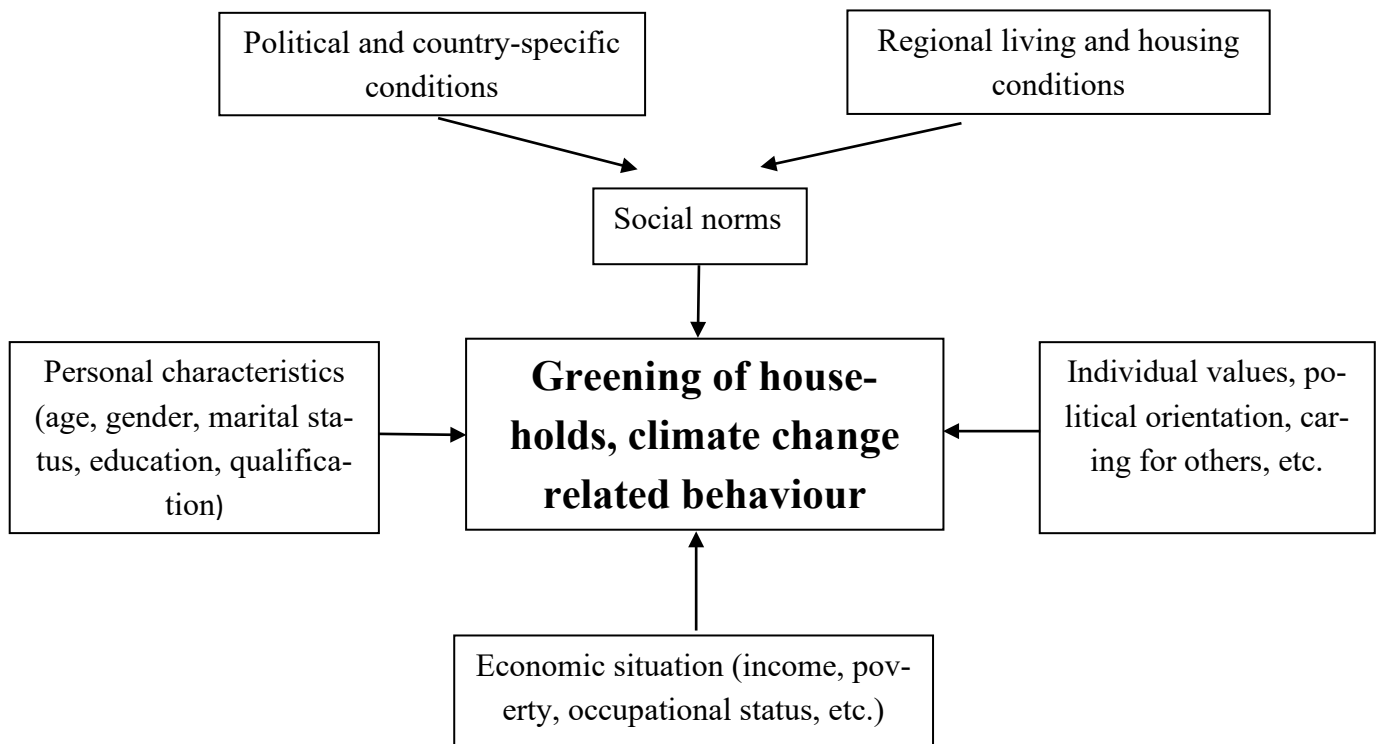
Source: Horbach (2022), adapted version.

The concept of value–attitude–behaviour does not rely on rational behaviour, but, rather, stresses the importance of functional, social, or emotional values to consumer behaviour (Zhang and Dong, 2020). In addition to a rational calculation of the social consequences of green behaviour, individual values such as political orientation, environmental consciousness, or willingness to care for others, might trigger environmentally advantageous consumer behaviour.

Many empirical studies on environmentally relevant behaviour suggest that other factors such as personal characteristics and economic situation should also be considered (e. g. Ziegler, 2020; Vögele et al., 2021; Lange et al., 2017; Kahn, 2007).

Several studies show that women have a higher environmental consciousness than men and are more likely to buy green products (e. g. Liobikiene et al., 2016). Economic situation and occupational status are also crucial determinants of environmental behaviour - poor and/or unemployed people may be less likely to pay a premium for green, climate change friendly products. This raises the question of whether a low income similarly impacts 'costless' green activities, such as the separation of waste or the use of bicycles instead of cars. Low-income households might be even more climate friendly as they cannot afford a car or they consume less compared with rich households.

Professional activity might be positively or negatively correlated to green behaviour because individuals working in environmentally relevant professions might be more open to green products. The reverse may also be true - working in polluting or energy-intensive industries might lead to lower environmental awareness, as job opportunities could be negatively affected by green measures (e. g. workers in the lignite industry are perhaps less well-disposed towards climate protection measures such as the extension of renewable energy). Education and qualification level of individuals may also be an important factor, with higher qualified people perhaps more likely to be informed on the complex effects of climate change or other environmental problems, triggering green behaviour.

The empirical analysis in Section 4 will test the following hypotheses:

H1:   Personal characteristics, such as gender, influence green behaviour and climate change affectedness.

H2:   Determinants of climate change related behaviour differ between costless and cost-intensive green activities, with economic situation relevant primarily for cost-intensive activities.

H3:   Highly educated and (in most cases) better-informed people are more likely to engage in green activities.

H4:   Occupational situations are relevant to green behaviour.

H5:   The political climate in a country influences green behaviour.

3. Empirical analysis of green household behaviour: Summary of the literature

Due to the extensive literature on green household behaviour the following analysis is restricted to meta-analyses and literature overviews (for a more detailed and comprehensive literature overview see Horbach, 2022). Zhang and Dong (2020) analyse 97 papers on green purchasing behaviour published between 2015 to 2020. They consider individual factors, product attributes and marketing, and social factors. The evidence on individual factors is quite mixed and varies between green products. In most studies, women seem to be more likely to buy green products, although some papers find that gender does not play a significant role. Age and income are important factors for buying electric vehicles: middle aged and a middle-income level seem to

promote demand for these cars, although these factors are not significantly relevant for green food. The role of education level is similarly mixed. Looking at product attributes, eco-labels seem to be very important for consumers' purchase of green products. Social factors are crucial for green consumption behaviour. For example, for food products, a positive reputation enabled by mass communication and social media publicity triggers consumers' purchase intention for green food.

A comprehensive literature overview by Testa et al. (2021) considers 113 papers published between 2000 and 2018, using a survey-based quantitative approach to measure drivers of green consumption. The authors look at behavioural factors, socio-demographic variables, individual values and capabilities, products, producer, and context-related factors. The results show that ecological values, altruism, collectivism, and social justice are positively correlated with green consumption behaviour. Pro-environmental behaviours are also adopted because they are linked to positive self-image. Some of the studies find that collectivistic cultures favour green consumption. Path dependencies also seem to be relevant, with past green behaviour significantly driving green consumption in the future. Personal capabilities such as technological knowledge, income and education are also important drivers of green consumption, but the results are mixed for different products. For product and producer-related factors, a green brand image and trust promote green purchase decisions. The perceived economic future value of products - lower energy consumption or longer durability – is important. Contextual factors, including product access possibilities, social norms and marketing measures, also affect green consumption behaviour. If a green product requires effort to find, consumers may switch to non-environmental alternatives. Social norms such as the behaviour of peers, parents and general social pressure are also crucial for green behaviour. Most of the studies consider gender, age, income, and education level as control variables. Females seem to be more receptive to green consumption, the results for the other socio-demographic variables are more mixed.

Andor and Fels (2018) provide a survey of 44 international studies on non-price interventions targeting energy conservation behaviour of private households. They only consider studies allowing for the analysis of causal effects. The four interventions - social comparison, commitment devices, goal-setting, and labelling - seem to have significant effects on reducing energy consumption of private households.

Summary and stylised facts
The analysis of the extensive literature on green (consumption) behaviour shows that there are common determinants across different indicators and countries, but also indicator-related specificities (see Horbach, 2022):

- Personal factors such as female gender, education, and high income, are positively correlated with green (consumption) behaviour, although there are considerable differences between green products. For example, one study shows that middle age and middle income are important factors in buying electric vehicles, but they are not significantly relevant for green food.

- A perceived environmental concern is also connected with green behaviour: environmentally conscious people appear more likely to use public transport, purchase hybrid vehicles, and consume less petrol compared with non-environmentalists. A caveat of this kind of analysis, however, is that environmentally active individuals are expected to show high values for self-perceived environmental awareness, although many of the studies reviewed do not discuss this endogeneity problem.

- The role of the number of children in a household seems to be mixed: a higher number of children reduces the probability of buying green products because of the negative income effect, while other 'costless' environmental activities (e. g. waste minimisation) may be positively correlated with the household size.

- Social norms - especially peer effects and the consumption patterns of reference persons - are significantly correlated with greenness indicators. Learning from peers seems to enforce pro-environmental and climate change related behaviour. Social norms are particularly relevant for recycling activities and public transport.

- Unsurprisingly, income is especially important for cost-intensive green activities, such as the installation of renewable energy or heating systems. Poor households show a lower probability of adopting high-cost energy efficient technology, such as the installation of photovoltaic systems. Economic incentives seem to be very important in triggering the use of these technologies.

- Interestingly, some studies also find a significant negative relationship between the pollution intensity of the most prevalent economic sectors in a region and green household behaviour. Results show that high regional incidence of polluting industries may lower the willingness to pay for environmental protection.

- Some of the studies point to the important role of labelling and information. One interesting example is that illustrations of forests on labels might promote the purchase of certified forest coffee.

- The political orientation of an individual plays an important role in green behaviour, with left-green policy identification positively correlated with support for energy policy measures. This is not the case for respondents showing a liberal-conservative policy orientation.

Despite the extensive literature on green household behaviour, research gaps persist. Most of the analyses are for a single country, whereas comparative quantitative country analyses are rare. This paper attempts to close some of those gaps and is exclusively based on European-

wide databases. Comprehensive comparisons of different green activities within a common econometric framework are similarly lacking, and Section 4 tries to close this gap.

4. Econometric analysis
4.1 Data sources

The econometric analyses of the determinants of climate change behaviour and attitudes relies on a European-wide social survey of 2020. This analysis uses the European Social Survey (ESS) round 10 (2020), with 58,810 observations. Looking at indicators for green household behaviour, ESS 2020 allows an analysis of subjective perceptions of their personal responsibility and affectedness concerning climate change. One major advantage of this data source is the broad country coverage. ESS 2020 covers the EU (without Cyprus, Malta, Luxembourg, Romania) and Iceland, Israel, Montenegro, North Macedonia, Norway, Serbia and Switzerland. (European Social Survey, 2020).

Furthermore, the database of Eurobarometer 92.4 (December 2020) allows the analysis of climate change behaviour of households by various fields. It also contains revealed preference indicators, such as the use of renewable energy for heating, insulation of houses and flats, waste, recycling, and tourism. It covers all European countries, with 27,498 observations in the sample. The survey was carried out by Kantar Public Brussels, at the request of the European Commission in 2019 (European Commission, 2019).

4.2 Estimation results based on the ESS (2020)

Estimation strategy

Most of the dependent variables capturing climate change behaviour are binary, thus probit models can be used for estimation. For example, concerning environmental-friendly ways of travelling, a household has to decide whether to use a green alternative (Y=1) or the non-green one (Y=0). Following the theoretical considerations, different factors such as gender, income, and education level, summarised by a vector x, may influence this decision. Therefore, an estimation of the probability *Prob (Y = 1| x) = F (x, β)* is needed. The β parameters reflect the impact of changes in x on this probability (Greene, 2008, p. 772). Average marginal effects for all covariates are calculated, allowing comparisons of the different climate change activities. The analysis of different climate change activities requires an estimation of a multivariate probit model instead of simple probit models, as the different outcomes are correlated. The multivariate probit model simultaneously estimates the determinants of five different activities, including a common set of covariates (see Section 4.3).

ESS 2020 includes two questions on the climate change perception and behaviour of households, one on the personal responsibility to reduce climate change and one on how the household is worried about climate change (see Table 1). These two questions are combined so that the variable climate change affectedness gets the value one if the respondent confirms a high personal responsibility to reduce climate change and is furthermore very or extremely worried about climate change.

Table 1: Indicator for the climate change affectedness of households (dependent variable)

Climate change related indicator	In % of all respondents	Number of observations
ESS 2020		
Climate change perception: High personal responsibility to reduce climate change and highly worried about climate change	22.67	58,810

Source: European Social Survey, 2020, own calculations.

Table 2: Indicators for the determinants of climate change behaviour

Determinants of climate change behaviour	ESS indicators
Individual variables	
Personal characteristics and orientation	*Age* (in years), *female* (gender), *married, academic* education, *eduyrs* (education in years), *selfemployed* (self employment), *responsibility* (responsible for supervising other employees), *selfemployed*, *publicemp* (employed in the public sector), *manuintens* (employed in environmentally intensive production sectors), employed in the *construction* sector, *healthsocial* (working in health or social oriented professions) *happydum* (high happiness), *relig* (very religious), *polinterest* (interested in politics), *economicsatis* (highly satisfied with present state of economy in country), *socialcontacts* (many social contacts with friends, relatives or colleagues)
Housing characteristics	*householdsize* (household size)
Income/poverty	*highincome* (8th to 10th decile of the income distribution), *poverty* (first decile of household's total net income)
Contextual variables	
Regional living conditions, social milieu	*Acchome* (possibility to access the internet at home)*, , country* (farm or home in countryside), *smallcity* (small city)

Table 2 summarises the indicators for the determinants of climate change behaviour (see Table A1 for descriptive statistics of these variables).

Results of ESS 2020

The results of the probit models for the determinants of climate change perception and behaviour are summarised for all countries and country groups (see Table 3).

Confirming other studies in the literature (see Section 3), the results show that women show a high personal responsibility to reduce climate change and are highly worried about climate change, supporting the hypothesis H1. For the Northern countries (Denmark, Finland, Iceland, Norway, Sweden), the marginal effects for *female* (10.2%) are much higher than those for all countries (6.6%). For the *age* of the respondents, results are mixed. For all countries and the core EU, age is positively correlated with climate change affectedness, but this is not the case for the other country groups. The *married* status does not play a significant role for climate change behaviour. Except the Balkan countries, high qualification and education seem to be crucial for climate change affectedness, documented by the significant marginal effects of *academic* and *eduyrs* (supporting H3). In all country groups except the Northern countries, a high *relig*iousness is positively correlated with the climate indicator.

For all countries and the core EU, a *high income* is positively correlated to the climate change affectedness of households. Interestingly, this is not the case for the other country groups. On the other side, a poor economic situation is at least not a barrier to climate change affectedness, as the marginal effect for *poverty* is not significant. Respondents' occupation is also correlated with climate change attitudes (supporting H4). Employees in the public sector (*publicemp*) seem to be significantly more affected by climate change. The Northern countries show the highest marginal effects for this variable (3%). For all countries and the core EU, working in the *construction* sector seems to reduce the climate change affectedness whereas in the Baltic countries, this variable leads to a positive result.

Table 3: Climate change: Responsibility and affectedness of European households

Correlates	All countries	Core EU/CH	EEC	Baltic countries	Balkan countries	Northern Europe
Age	0.004*	0.008**	0.002	-0.002	0.003	-0.003
	(0.002)	(0.002)	(0.003)	(0.005)	(0.005)	(0.004)
Female	0.066**	0.069**	0.029**	0.066**	0.079**	0.102**
	(0.004)	(0.007)	(0.009)	(0.014)	(0.013)	(0.012)
Married	-0.004	-0.009	-0.006	-0.016	0.004	0.007
	(0.005)	(0.008)	(0.009)	(0.015)	(0.014)	(0.014)
Householdsize	-0.002	0.005	-0.002	-0.003	-0.005	-0.010+
	(0.002)	(0.003)	(0.004)	(0.006)	(0.005)	(0.006)
Academic	0.028**	0.021**	0.033*	0.036*	-0.006	0.068**
	(0.006)	(0.008)	(0.013)	(0.017)	(0.018)	(0.014)
Eduyrs	0.007**	0.009**	0.001	0.006**	0.003	0.004*
	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
Highincome	0.019**	0.017*	0.017	0.021	0.021	0.019
	(0.005)	(0.008)	(0.011)	(0.017)	(0.016)	(0.014)
Poverty	0.008	0.019	-0.007	-0.025	0.007	0.034
	(0.009)	(0.015)	(0.016)	(0.027)	(0.028)	(0.027)
Responsibility	-0.003	-0.013+	0.010	0.013	0.030*	-0.004
	(0.005)	(0.007)	(0.011)	(0.015)	(0.015)	(0.013)
Selfemployed	0.023**	0.030**	-0.012	0.015	0.052*	0.028
	(0.007)	(0.010)	(0.014)	(0.022)	(0.023)	(0.020)
Construction	-0.018+	-0.036*	-0.018	0.089**	0.012	-0.041+
	(0.010)	(0.015)	(0.017)	(0.033)	(0.027)	(0.025)
Healthsocial	0.007	0.024*	-0.030*	-0.021	0.030	-0.021
	(0.007)	(0.011)	(0.015)	(0.023)	(0.026)	(0.016)
Manuintens	-0.009	0.007	-0.028*	0.003	-0.021	-0.003
	(0.009)	(0.015)	(0.013)	(0.033)	(0.019)	(0.032)
Publicemp	0.013**	0.016*	0.008	0.007	0.003	0.028*
	(0.005)	(0.008)	(0.010)	(0.015)	(0.015)	(0.013)
Economicsatis	0.039**	0.056**	0.024	0.024	0.002	0.034**
	(0.006)	(0.009)	(0.015)	(0.019)	(0.021)	(0.013)
Happydum	0.033**	0.045**	0.045**	0.027+	0.011	0.011
	(0.005)	(0.007)	(0.009)	(0.014)	(0.014)	(0.013)
Polinterest	0.099**	0.115**	0.078**	0.126**	0.064*	0.085**
	(0.007)	(0.010)	(0.019)	(0.033)	(0.026)	(0.018)
Relig	0.033**	0.024**	0.040**	0.078**	0.051**	0.024
	(0.005)	(0.008)	(0.010)	(0.017)	(0.013)	(0.015)
Socialcontacts	0.010*	0.007	0.009	-0.002	0.013	0.019
	(0.005)	(0.007)	(0.010)	(0.016)	(0.013)	(0.012)
Acchome	0.037**	0.050**	0.031*	0.001	0.018	0.043
	(0.008)	(0.013)	(0.012)	(0.023)	(0.019)	(0.033)
Country	-0.023**	-0.018*	-0.036**	0.002	-0.025	-0.049**
	(0.005)	(0.008)	(0.010)	(0.018)	(0.015)	(0.014)
Smallcity	-0.020**	-0.022**	-0.015	0.009	-0.020	-0.030*
	(0.005)	(0.008)	(0.010)	(0.016)	(0.016)	(0.013)
Observations	39,048	18,891	6,833	3,278	3,871	5,432
Wald Chi	3088.1	1313.2	403.4	172.0	205.1	268.2
Pseudo R^2	0.08	0.06	0.08	0.06	0.06	0.05

Probit models. Average marginal effects are reported. Robust standard errors in parentheses, ** $p<0.01$, * $p<0.05$, + $p<0.1$.

Source: European Social Survey, 2020, own estimations.

In nearly all countries except the Balkan and the Northern country group, a high degree of happiness (*happydum*), is positively correlated to climate change affectedness. Across all countries a high political interest (*polinterest*) is significantly positively correlated to climate change behaviour and affectedness. In nearly all countries, living in a *small city* or in the *country*side seems to reduce climate change affectedness.

4.3 Estimation results based on Eurobarometer 92.4 (2020): European citizens' Attitudes towards the environment

Eurobarometer 92.4 (European Commission, 2019) allows an analysis of different climate change related activities for 28 European countries (see Table 4).

Table 4: Different climate change related activities

Activities during the past six months	In %
1. Chosen a more environmentally-friendly way of travelling (walk, bicycle, public transport, electric car),	27.8
2. Cut down your energy consumption (e. g. by turning down air conditioning or heating, not leaving appliances on stand-by, buying energy-efficient appliances),	36.1
3. Bought local products,	43.6
4. Used your car less by avoiding unnecessary trips, working from home (teleworking), etc.,	18.8
5. Bought second-hand products (e. g. clothes or electronics) instead of new ones,	20.7
6. Repaired a product instead of replacing it.	30.9

Source: European Commission, 2019, own calculations.

The econometric results for the model capturing all countries (see Table 5) show that women are more likely to engage in climate change related activities, confirming the findings of the literature review, H1, and the econometric models in Section 4.2.

Table 5: Results for climate change related activities

Correlates	All countries	EU core	Eastern European countries	Baltic countries	HR, CY, GR, MT	DK, FI, SE
Age	0.000	0.000	0.001	0.000	-0.000	-0.002**
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
Female	0.022**	0.032**	-0.009	0.036*	0.010	0.043**
	(0.005)	(0.008)	(0.011)	(0.016)	(0.013)	(0.011)
Partner	0.027**	0.034**	-0.003	0.011	0.076**	0.013
	(0.006)	(0.009)	(0.014)	(0.018)	(0.016)	(0.016)
Householdsize	0.013*	0.015	0.041**	0.006	-0.010	0.004
	(0.006)	(0.009)	(0.013)	(0.018)	(0.014)	(0.017)
Highqual	0.049**	0.065**	0.059**	0.027	0.005	0.046**
	(0.006)	(0.009)	(0.014)	(0.016)	(0.016)	(0.013)
Diffbills	-0.018**	0.009	-0.002	-0.073**	-0.074**	-0.016
	(0.006)	(0.009)	(0.012)	(0.018)	(0.013)	(0.023)
Upphighclass	-0.069*	-0.005	0.016	-0.197	-0.416**	-0.036
	(0.032)	(0.042)	(0.072)	(0.125)	(0.115)	(0.059)
Workclass	-0.028**	-0.021*	-0.047**	-0.020	-0.052**	-0.001
	(0.006)	(0.009)	(0.014)	(0.017)	(0.015)	(0.015)
Housemanwife	0.009	0.012	-0.033	0.061	0.021	-
	(0.012)	(0.017)	(0.031)	(0.040)	(0.028)	-
Employed	0.016*	0.020+	0.003	0.024	0.021	0.027+
	(0.007)	(0.010)	(0.015)	(0.022)	(0.016)	(0.015)
Unemployed	-0.005	0.002	-0.048	-0.037	0.026	0.058**
	(0.011)	(0.017)	(0.030)	(0.034)	(0.025)	(0.021)
Retired	-0.009	-0.009	-0.029	-0.048+	0.042*	0.031
	(0.008)	(0.013)	(0.020)	(0.026)	(0.021)	(0.020)
Bigtown	0.020**	0.014	0.014	0.049**	0.024	0.004
	(0.006)	(0.009)	(0.014)	(0.017)	(0.016)	(0.013)
Countryside	0.001	0.013	-0.013	0.023	-0.014	-0.011
	(0.006)	(0.009)	(0.013)	(0.016)	(0.015)	(0.013)
Envaffected	0.076**	0.079**	0.075**	0.032*	0.112**	0.061**
	(0.005)	(0.007)	(0.011)	(0.015)	(0.013)	(0.011)
Envcostbear	0.039**	0.056**	0.035*	0.030	0.020	0.014
	(0.006)	(0.009)	(0.014)	(0.021)	(0.014)	(0.011)
Highsatisfaction	0.005	-0.001	0.004	-0.002	0.016	0.021+
	(0.006)	(0.009)	(0.016)	(0.021)	(0.015)	(0.012)
Left	0.050**	0.048**	0.064**	0.036+	0.045**	0.033*
	(0.006)	(0.009)	(0.014)	(0.020)	(0.016)	(0.014)
Middle	0.041**	0.057**	0.035**	0.073**	0.015	0.003
	(0.005)	(0.009)	(0.012)	(0.015)	(0.014)	(0.013)
Politunsatisfied	0.018**	0.013	0.024*	0.011	0.028*	0.018+
	(0.005)	(0.008)	(0.011)	(0.015)	(0.013)	(0.011)
Observations	27,397	11,173	6,151	2,991	4,039	3,030
Wald Chi^2	1757 ** (48)	904** (31)	226** (25)	147** (22)	233** (24)	171** (21)
Pseudo R^2	0.07	0.09	0.03	0.05	0.06	0.09

Probit models. Average marginal effects are reported. Robust standard errors in parentheses, ** $p<0.01$, * $p<0.05$, + $p<0.1$.

Source: European Commission, 2019, own estimations.

Interestingly, this result does not hold for Croatia, Cyprus, Greece and Malta and the Eastern European countries. The highest marginal effect can be observed for the Northern and the

Baltic countries (4.3% and 3.6%). Living in a *partnership* also promotes green activities. The result for *partnership* is especially relevant for Croatia, Cyprus, Greece and Malta, but is not significant for the Northern, Eastern European and the Baltic countries.

Except the Baltic and the Balkan countries, a high qualification (*highqual*) is positively correlated with climate change activities.

The economic situation of the household matters for their climate change activities. Households with lower income indicated by belonging to *workclass,* or by difficulties paying bills (*diffbills*) in the last 12 months are less likely for climate change affectedness and behaviour. Interestingly, these results are not valid for the Northern countries, the low income variables *diffbills* and *workclass* are not significant. This result is likely due to the highly developed social security systems in these countries.

Living conditions characterised by a high level of pollution play a role for all countries. Those feeling a direct daily negative life effect of environmental problems (*envaffected*) show more green activities. This result holds for all considered country groups. Interestingly, for the model of all countries, living in big towns (*bigtown*) increases the probability of climate change related activities, while living in the *countryside* has no significant effect.

The results for political orientation show that politically *left* and *middle* oriented people are more likely to engage in green climate activities, as are those who are dissatisfied with politics in their country. This might be because the majority of the parties with government responsibilities do not sufficiently represent the preferences of green respondents (H5). This result is especially relevant for the Eastern European and the Balkan countries but is not the case in the Baltic and Northern countries, where green consumers seem to support their governments.

Differences between climate change activities

The analysis of different climate change-related activities uses a multivariate probit model (Roodman, 2011) instead of simple probit models (see Table 6), as the different green activities could be correlated. As the error terms of the single models are significantly correlated, this choice of model is appropriate.

Gender (*female*) is relevant only for environmentally-friendly ways of travelling (walk, bicycle, public transport or electric car) and for buying local products. By contrast, recycling activities such as repairing rather than replacing a product or energy saving activities show no gender difference. Not surprisingly, younger people are more likely to use bicycle or public transport whereas older people are less able to move about on foot or bicycle so that the marginal effect of *age* becomes significantly negative. Contrary to this result, the *age* of the respondent is positively correlated with energy saving activities and buying local products.

Table 6: Results for different climate change related activities

Correlates	Env. travel	Energy savings	Local pro-ducts	Home wor-king	Secondhand repair
Age	-0.002**	0.001*	0.001**	0.000	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.022**	0.009	0.053**	-0.014**	-0.005
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)
Partner	-0.022**	0.025**	0.035**	0.023**	0.036**
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Householdsize	0.000	0.016*	0.003	0.018**	0.017*
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Highqual	0.048**	0.054**	0.068**	0.052**	0.052**
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Diffbills	-0.009	-0.024**	-0.043**	-0.004	0.025**
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Upphighclass	-0.028	0.015	-0.019	0.001	-0.026
	(0.029)	(0.034)	(0.034)	(0.026)	(0.034)
Workclass	-0.021**	-0.022**	-0.007	-0.042**	-0.001
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Housemanwife	-0.027*	0.040**	-0.008	-0.006	-0.025+
	(0.013)	(0.015)	(0.015)	(0.012)	(0.015)
Employed	-0.006	0.033**	0.021*	0.014*	0.008
	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)
Unemployed	0.016	-0.023	-0.011	0.014	0.004
	(0.013)	(0.014)	(0.014)	(0.012)	(0.014)
Retired	0.022*	-0.008	-0.012	-0.003	-0.026*
	(0.010)	(0.010)	(0.010)	(0.008)	(0.010)
Bigtown	0.058**	0.020**	-0.013+	0.012*	0.009
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Countryside	-0.033**	0.019**	0.035**	-0.019**	0.028**
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Envaffected	0.074**	0.099**	0.080**	0.044**	0.060**
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)
Envcostbear	0.035**	0.042**	0.044**	0.033**	0.056**
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Highsatisfaction	0.018**	0.009	0.020**	0.032**	0.004
	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Left	0.056**	0.036**	0.055**	0.034**	0.054**
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)
Middle	0.027**	0.015*	0.042**	0.017**	0.019**
	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)
Politunsatisfied	-0.007	0.026**	0.011+	0.011*	0.031**
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)

Multivariate probit model. Average marginal effects are reported. Robust standard errors in parentheses. LR Chi^2 (240) = 7245**. Number of observations = 27,397. ** $p<0.01$, * $p<0.05$, + $p<0.1$.

Source: European Commission, 2019, own estimations.

People struggling to pay their bills (*diffbills*) show a lower probability of buying local products or energy saving measures, but the marginal effects of this variable for environmentally friendly mobility and recycling are insignificant or even positive (recycling).

These findings do not imply that high income households are more environmentally friendly in their overall ecological footprint per se. Compared to low-income households, they might have higher total consumption, polluting more despite their higher willingness to consume green local products. Furthermore, they are less likely for recycling and the use of second-hand products.

As expected, people living in the *countryside* show less environmentally-oriented mobility behaviour because the supply of public transport is less developed, but they show more energy saving activities and buy more local products. A politically *left* or *middle* orientation is positively correlated with all climate change related activities.

4.4 Limitations of the econometric analysis

The econometric models in Section 4 explaining pro-environmental behaviour of households might show endogeneity problems because variables such as the choice of occupation or the degree of happiness might be dependent on the greenness of households. Even a time lag structure does not remedy the issue, as many of the personal characteristics or choice of occupation do not change over time (or change only in the longer term). Nor are instrumental variable estimations useful here, due to the lack of appropriate instruments not correlated to the climate change perception of households. The results of the econometric analysis should therefore be interpreted as correlations rather than causal effects.

An additional issue is the social desirability of pro-environmental behaviour, potentially creating a bias in self-perceived survey indicators. The importance of green social norms may differ between countries, and this bias might partially explain country-specific results. Despite the inclusion of country dummies, unobserved heterogeneity in country differences may remain.

A final limitation of the analysis is the fact that, typically, one household member responds to the questionnaire and the answers might be not representative for the whole household. For example, a female respondent might give more optimistic answers about green behaviour, resulting in an overestimation of the greenness of the household.

5. Summary and European policy implications

This paper analyses the determinants of green household attitudes and behaviour based on a literature review and econometric estimations of European survey data. The data allows the use of perceived climate change affectedness and six climate change related activities such as energy saving or the choice of environmental-friendly means of transport as revealed preference indicators.

In general, personal factors such as female gender, education and a high income are positively correlated with climate change affectedness of households. Women are disproportionally concerned by climate change problems. The gender-specific result also holds for environmental activities such as the choice of environmental-friendly means of transport or buying local products. By contrast, recycling activities such as repairing instead of replacing a product do not show gender differences. In all countries, higher education is positively correlated with all green behaviour indicators considered. Respondents' occupation is also correlated with green attitudes, with employees in the public sector disproportionally showing higher climate change concerns.

In all countries, living conditions characterised by high exposure to environmental pollution play a role. People feeling a direct daily negative life effect of environmental problems engage in more green activities. Looking at political orientation, left and middle-oriented people are more likely to engage in green activities.

Income and the occupation situation are also relevant for climate change related activities and attitudes, but considerable differences are evident between cost-intensive and 'costless' green activities. The econometric results show that income is positively correlated with cost-intensive green activities, such as buying relatively expensive local environmental-friendly products marked. Consequently, people struggling to pay their bills have a lower probability of buying green products. By contrast, the marginal effects of these variables are insignificant for mobility and are even positively significant for recycling. In fact, a poor economic situation is not principally a barrier to green attitudes.

From a political perspective, the fight against poverty and unemployment increases green consumption, with the results showing that poor households are not less green *per se,* but only in respect of cost-intensive green activities. Information policy that helps to create green social norms matters, as the discussion on climate change triggers self-perceived green attitudes and prompts green behaviour. The results of the literature review and the econometric analysis imply that financial incentives and subsidies are highly relevant for cost-intensive green consumption activities, especially for low-income households.

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Appendix: Table A1: Descriptive statistics - ESS 2020

Variable	Description of variables (all personal variables are related to the respondent)	Mean	Std. Dev.
Climateaffect	High personal responsibility to reduce climate change and highly worried about climate change: 1: Yes, 0: Otherwise	.227	.419
Age	Age in years/10	5.052	1.857
Female	Gender: 1: Female, 0: Male	.529	.499
Married	Family status married: 1 Yes, 0: No	.478	.500
Householdsize	Number of persons living in the household	2.62	1.374
Academic	Academic education: 1: Yes, 0: No	.342	.474
Eduyrs	Years of education	13.26	4.208
Highincome	8th to 10th decile of household's total net income	.284	.451
Poverty	First decile of household's total net income	.074	.261
Responsibility	Responsible for supervising other employees: 1: Yes, 0: No	.291	.454
Selfemployed	Self-employed: 1: Yes, 0: No	.137	.344
Construction	Working in the construction sector: 1: Yes, 0: No	.05	.217
Healthsocial	Working in the health sector/social institutions: 1: Yes, 0: No	.088	.283
Manuintens	Working in an environmentally intensive sector: 1: Yes, 0: No	.055	.228
Publicemp	Working in the public sector: 1: Yes, 0: No	.332	.471
Economicsatis	How satisfied with present state of economy in country: 1: Very or extremely satisfied, 0: Otherwise	0.158	0.365
Happydum	How happy are you: 1: Very happy, 0: Otherwise	.506	.500
Polinterest	Very interested in politics: 1: Yes, 0: No	.112	.315
Relig	Highly religious: 1: Yes, 0: No	.300	.458
Socialcontacts	How often socially meet with friends, relatives or colleagues: 1: every day or several times a week, 0: Otherwise	.366	.482
Acchome	Possibility to access the internet at home: 1: Yes, 0: No	.859	.348
Country	Living at the countryside: 1: Yes, 0: No	.302	.459
Smallcity	Living in a small city: 1: Yes, 0: No	.302	.459
AT	Austria	.034	.181
BE	Belgium	.023	.149
BG	Bulgaria	.046	.21
CH	Switzerland	.026	.159
CY	Cyprus	.042	.201
CZ	Czechia	.148	.355
DE	Germany	.026	.16
EE	Estonia	.039	.193
ES	Spain	.027	.162
FI	Finland	.034	.18
FR	France	.02	.138
GB	Great Britain	.048	.213
HR	Croatia	.027	.162
HU	Hungary	.031	.175
IE	Ireland	.03	.171
IL	Israel	.022	.147
IS	Iceland	.015	.123
IT	Italy	.045	.207
LT	Lithuania	.028	.166
LV	Latvia	.017	.131
ME	Montenegro	.022	.146
MK	Macedonia	.024	.154
NL	Netherlands	.025	.156
NO	Norway	.024	.153
PL	Poland	.035	.184
PT	Portugal	.031	.174
RS	Serbia	.026	.158
SE	Sweden	.039	.193
SI	Slovenia	.021	.144
SK	Slovakia	.024	.153

Table A2: Descriptive statistics - Eurobarometer 92.4 (2020)

Variables	Description of variables (all personal variables are related to the respondent)	Mean	Std. Dev.
Climateact	Green activities (Table 4) 1, 2, 3, 4, 5 or 6: 1: Yes, 0: No	.796	.403
Climtravel	Green activities 1: 1: Yes, 0: No	.278	.448
Climenergy	Green activities 2: 1: Yes, 0: No	.361	.480
Climlocalprod	Green activities 3: 1: Yes, 0: No	.436	.496
Climlesscar	Green activities 4: 1: Yes, 0: No	.188	.391
Climsechandrepair	Green activities 5 or 6: 1: Yes, 0: No	.412	.492
Age	Age in years	51.83	18.20
Female	Gender: 1: Female, 0: Male	.541	.498
Partner	Family status: 1: Partner, 0: Otherwise	.644	.479
Householdsize	Number of household members (ln)	.795	.537
Highqual	At least 21 years old when stopping full-time education: 1: Yes, 0: No	.297	.457
Diffbills	Difficulties paying bills last year: 1: Yes, 0: No	.319	.466
Upphighclass	Belonging to the middle/higher class: 1: Yes, 0: No	.007	.085
Workclass	Belonging to the working class of society: 1: Yes, 0: No	.263	.44
Housemanwife	Only working at home: 1: Yes, 0: No	.048	.214
Employed	Employed: 1: Yes, 0: No	.31	.463
Unemployed	Unemployed: 1: Yes, 0: No	.052	.222
Retired	Retired, unable to work: 1: Yes, 0: No	.334	.472
Bigtown	Living in a big town: 1: Yes, 0: No	.286	.452
Countryside	Living at the countryside: 1: Yes, 0: No	.329	.47
Envaffected	Direct daily life effect of environmental problems: 1: Yes, 0: No	.356	.479
Envcostbear	Willingness to bear environmental costs: 1: Yes, 0: No	.242	.428
Highsatisfaction	Very high life satisfaction: 1: Yes, 0: No	.266	.442
Left	Left political orientation: 1: Yes, 0: No	.253	.435
Middle	Middle political orientation: 1: Yes, 0: No	.44	.496
Politunsatisfied	Unsatisfied with national or EU policy: 1: Yes, 0: No	.561	.496
AT	Austria	.037	.189
BE	Belgium	.037	.188
BG	Bulgaria	.037	.19
CY	Cyprus	.018	.134
CZ	Czechia	.036	.187
DEW	West-Germany	.037	.189
DEE	East-Germany	.018	.134
DK	Denmark	.037	.19
EE	Estonia	.036	.187
ES	Spain	.037	.188
FI	Finland	.037	.188
FR	France	.037	.19
GB	Great Britain	.037	.189
GR	Greece	.037	.188
HR	Croatia	.037	.19
HU	Hungary	.037	.19
IE	Ireland	.037	.189
IT	Italy	.037	.189
LT	Lithuania	.036	.187
LU	Luxembourg	.019	.135
LV	Latvia	.036	.187
MT	Malta	.018	.134
NL	Netherlands	.038	.19
PL	Poland	.038	.19
PT	Portugal	.036	.187
RO	Romania	.039	.194
SE	Sweden	.037	.188
SI	Slovenia	.037	.188
SK	Slovakia	.038	.191