DISTRIBUTIVE OUTCOMES MATTER: MEASURING SOCIAL PREFERENCES FOR CLIMATE POLICY

Lea Skræp Svenningsen

October 02, 2017

ABSTRACT

This study examines whether people have distributional preferences for the impacts of climate policy when making donations towards such policies. In an online choice experiment, using a real donation mechanism, a representative sample of 95 members of the Danish public are provided 27€ and asked to make 16 donation choices among different climate policy options. The climate policies are described in terms of two main outcome variables, including future effects on income in 2100 and present co-benefits from mitigation action. Both outcomes are described for three specific regions of the world, Western Europe, Southeast Asia and Sub-Saharan Africa. For each participant, one policy choice was drawn at random to be realised and the total amount donated by participants was used to purchase and withdraw CO_2 quotas and credits in the European Emission Trading Scheme and as a donation to the UN Adaptation Fund. A random parameter logit model shows that distributional concerns matter for people when they donate to climate policy and that elements of both inequity aversion and general altruism influence the choice of climate policy. The results underscore the importance of considering preferences for distributional outcomes when designing climate policy.

Keywords: choice experiment, climate change, inequity aversion, altruism, random parameters logit, intergenerational, distributional social preferences

JEL: D30, D91, Q51, Q54, Q58

1. INTRODUCTION

Climate change is projected to generate impacts that are unequally distributed globally (IPCC 2014), giving rise to uneven consequences for the general wealth levels of future generations globally. Climate policies intended to mitigate the impacts of climate change may therefore also implicitly influence the wealth of future generations. In the design of climate policy, a central metric is the social cost of carbon (SCC), which captures the social cost of a marginal increase in greenhouse gas emissions today (Pearce 2003, Tol 2011). The expected uneven welfare impact of climate change can be incorporated in the SCC through the introduction of equity weights, but an empirical investigation of how people value distributional impacts from climate change policies has yet to be undertaken. This paper contributes to addressing this question by conducting an online choice experiment with a real donation mechanism, specifically designed to uncover the role and influence of intergenerational distributional social preferences[1].

The consequences of a policymaker considering the future uneven global distribution of impacts in her/his own national climate policy design have been explored by Anthoff and Tol (2010). They found that the consequences of introducing social preferences meant a higher (albeit heterogeneous) cost of not mitigating climate change, hereby establishing the policy relevance of considering social preferences in climate policy design. Building on the concepts in Anthoff and Tol (2010), this paper proposes the identification of two specific social preference types in relation to the distributional impacts of climate change. These are defined as Inequity Averse Altruists and Altruists. The Inequity Averse Altruist type is based on findings in the behavioural economics literature (Fehr and Schmidt 1999) that show some people experience disutility from unequal distributions of income. This paper adapts this behavioural pattern by defining the Inequity Averse Altruists type as people who prefer climate policies that reduce the impacts of climate change more for the poorest individuals, relative to policies reducing impacts for more affluent people. The Altruist type is inspired by the efficiency criterion in the cost-benefit literature. In this paper, the Altruist is defined as a person who is not concerned with whom the impacts of climate change affect. Rather, they prefer to support climate policies that minimize the aggregate impact on income across all individuals.

The interest in linking concepts from behavioural economics to the climate change context is not new (Brekke and Johansson-Stenman 2008). The relevance of social preferences in the climate change context has been explored in terms of the influence of social norms on people's preference for climate

[1] The author has previously pursued this question in a stated preference context (reference removed in adherence to the blind review process). The study presented in the present paper builds on the same survey design, but applies a revealed preference measure to investigate the same research question.

policy (Alló and Loureiro 2014), a theoretical investigation into the trade-off between intra and intergenerational equity in the context of climate policy (Kverndokk, Nævdal et al. 2014) and the role of equity concerns for climate change negotiators (Lange, Vogt et al. 2007, Dannenberg, Sturm et al. 2010) and for members of the general public when considering how the current cost of mitigation should be shared (Carlsson, Kataria et al. 2013, Gampfer 2014). The novel contribution of this paper is to identify preferences for the intergenerational, distributional effects of climate policy; to the author's knowledge, this has not been done before.

The method used in this paper to identify intergenerational social preferences for climate policies is an internet-based, discrete choice experiment (DCE) using a real donation mechanism as a payment vehicle. The typical arena for studying social preferences has been behavioural and experimental economics, using controlled, physical lab experiments (Kagel and Roth 1995). However, with the emergence of online experimental platforms, such as Amazon Mechanical Turk, several papers have explored how internet experiments, with the primary benefits of low-cost implementation and a diverse subject pool, compare to traditional lab experiments. The typical finding is that patterns of social preferences on the web mimic those found in the lab (Horton, Rand et al. 2011, Suri and Watts 2011, Amir and Rand 2012). A number of papers use DCEs to analyse variants of distributional preferences in the area of relative or absolute income or consumption comparisons, such as the papers by Yamada and Sato (2013), Johansson-Stenman, Carlsson et al. (2002), Alpizar, Carlsson et al. (2005) and Carlsson, Johansson-Stenman et al. (2007). Johansson-Stenman, Carlsson et al. (2002), study the preferences of a sample of students who are asked to choose the best future society in the interest of their (hypothetical) grandchildren, using a hypothetical DCE. These papers focus on determining relative risk aversion and positionality, and their results indicate an average risk aversion, as well as signs of aversion to inequality. Alpizar, Carlsson et al. (2005) use the same non-incentivized experimental protocol as Johansson-Stenman, Carlsson et al. (2002) but with a focus on the positionality of different goods as well as a different sample (students in Costa Rica). They find that, on average, both relative and absolute income and consumption matter for individual utility. Expanding the experimental design of these two papers, Carlsson, Johansson-Stenman et al. (2007) use a representative sample of the Swedish population to examine the degree of positionality over different goods and income. They confirm the findings of the two previous papers in that relative income and absolute consumption play a role for some goods. Yamada and Sato (2013) study general income comparison effects in Japan, using a large Japanese sample and examining the importance of comparison benchmarks and reference groups.

The abovementioned papers illustrate cases where the DCE method is used to investigate distributional preferences[2]. However, when applying this method, one needs to consider the challenges to which the stated preference method is subjected, the most prominent being hypothetical bias, which usually involves inflating calculated willingness-to-pay estimates (List and Gallet 2001, Murphy, Allen et al. 2005). Several papers have found that introducing real economic incentives to valuation methods does influence hypothetical bias (Ready, Champ et al. 2010, Taylor, Morrison et al. 2010, Johansson-Stenman and Svedsäter 2012), while some studies have found little or no effect (Carson, Flores et al. 1996, Cameron, Poe et al. 2002, List, Sinha et al. 2006). As hypothetical bias have been found to be more pronounced for public goods (Murphy, Allen et al. 2005), such as the good studied in this paper, real monetary incentives were used in this study in an attempt to alleviate a potential hypothetical bias. This study introduced a real donation mechanism resembling the methods used in Löschel, Sturm et al. (2013) and Diederich and Goeschl (2014). In those studies, participants are given the option between cash or a European Union Allowance (EUA) that would be deleted after the completion of the experiment. In a recent study, Uehleke and Sturm (2017) analyse the effects of collective action upon the demand for voluntary climate change mitigation using an internet survey on a sample of the German population. Their design includes both a non-hypothetical and hypothetical preference elicitation mechanism, and their results suggest the presence of a small, but statistically significant hypothetical bias. They argue that the good (EUA) studied in their paper is abstract and not particularly morally inducing, which they suggest could be the cause of the small hypothetical bias. Although the present study uses the same mechanism to incentivize the decision of the participants, the focus here is on the outcome from the mitigation and adaptation mechanism, specifically the distributional effects from climate change impacts. This good appeals to the participants' sense of moral and ethics, which could result in the hypothetical bias being larger, as is often the case for goods with a high moral content (Johansson-Stenman and Svedsäter 2012).

Using a representative sample of the Danish population, 95 participants were provided with 200 DKK (~ 27 €) and subjected to a discrete choice experiment. Participants were asked to make 16 donation choices related to climate policy. Each climate policy was

described in terms of two outcome variables: 1) future income effects in the year 2100 as a result of climate policy and 2) present-day provision of co-benefits from mitigation actions. Both effects were

[2]In addition to the literature on positionality, the DCE method has also been used to elicit general willingness to pay estimates for climate policies. For examples, see papers by Brouwer, Brander et al. (2008), MacKerron, Egerton et al. (2009), Johnson and Nemet (2010), Carlsson, Kataria et al. (2012).

described for three specific regions of the world, Western Europe, Southeast Asia and Sub-Saharan Africa. For each participant, one of the 16 donation choices was selected at random to be realised. The participant's earnings were the difference between the amount donated to the selected climate policy and the original amount of money provided. The real donation mechanism was implemented through purchasing and subsequent cancelling of CO_2 quotas and credits from the European Emission Trading Scheme (EU ETS) and as donations to the UN Adaptation Fund.

Analysing the donation choices and estimating a random parameters utility function, this paper finds that intergenerational distributional preferences exist when people donate to climate policy and evidence from the study points towards elements of inequity aversion and general altruism as relevant factors in explaining average distributional social preferences. The findings contribute towards an empirical foundation for the use of equity weights in determining the social cost of carbon, with the implication that the price on greenhouse gas emissions should be higher due to the concern for intergenerational distributional impacts.

The remainder of the paper is structured as follows: Section 2 presents the case study and the experimental design and introduces the econometric framework; Section 3 presents the results and discusses the interpretation and sensitivity of the findings; and Section 4 presents the conclusion.

2. MATERIALS AND METHOD

2.1 CASE STUDY

The study considers effects of climate policy in three different regions of the world; Western Europe (WE), Southeast Asia (SEA) and Sub-Saharan Africa (SSA), which are regions commonly used in integrated assessment models that calculate the expected impacts of climate change (Anthoff and Tol (2010)). Figure 1 displays the regions in the study.

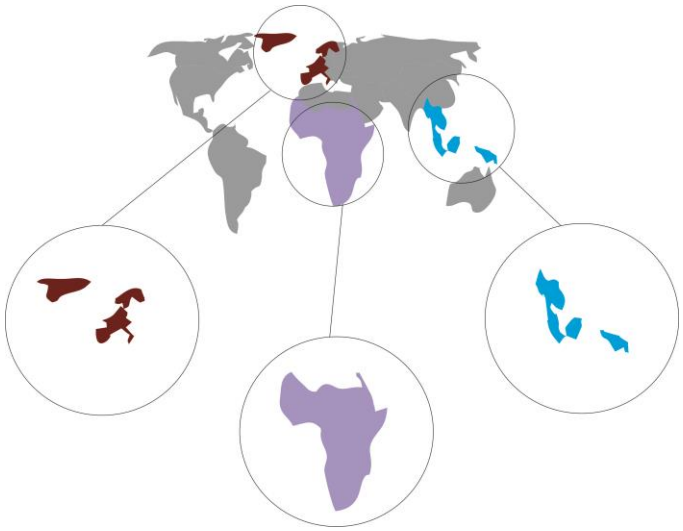

FIGURE 1. REGIONS INCLUDED IN THE STUDY: (WE) MARKED WITH PURPLE, (SEA) MARKED WITH BLUE AND (SSA) MARKED WITH LILAC.

Two effects of climate policy were considered for these three regions. The first effect was the impact that a specific climate policy would have on future average income in 2100, based on the policy lowering the expected level of climate change. The year 2100 was chosen as reference year in accordance with the approach in much of the scientific literature on climate change, where long time horizons are often used to reflect the slow adjustment of many physical and ecological processes (IPCC 2014). Participants were given the scenario that without additional investment in climate policy, people living in the selected three regions in year 2100 would suffer a loss of 5% in yearly, average income. The effect of additional climate policy initiatives (a mixture of mitigation and adaptation policies) would reduce this loss and create a gain in income, in comparison to no additional climate policy action (the status quo). Thus, the effect of additional climate policy initiatives was presented to participants as securing a gain in future income, compared to the status quo level of policy. The levels of the income effect attribute were set using the online appendix to Anthoff and Tol (2010) and were defined in accordance with

expected levels of climate change impact from integrated assessment models at the time. Please refer to Table 1 for the attribute levels.

The second effect of climate policy considered was the provision of present-day co-benefits through the mitigation aspect of climate policy. Participants were informed that the implemented climate policy could reduce CO_2 emissions through efforts targeted at lowering fuel consumption and changing combustion technologies in sectors such as industry, transportation and households[3], which would reduce levels of CO_2 emissions and result in lower levels of air pollution. The presented policies varied as to whether the policy included "fewer cases of respiratory diseases" in any of the three regions (See Table 1).

TABLE 1. ATTRIBUTES AND LEVELS

Attributes	Levels							Status quo
Co-benefit from regional mitigation efforts	Fewer cases of respiratory diseases (Western Europe) Fewer cases of respiratory diseases (Southeast Asia) Fewer cases of respiratory diseases (Sub-Saharan Africa) No effect							No effect
Income effect in terms of per capita income loss, DKK								
Western Europe	42,000		33,600		16,800		8,400	42,000
Southeast Asia	21,000		16,800		8,400		4,200	21,000
Sub-Saharan Africa	10,500		8,400		4,200		2.100	10,500
Donation, DKK	0	10	20	40	60	90	120	200	0

It was explained to the participants that the presented climate policies included *either* mitigation and adaption efforts *or* only adaptation effort. This could be inferred from the co-benefit attribute if it was specified as "No effect", which implied that the considered policy only included adaptation efforts. The

[3] Unfortunately, there was no feasible way of identifying this specific feature of the presented climate policy, as CO_2 quotas and credits were bought and erased without the possibility of specify the origin of reduction.

development of the survey included 3 focus groups and 2 pilot data collections, all of which provided valuable feedback and input to the survey development.

2.2 THE REAL DONATION MECHANISM

Participants were invited to participate in the survey via an email from the survey company that informed the participant that if they participated in this survey they would be able to earn up to 18.000 points or the

equivalent of 200 DKK / 27 €, depending on their choices throughout the survey[4]. In an earlier, similar study, the average response time was 20 minutes, suggesting that the hourly wage of participation in this experiment was 600 DKK ~ 80 €, which places the payment at the high end of comparable studies[5].

The actual donations to climate policy were fixed at intervals between 0-200 DKK (please refer to Table 1 for levels). Each participant made 16 climate policy donation choices, of which one donation option was selected at random to be realised. Participants were informed that they could choose how much of the endowment to keep or donate to climate policy and that all the realized donations would be used to purchase and delete CO_2 quotas and credits in the EU ETS[6], which would reduce CO_2 emissions, and donated to the UN Adaptation Fund[7]. Participants were given the opportunity to click on links that would direct them to official websites with information on the EU ETS as well as the UN Adaptation Fund[8]. We informed participants that the researchers behind the study would be responsible for purchasing quotas and credits as well as providing donations to the UN Adaptation Fund[9]. If participants chose to donate, then they had the option to receive documentation for the total amount used to

[4] The individuals participating in the internet panel earn points when they answer a survey for the company. These points can be exchanged for gift-certificates to a wide variety of non-food and food stores, as well as used to enter lotteries and as donations to good causes. We motivated the higher payment by informing the participants that the survey would be more complex than the ones they typically would answer.
[5] In Löschel, Sturm et al. (2013) participants were endowed with 40 €, and the experiment lasted 60-75 minutes.
[6] The EU ETS was established in 2005 to facilitate a European carbon market for greenhouse gas emissions and has since been used as in instrument in economic experiments (Löschel, Sturm et al. 2013, Diederich and Goeschl 2014) as a facilitator for measuring revealed individual demand for climate change mitigation.
[7] Because we purchased both CO_2 quotas and credits, we could ensure that CO_2 reduction was possible both in the EU and elsewhere globally, making the co-benefit in regions other than WE realistic.
[8] Initially the survey included detailed information on the European Emissions Trading Scheme and the UN Adaptation Fund, but extensive testing in focus-groups revealed that this information was irrelevant for participants and that the preferred option was to be given the opportunity of pursuing information if needed. The links provided were https://erhvervsstyrelsen.dk/eus-co2-kvoteregister-og-det-danske-kyoto-register and https://www.adaptation-fund.org.
[9] The participants were informed that the distribution of funds between mitigation and adaption effort was decided by the choices made by them and the other participants.

purchase CO_2 quotas/credits and donated to the UN Adaptation Fund, provided they supplied their email address[10]. This was done to increase the credibility of the transactions taking place.

Participants were informed that the difference between the donated amount and the original endowment of 200 DKK would be paid out in points to the participants when the survey closed and no later than the 18th of March 2016. In the survey, after making their choices, participants were informed about which donation decision that was realised and the number of points that would be transferred to their user account with the survey company.

2.3 EXPERIMENTAL DESIGN

The survey consisted of three sections. The first section introduced the case study and included questions related to general attitudes and beliefs towards climate change. The second section contained the choice sets, and the third section included follow-up questions as well as socio-demographic information. The experimental design consisted of 16 choice tasks, with 3 alternatives each, distributed into 2 blocks, leaving a total of 32 unique choice card designs. The technical design was optimized according to D-efficiency, using the program Ngene (Rose, Collins et al. 2009), using a main-effects dummy-coded MNL model with a D-error of 0.1919.

[10] 18 out of 95 participants supplied their email address.

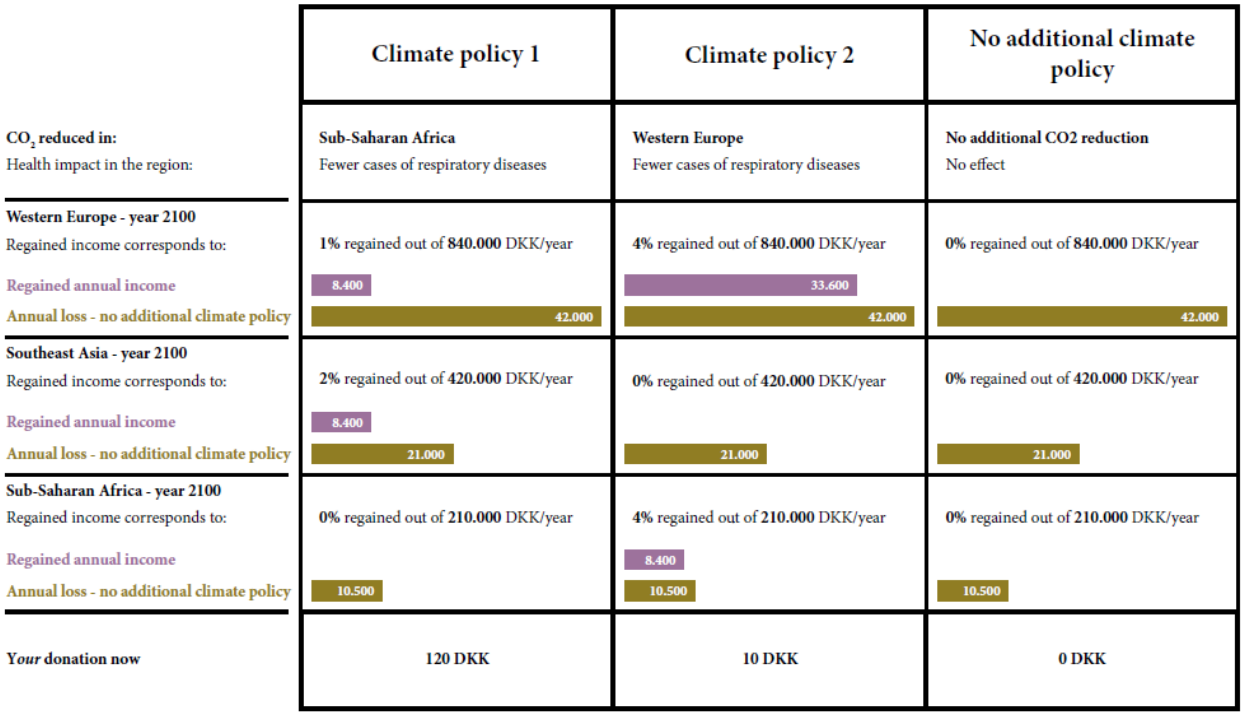

FIGURE 2. CHOICE CARD EXAMPLE

2.4 SURVEY STRATEGY AND DATA CONSTRUCTION

The survey was administered through Userneeds, a company specializing in online surveys that has an online panel of more than 95,000 members of the public in Denmark. The company has reliably handled several data collections involving scientific choice experiments and guarantees their participants complete anonymity. Data were collected through the online panel as it offered an opportunity to sample from the public in Denmark, a sample which is of specific interest in identifying average social preferences for the distributional effects of climate policy. The survey ran in February 2016, and 1,008 were invited to participate, of which 101 completed the

survey[11]. The survey was closed once a minimum population of representative participants had replied; thus, a standard response rate cannot be estimated. Of the 101 participants, 10 always chose not to donate, and of these 10, 6 were characterized as protesters[12] and excluded from the sample, leaving a sample of 95 respondents making 1,520 choice observations. The average response time was 23

[11] In total, 221 persons participated in the survey, but 120 of these participants had participated in an earlier, different version of the survey and are excluded in this paper.
[12] Participants were classified as protesters if they lacked faith in the presented scenarios, e.g., agreed to a statement of climate change being a global problem, which meant that Denmark should not be the only country engaging in additional climate policy, or they agreed to a statement of not wanting to pay for a policy that did not indicate how many tonnes CO_2 would be reduced.

minutes, with a standard deviation of 8 minutes. The sample was designed to be representative of age, gender and income, and Table 2 indicates that the sample was representative of gender and income, whereas the sample is on average older than the average population of Denmark. For some of the educational characteristics, the sample matches the general public, suggesting that the sample contained the same proportion of people with secondary and tertiary education as the public. The sample is overrepresented with respect to participants holding a vocational education and underrepresented with respect to participants with a primary education.

TABLE 2. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE AND THE POPULATION OF DENMARK

	Sample, n = 95	Population of Denmark
Female	0.49	0.50
Age	47.92	41.1
Income[a]	250,000 – 274,999	261,323
Education - Tertiary	0.21	0.27
Education - Secondary	0.11	0.09
Education – Vocational	0.61	0.30
Education - Primary	0.07	0.27

Education levels are provided for the population aged above 18 years.

[a]: Mean interval- income per participant, in DKK, for the sample.

2.5 ECONOMETRIC MODELS

Three different models are used to investigate the prevalence and stability of distributive preferences for the outcome of climate policy. All models are based on the random utility framework (McFadden 1973), in combination with Lancaster's theory on the characteristics of demand (Lancaster 1966), suggesting that we can model participant *n's* utility (*U*) for choice *i* as

$$U_{ni} = \beta x_{ni} + \varepsilon_{ni} \quad (1)$$

where β is a vector of parameter coefficients to be estimated, x_{ni} are observed parameters, such as individual characteristics and the choice attribute levels, and ε_{ni} is the unobserved, individual stochastic error term, assumed to be type I extreme value distributed.

The first model is a multinomial logit model (MNL), where the additional assumption of a utility maximizing participant leaves the choice probability over a sequence of choices *T* to be derived as

$$P_{ni} = \prod_{t=1}^{T} \frac{e^{\beta x_{nit}}}{\sum_j e^{\beta x_{njt}}} \quad (2)$$

where βx_{ni} is interpreted as above and *j* denotes alternative $j \neq i$. A critical aspect of the MNL model is the assumption of preference homogeneity, which means that the model assumes that the preferences of all participants in a sample can be accurately described by one estimate.

The second model is a random parameter logit model (RPL). This model allows for a heterogeneous distribution of preferences within the sample instead of assuming that all individuals have the same sensitivity to the estimated parameters as in the MNL model (Train 2009). The choice probability of the RPL model is

$$P_{ni} = \int \prod_{t=1}^{T} \frac{e^{\beta_n x_{nit}}}{\sum_j e^{\beta_n x_{njt}}} f(\beta) d\beta \quad (3)$$

Equation (3) captures that the estimated coefficients β varies over participants, with a density described by $f(\beta)$, and not fixed as in eq. (2). In RPL models, the distributional assumptions of the random parameters is made by the researcher (Hensher and Greene 2003), and here a normal distribution is assumed for all random parameters, thereby allowing for both negative and positive preferences for each attribute[13].

The third model is a variation of the RPL model, which allows for correlation between the estimated random parameters, which is often a more realistic assumption (Revelt and Train 1998, Hensher and Greene 2003). In the specific context given in this paper, it seems reasonable to assume that preferences for either mitigation or adaptation efforts across the three regions could be linked. One could imagine that a participant's preference for co-benefits in WE is related to his/her preference for co-benefits in the other two regions. Furthermore, the specification of the two social preference types, Inequity Averse Altruists and Altruists, implicitly assumes a relationship between one parameter across the three regions, and as such, it makes sense to explore the implications of this assumption further.

[13] A previous, related study indicated that a non-trivial share of the sample had a positive price coefficient, suggesting that they were willing to sacrifice money in order to support climate policy (reference removed in adherence to the blind review process). To allow for such preferences in the present study, the price parameter was assumed normally distributed. Several distributional forms were tested for the price parameter, including a lognormal distribution, triangular distribution and discrete, 2 class distribution, but in terms of stability the assumption of a normally distributed price outperformed all other specifications. The instability of the price parameter in the other model specifications did not influence the interpretation of the other utility parameters, nor the relationship between them. Only in the case where no preference heterogeneity was allowed (fixed parameter on price) did the relationship between the co-benefits in all three regions change, but the conclusions with respect to the relationship between the income effects remained stable. The models assuming a fixed price had the lowest performance in terms of model fit. All sensitivity tests are available upon request.

The utility function that we estimate across all models is specified as follows:

$$U_{ij} = \alpha ASC_j + \rho price_j + \delta_{WE} cobWE_j + \delta_{SEA} cobSEA_j + \delta_{SSA} cobSSA_j + \beta_{WE} incWE_j + \beta_{SEA} incSEA_j + \beta_{SSA} incSSA_j + \varepsilon_{ij} \quad (4)$$

where α is the coefficient for the alternative specific constant, the coefficient for the cost of donation is captured by p_j, and ε_{ij} represents the random error term. δ's are parameter coefficients for the co-benefit (*cob*) in all three regions, and the β's capture the utility effect of income losses (*inc*) in all three regions.

The test for distributional social preferences is based on the estimated coefficients for the income effect and co-benefit parameters in eq. (4), and (reference removed in adherence to the blind review process) present a motivated theoretical framework for the empirical formulation of the two social preference types, and test the implications on data from a stated choice experiment.

The Inequity Averse Altruist assigns a greater sensitivity to income effects and co-benefits in the two poorer regions of the study, e.g. SEA and SSA, compared to WE, suggesting that the utility of agents is more sensitive to income effects and co-benefits for poorer agents. This behavioural type cannot be rejected if the conditions in eq. (5) are met:

Inequity Averse Altruists: $\delta_{WE} < \delta_{SEA} < \delta_{SSA}$ and $|\beta_{WE}| < |\beta_{SEA}| < |\beta_{SSA}|$ (5)

The conditions imply that for a one-unit increase in income loss or co-benefit attribute in each region, Inequity Averse Altruists' marginal utility is statistically significantly more impacted by income losses and co-benefits in a poorer region compared to a richer region.

The Altruist type is characterized by showing no sensitivity towards who receives the income effect or co-benefits. Instead, this type is concerned with the overall outcome of climate policy (e.g. across the three regions, WE, SEA and SSA). The behavioural pattern of Altruists cannot be rejected if the following conditions are met:

Altruists: $\delta_{WE} = \delta_{SEA} = \delta_{SSA}$ and $|\beta_{WE}| = |\beta_{SEA}| = |\beta_{SSA}|$ (6)

For a one-unit increase in the income effect or co-benefit attribute for each region, the behaviour of the Altruists type predicts that individuals' marginal utility is not statistically significantly different across the three regions.

3. RESULTS

3.1 THE DONATION PATTERN

Figure 2 shows the distribution of choices for each of the three policy alternatives, from which it is visible that the status quo policy option is chosen somewhat less frequent compared to the other two alternatives. Figure 2 also displays the percentage of all donation choices for each donation level, indicating that a little less than half of the donations (40%) were donations of 0 DKK. When looking only at the two climate policy alternatives, Figure 3 illustrates that the share of respondents choosing either of these two policies drops when the price of the policy increases, but that at the high donation levels approximately 30% of participants still choose to donate. The average amount donated to climate policy was 54 DKK, with a standard deviation of 61 DKK. This corresponds to approximately 7.25 €, and represents 27% of the endowment of 200 DKK

[14]. The average amount donated in this study is comparable to the typical average donation level found in voluntary contribution mechanism (VCM) experiments, as summarized in Ledyard (1995), which suggests that people on average donate 20-30% of their endowment.

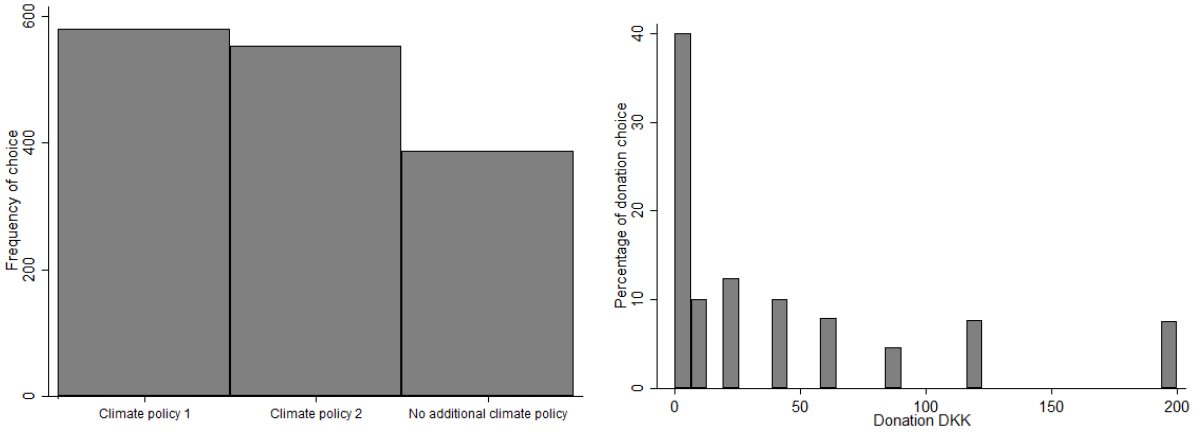

FIGURE 2. HISTOGRAM SHOWING THE FREQUENCY OF CHOICE OF EACH OF THE THREE CLIMATE POLICIES AND BAR CHART SHOWING THE DISTRIBUTION OF MONEY (DKK) DONATED TO CLIMATE POLICY. IN TOTAL, THERE ARE 1,520 OBSERVATIONS, DISTRIBUTED ACROSS 95 PARTICIPANTS, EACH MAKING 16 CHOICES.

[14] The average donated amount is based only on choices of climate policy, e.g., alternative 1 and 2. If the status quo option choices are included, the average drops to 41 DKK.

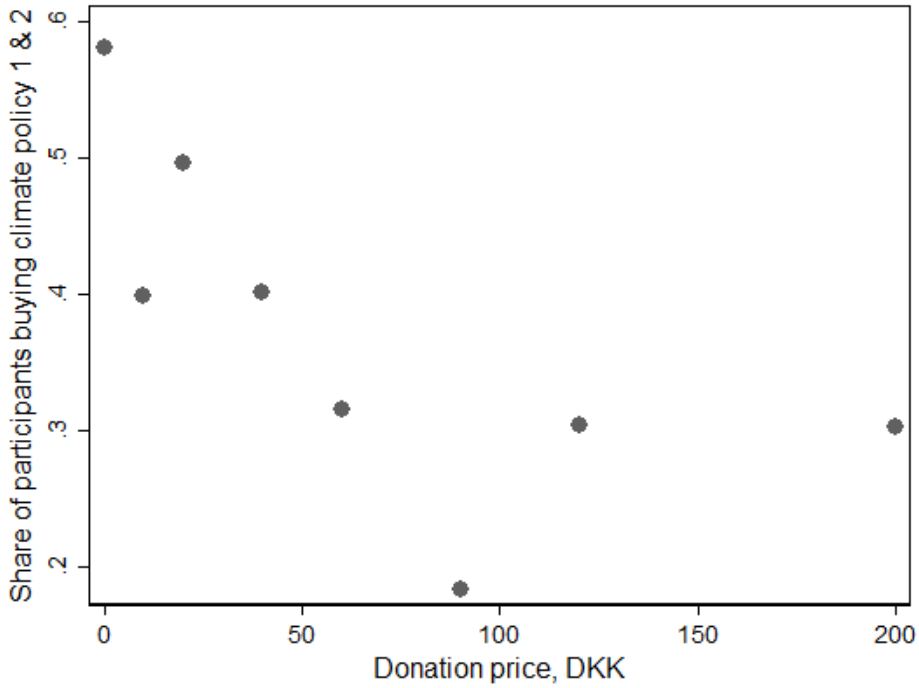

FIGURE 3. THE CHOICE OF CLIMATE POLICY AS A FUNCTION OF THE DONATION PRICE. THE VERTICAL AXIS MEASURES THE SHARE OF PRO-CLIMATE POLICY CHOICES AT EACH PRICE LEVEL.

3.2 ECONOMETRIC ANALYSES

Table 3 presents the results of both the MNL and the two RPL models without/with full correlation between the random parameters. All models are estimated in STATA 13.1, using the mixlogit command (Hole 2007) with simulation of the log-likelihood function, using 1000 Halton draws per participant and random parameter.

Across all three models in Table 3, indications of distributional preferences emerge which for the income effects are robust to variations in model specification. The results for the income effects consistently show that the parameter estimates for future income losses in WE are lower than the estimates for both SEA and SSA, with a statistically significant difference between WE-SEA and WE-SSA. These results suggest participants in the sample, on average, experienced more disutility from income losses in the poorer regions, and the behavioural pattern of Inequity Averse Altruists cannot be rejected for the difference between WE–SEA and WE-SSA. Turning to the co-benefits, the distributional patterns of Model 2 and 3 indicate that the behavioural pattern of Altruists cannot be rejected, suggesting the respondents did not prefer providing co-benefits in a particular region but rather gained utility from the provision in any of the three regions. The results from each of the three models are discussed below in more detail.

TABLE 3. ESTIMATION RESULTS, N = 4,560

		Model 1		Model 2		Model 3	
		Est.	|z value|	Est.	| z value |	Est.	| z value |
ASC	μ	0.995	6.910	-0.328	0.720	-1.034	2.440
	σ			2.669	7.380	2.228	3.540
incWE	μ	-0.017	6.290	-0.040	5.510	-0.044	5.410
	σ			0.055	7.000	0.050	6.630
incSEA	μ	-0.041	7.260	-0.087	7.990	-0.087	7.310
	σ			0.043	2.450	0.057	3.990
incSSA	μ	-0.047	4.170	-0.107	3.490	-0.108	3.420
	σ			0.227	7.010	0.269	7.670
cobWE	μ	0.964	8.400	1.420	6.880	1.552	5.200
	σ			0.680	3.020	1.267	4.590
cobSEA	μ	0.730	6.680	1.459	7.330	1.888	5.560
	σ			0.736	3.490	1.674	6.340
cobSSA	μ	1.059	9.210	1.449	7.670	1.615	4.930
	σ			-0.417	1.730	1.762	6.370
price	μ	-3.667	-6.410	-39.653	5.200	-40.228	7.000
	σ			51.235	5.930	72.682	7.910
LL		-1509.373		-942.980		-881.262	
K		8		16		44	
ρ^2		0.096		0.375		0.416	

Model 1 shows the result of the standard MNL model. Future income losses in all three regions significantly decrease utility and income losses in SEA generate significantly more disutility than losses in WE (Wald-test, p=0.0002). The same pattern is found for income losses in SSA compared to income losses in WE (Wald-test, p=0.0100). There is no significant difference between income losses in SEA and SSA (Wald-test, p=0.5981). Provision of co-benefits in any of the three regions increases utility, with participants preferring co-benefits in their own region (WE) to the provision in SEA (Wald-test, p=0.0266). However, the results do not show a difference between co-benefits provided in WE compared to SSA (Wald-test, p=0.3133). Co-benefits in SSA have a significantly higher impact on utility than co-benefits in SEA (Wald-test, p=0.0016). As expected, increasing the cost of donating to climate policy significantly decreases utility. The status quo option captured by the ASC is positive and

significant, suggesting that not investing in additional climate policy on average had a positive impact on utility.

Model 2 displays the results of an RPL model, exploring the preference heterogeneity of the sample respondents. The overall fit of the RPL model is better than that of the MNL model, with a significant drop in the log-likelihood of approximately 550 units (likelihood ratio test = 1132.78, df = 8). The better fit is also reflected in the ρ^2 statistic, which increases by a factor 3.5. The results from Model 2 suggest significant preference heterogeneity, at a 5% level, for all estimated parameters, except for co-benefits in SSA. Several of the estimated parameters have standard deviations that are larger than the mean estimate. These include the status quo option (ASC), income effects in Western Europe (incWE) and Sub-Saharan Africa (incSSA) as well as the price of climate policy (price). The implications of these large standard deviations are that both utility and disutility can be derived from these attributes. For example, some participants derive utility from the status quo and future income effects in WE and SSA. The former interpretation is not controversial, as one would expect to find people who have no interest in investing in additional climate policy. However, the latter interpretation is slightly more surprising, suggesting that some of the participants gain utility from future income losses for people living in either WE or SSA.

The interpretation and significance of all estimated parameters does not change between Model 1 and 2, except for the influence of the status quo option, which in Model 2 is negative, indicating that the average effect of not choosing a climate policy is negative. Income effects in WE and SEA remain negative and significant, with income losses in SEA and SSA generating significantly more disutility than income losses in WE (WE-SEA, Wald-test, p=0.0001, WE-SSA, Wald-test, p=0.0301). The provision of co-benefits in all three regions increases utility, with no significant difference between where the co-benefits are provided. Increases in the price of climate policy have a negative and significant impact on utility.

In Model 3, the assumption of independent univariate normal distributions is relaxed by allowing for correlation between the random parameters. Looking at general model performance, a significant drop of approximately 60 log-likelihood units (likelihood ratio test = 123.44, df = 28) is observed along with an improved ρ^2 statistic. The resulting superior model fit compared to Model 2 suggests that correlation between the random parameters is relevant in describing the observed preference heterogeneity. This is also reflected in the higher magnitude for more than half of the estimated coefficients compared to Model 2, suggesting that allowing for correlation between the random parameters captures more variance in the unobserved part of utility. This effect is most pronounced for co-benefits in all three regions and the status quo, whereas the coefficients on income effects in all three regions changes only slightly between Model 2 and 3. The interpretation with respect to the distributional preferences for both income effects and co-benefits remains the same in Model 3 as in Model 2. The only changes from

Model 2 to 3 is that the status quo option becomes statistically significant and that the preference heterogeneity for co-benefits in SSA becomes significant at a 5% level, leaving all random parameters with significant heterogeneity around the mean. This heterogeneity suggests that 19% of respondents preferred higher future income losses in WE, while 6% of respondents preferred this in SEA. With respect to SSA, 34% of the sample preferred future income losses in this region to be higher. Co-benefits were on average valued as positive, but co-benefits provided in WE generated disutility for approximately 11% of the participants, whereas this number was 12% for co-benefits provided in SEA and 17% for co-benefits provided in SSA.

TABLE 4. CHOLESKY DECOMPOSITION AND CORRELATION MATRIX

	ASC	incWE	incSEA	incSSA	cobWE	cobSEA	cobSSA	price
ASC	2.228	-0.007	-0.021	-0.062	0.375	0.269	0.348	0.076
incWE	0.017	0.047	0.145	0.348	-0.116	-0.095	-0.106	0.146
incSEA	0.029	0.004	0.049	0.338	0.066	-0.070	0.115	0.203
incSSA	0.128	0.112	0.094	0.186	-0.007	-0.056	-0.029	-0.018
cobWE	-0.131	-0.448	0.874	-0.180	0.768	0.722	0.835	0.038
cobSEA	0.167	-0.292	0.119	0.083	1.587	-0.385	0.775	-0.244
cobSSA	0.175	-0.616	0.735	-0.458	1.367	-0.270	-0.055	-0.022
price	-46.713	-3.505	28.226	-38.975	-4.381	20.408	13.409	12.533

The estimated standard deviations for the random parameters in Model 3 are not independent because of the correlation between the random parameters. Table 4 reports the Cholesky decomposition and correlation matrix and demonstrates that there is a high level of positive correlation between the co-benefits in all regions, suggesting that participants who value co-benefits in one region also tend to value the provision of co-benefits in the other two regions. Table 4 also indicates a somewhat less strong positive correlation between income effects in WE–SSA and SEA-SSA, which suggests that respondents who valued income effects in SSA also tended to value them in WE and SEA.

3.3 BEYOND THE MEAN TENDENCIES – DISTRIBUTION OF INDIVIDUAL COEFFICIENTS

As suggested by the significant preference heterogeneity across all climate policy attributes in the preferred Model 3, respondents in the sample valued the climate policy attributes differently. Although the results show that on average tendencies for Inequity Averse Altruists to be present between income

effects in WE–SEA and WE-SSA, as well as an average tendency for Altruists for the provision of co-benefits, these average tendencies are compiled by many different behavioural patterns in the data. Therefore, this subsection explores the individual specific coefficients for income effects and co-benefits in the three regions[15].

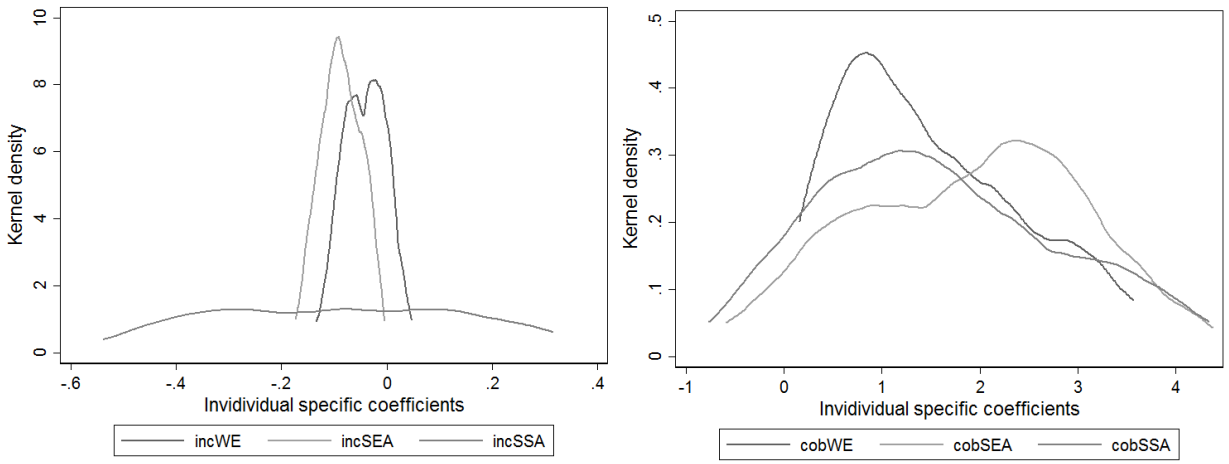

FIGURE 4. DISTRIBUTION OF INDIVIDUAL SPECIFIC COEFFICIENTS FOR INCOME EFFECTS (LEFT) AND CO-BENEFITS (RIGHT).

Looking at the distribution of individual specific coefficients for income effects in the three regions (left panel of Figure 4), the distribution of individual-specific coefficients for income effects in WE and SEA have almost the same shape, with the distribution of coefficients for SEA shifted more to the left, suggesting a more negative range of valuation of income effects in SEA. The plot of individual-specific coefficients for income effects in SSA reflects the imprecise estimation of this parameter, with the distribution of individual-specific coefficients overlapping the distributions for the two other regions. The right panel of Figure 4 show distributions of individual-specific coefficients for co-benefits in the three regions. The distribution for co-benefits in WE is narrower and spikes in low valuation levels, compared to the distributions for co-benefits in SEA and SSA. Both distributions for the two latter regions are more spread out, with co-benefits in SEA spiking at higher valuation levels compared to co-benefits in SSA. From Figure 4, it is not possible to discern how an individual valued income effects in SEA compared to income effects in SSA, which is of interest when exploring the behavioural patterns underlying the mean tendencies. The panels in Figure 5 illustrate combinations of individual specific coefficients for both regional income effects and co-benefits. The comparison of income effect coefficients for WE and SEA show a tendency for income effects in SEA to be valued more than income effects in WE, with most coefficients being above the 45-degree line. When comparing how an individual valued coefficients in WE-SSA and SEA-SSA, there is a tendency for two clear groupings, individuals who

[15] The individual specific coefficients are calculated by the command mixlbeta (Hole 2007) and build on the method in Train (2009).

preferred securing lower future income losses in SSA (a negative coefficient for income effects in SSA) and valued this more than securing lower income losses in SEA or in WE. On the other hand, individuals who disliked securing lower income losses in SSA (a positive coefficient) preferred securing lower income losses in both SEA and WE. These two groupings suggest some form of inequity aversion for a group of individuals who react more strongly to income losses in the poor region of SSA than to losses in WE and SEA. Another group seems unwilling to support policies that favour SSA and instead prefer to lower income losses in WE and SEA.

Turning to the comparisons of individual specific coefficients for regional co-benefits, a clear grouping based on the sign and range of the coefficients does not emerge. Rather, the three lower panels in Figure 5 indicate a somewhat even spread around the 45-degree line, with a tendency of inequity aversion in the form of more individuals preferring co-benefits in SEA compared to WE, but the plot also shows a tendency for co-benefits in SEA to be valued more than in SSA. Compared to the coefficient comparisons for income effects, the three panels for co-benefits also show a higher share of individuals having the same valuation of regional co-benefits, which is consistent with the average tendency of Altruists.

In conclusion, the above coefficient comparisons indicate that elements of inequity aversion can be traced back to the individual level, both with respect to income effects and co-benefits, but the comparisons also show that the sample contains individuals for whom inequity aversion does not seem to play a role. The limited dimensionality of the above two-way coefficient comparison hinders a full-out classification of an individual's coefficients across more than two regions; thus, the above results should be viewed in this light. Additionally, the panels in Figure 4 and 5 display tendencies, but offer no grounds for a statistical test of behavioural hypotheses at the individual level.

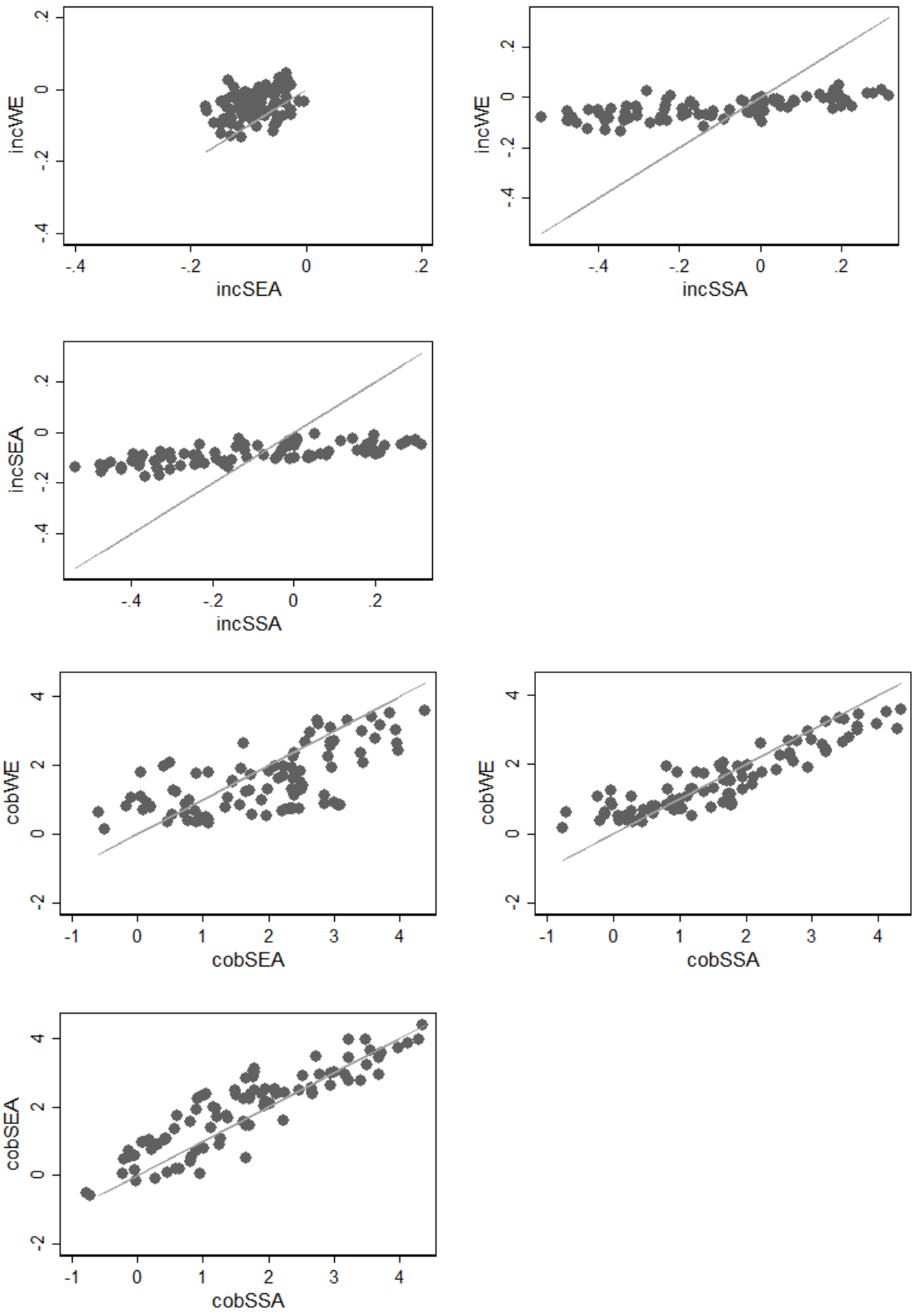

FIGURE 5. PLOTS OF INDIVIDUAL SPECIFIC COEFFICIENTS FOR INCOME EFFECTS AND CO-BENEFITS IN ALL THREE REGIONS. THE DOTS MARK THE INDIVIDUAL COEFFICIENTS AND THE 45-DEGREE LINE MARK WHERE THE TWO REGIONAL COEFFICIENTS THAT ARE BEING COMPARED ARE IDENTICAL FOR A RESPONDENT.

4. CONCLUDING DISCUSSION

This paper investigates whether distributional social preferences are important for actual donations to climate policy; a question of relevance because concerns for distributive outcomes of climate change affect the optimal climate policy level. Using a representative sample of the Danish public, this paper finds that there does appear to be an empirical foundation for the existence of distributional social preferences in relation to climate policy and that elements of both Inequity Averse Altruists and Altruists are particularly relevant in describing the observed distributional preferences across a range of climate policy attributes. With respect to future income losses from climate change, the characterization of social preferences suggests that Inequity Averse Altruists matter for the choice of climate policy, indicating that income losses in a rich region (WE) give rise to less disutility than income losses in poorer regions (SEA and SSA). For the more immediate consequence of climate policy in the form of provision of co-benefits, this paper finds no statistically significant difference between the average valuation of co-benefits in participants' own region (WE) compared to two other regions (SEA and SSA), which suggests Altruists cannot be rejected for this set of attributes of climate policy.

Although the specific focus of this paper is centred around a previously understudied area of the economic valuation literature on climate policy, links to existing studies emerge. Like previous studies, this paper finds that donation levels towards climate policy, on average, are above zero (Löschel, Sturm et al. 2013, Diederich and Goeschl 2014). In addition to this confirmation of a general willingness to support climate policies, this paper provides additional empirical evidence for the relevance of social preferences in a climate policy context. Intergenerational equity concerns have been found to influence preferences for climate policy (Lange, Vogt et al. 2007, Dannenberg, Sturm et al. 2010), which is a finding that this paper corroborates in an intergenerational context, by identifying social preferences for the distributive outcomes of climate policy.

Previous studies have found mixed evidence for the "yes in my backyard" effect on peoples' willingness to pay (WTP) for climate policy, with some studies suggesting that WTP increases with implementation in their own country/region (Carlsson, Kataria et al. 2012, Longo, Hoyos et al. 2012, Torres, MacMillan et al. 2015, Buntaine and Prather 2017). Other studies find a reverse effect, with a clear preference for implementation in other regions (Baranzini, Borzykowski et al. 2016) or no preference at all for implementation site (Diederich and Goeschl 2017). The results presented in this paper conform to the latter pattern, as no statistically significant difference between where the co-benefits are provided is found. The present choice context design had a strong focus on distributional issues, which could have caused respondents to consider the effect in the two other regions (SEA and SSA) more as compared to a situation where they are asked about their general preference for implementation site as in

Carlsson, Kataria et al. (2012).

The differing characterization of distributional social preferences for income effects and co-benefits may not only be caused by the temporal difference, but also could be attributed to the specification of income effects as quantitative and co-benefits as qualitative. Previous studies have typically specified co-benefits as qualitative (as in the present study), with results not producing a clear direction for peoples' preferences regarding the location of co-benefits. However, it may be argued that the monetized income effects are formulated in a metric that people encounter in their everyday life, with existing literature having shown that relative income comparisons matter for people (Johansson-Stenman, Carlsson et al. 2002, Yamada and Sato 2013), making the preferences for such an attribute especially susceptible for elements inequity aversion. It would be interesting to investigate whether the tendency for inequity aversion remains with only a qualitative attribute description of the income effects.

Some caveats with respect to design and external validity also should be mentioned. Given that the payment vehicle was a voluntary, real donation, free-riding behaviour should be expected. Individuals who free-ride are not assumed to reveal their true preference for the good being valued, and with free-riding behaviour in the experiment, the expectation is that the observed donation level would be lower than that in an experiment with a coercive payment vehicle. Unfortunately, the data does not allow such a comparison to be carried out; thus, it cannot be determined whether the observed level of donation is a lower bound on the willingness to pay for climate policy. Furthermore, the donation context is arguably complex and challenging for the respondents' cognitive skills, because they are asked to consider effects in both time and space, which could lead to the respondents' using heuristics or decision rules to navigate a challenging task, as seen in other choice experiment contexts (Hensher 2006, Hensher and Greene 2010). The study is based on a small (representative) sample of the Danish population. In 2016, Denmark was ranked as 31st in a global comparison of GPD per capita,[16] and although a trade-off in the donation setting was observed (e.g. people did not simply give their endowment away) it is likely that the average donated amount is higher than it would have been in other, less wealthy countries. As identified in some experimental economics papers comparing behaviour of different nationalities, Danes tend to be very collaborative (Herrmann, Thöni et al. 2008, Engelmann and Normann 2010). Possible future work would benefit from focusing on establishing the relevance of distributional preferences in relation to climate policy in other regions/countries of the world to achieve a global, diversified measure of distributional preferences in relation to climate policy.

The study presented in this paper provides additional support and an empirical a foundation for the practice of including distributional social preferences in the design of policies using the social cost of

[16] https://www.cia.gov/library/publications/resources/the-world-factbook/rankorder/2004rank.html#da

carbon to value the impact of climate change. The findings of this study indicate that such an effort is not only warranted by theoretical arguments but also justified through a description of people's preferences, based on actual donations to climate policy. Policymakers seeking to increase the acceptability of proposed climate policy initiatives could benefit from stressing the intergenerational distributional aspects of such policies.

Acknowledgements

Funding: This work was supported by the University of Copenhagen

REFERENCES

Alló, M. and M. L. Loureiro (2014). "The role of social norms on preferences towards climate change policies: A meta-analysis." Energy Policy **73**(0): 563-574.

Alpizar, F., et al. (2005). "How much do we care about absolute versus relative income and consumption?" Journal of Economic Behavior & Organization **56**(3): 405-421.

Amir, O. and D. G. Rand (2012). "Economic games on the internet: The effect of $1 stakes." PloS one **7**(2): e31461.

Anthoff, D. and R. S. J. Tol (2010). "On international equity weights and national decision making on climate change." Journal of Environmental Economics and Management **60**(1): 14-20.

Baranzini, A., et al. (2016). Carbon offsets out of the woods? The acceptability of domestic vs. international reforestation programmes. London: Grantham Research Institute on Climate Change and the Environment. **Working paper No.257**.

Brekke, K. A. and O. Johansson-Stenman (2008). "The behavioural economics of climate change." Oxford Review of Economic Policy **24**(2): 280-297.

Brouwer, R., et al. (2008). ""A convenient truth": air travel passengers' willingness to pay to offset their CO2 emissions." Climatic Change **90**(3): 299-313.

Buntaine, M. T. and L. Prather (2017). Global Problems, Local Solutions: Preferences for Domestic Action Over International Transfers in Global Climate Policy, University of California.

Cameron, T. A., et al. (2002). "Alternative Non-market Value-Elicitation Methods: Are the Underlying Preferences the Same?" Journal of Environmental Economics and Management **44**(3): 391-425.

Carlsson, F., et al. (2007). "Do you enjoy having more than others? Survey evidence of positional goods." Economica **74**(296): 586-598.

Carlsson, F., et al. (2012). "Paying for Mitigation: A Multiple Country Study." Land Economics **88**(2): 326-340.

Carlsson, F., et al. (2013). "A fair share: Burden-sharing preferences in the United States and China." Resource and Energy Economics **35**(1): 1-17.

Carson, R. T., et al. (1996). "Contingent Valuation and Revealed Preference Methodologies: Comparing the Estimates for Quasi-Public Goods." Land Economics **72**(1): 80-99.

Dannenberg, A., et al. (2010). "Do Equity Preferences Matter for Climate Negotiators? An Experimental Investigation." Environmental and Resource Economics **47**(1): 91-109.

Diederich, J. and T. Goeschl (2014). "Willingness to Pay for Voluntary Climate Action and Its Determinants: Field-Experimental Evidence." Environmental and Resource Economics **57**(3): 405-429.

Diederich, J. and T. Goeschl (2017). Does Mitigation Begin At Home? Discussion Paper Series No. 634, University of Heidelberg.

Engelmann, D. and H.-T. Normann (2010). "Maximum effort in the minimum-effort game." Experimental Economics **13**(3): 249-259.

Fehr, E. and K. M. Schmidt (1999). "A Theory of Fairness, Competition, and Cooperation." The Quarterly Journal of Economics **114**(3): 817-868.

Gampfer, R. (2014). "Do individuals care about fairness in burden sharing for climate change mitigation? Evidence from a lab experiment." Climatic Change **124**(1-2): 65-77.

Hensher, D. A. (2006). "How do respondents process stated choice experiments? Attribute consideration under varying information load." Journal of Applied Econometrics **21**(6): 861-878.

Hensher, D. A. and W. H. Greene (2003). "The mixed logit model: the state of practice." Transportation **30**(2): 133-176.

Hensher, D. A. and W. H. Greene (2010). "Non-attendance and dual processing of common-metric attributes in choice analysis: a latent class specification." Empirical economics **39**(2): 413-426.

Herrmann, B., et al. (2008). "Antisocial Punishment across Societies." Science **319**(5868): 1362-1367.

Hole, A. R. (2007). "Estimating mixed logit models using maximum simulated likelihood." Stata Journal **7**(3): 388-401.

Horton, J. J., et al. (2011). "The online laboratory: conducting experiments in a real labor market." Experimental Economics **14**(3): 399-425.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change R. K. P. a. L. A. Meyer. Geneva, Switzerland, IPCC**:** 151 pp.

Johansson-Stenman, O., et al. (2002). "MEASURING FUTURE GRANDPARENTS' PREFERENCES FOR EQUALITY AND RELATIVE STANDING." The Economic Journal **112**(479): 362-383.

Johansson-Stenman, O. and H. Svedsäter (2012). "Self-image and valuation of moral goods: Stated versus actual willingness to pay." Journal of Economic Behavior & Organization **84**(3): 879-891.

Johnson, E. and G. F. Nemet (2010). WIllingness to pay for climate policy: a review of estimates. Working Paper Series, La Follette School

Kagel, J. and A. E. Roth (1995). The Handbook of Experimental Economics, PrincetonUniversityPress.

Kverndokk, S., et al. (2014). "The trade-off between intra- and intergenerational equity in climate policy." European Economic Review **69**(0): 40-58.

Lancaster, K. J. (1966). "A New Approach to Consumer Theory." Journal of Political Economy **74**(2): 132-157.

Lange, A., et al. (2007). "On the importance of equity in international climate policy: An empirical analysis." Energy Economics **29**(3): 545-562.

Ledyard, J. O. (1995). Public Goods: A Survey of Experimental Research. Handbook of Experimental Economics. J. Kagel and A. Roth, Princeton University Press**:** 111-181.

List, J. and C. Gallet (2001). "What Experimental Protocol Influence Disparities Between Actual and Hypothetical Stated Values?" Environmental and Resource Economics **20**(3): 241-254.

List, J. A., et al. (2006). Using Choice Experiments to Value Non-Market Goods and Services: Evidence from Field Experiments. Advances in Economic Analysis & Policy. **5**.

Longo, A., et al. (2012). "Willingness to Pay for Ancillary Benefits of Climate Change Mitigation." Environmental and Resource Economics **51**(1): 119-140.

Löschel, A., et al. (2013). "The demand for climate protection—Empirical evidence from Germany." Economics Letters **118**(3): 415-418.

MacKerron, G. J., et al. (2009). "Willingness to pay for carbon offset certification and co-benefits among (high-)flying young adults in the UK." Energy Policy **37**(4): 1372-1381.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behaviour. New York, Academic Press.

Murphy, J. J., et al. (2005). "A Meta-analysis of Hypothetical Bias in Stated Preference Valuation." Environmental and Resource Economics **30**(3): 313-325.

Pearce, D. (2003). "The Social Cost of Carbon and its Policy Implications." Oxford Review of Economic Policy **19**(3): 362-384.

Ready, R. C., et al. (2010). "Using respondent uncertainty to mitigate hypothetical bias in a stated choice experiment." Land Economics **86**(2): 363-381.

Revelt, D. and K. Train (1998). "Mixed Logit with Repeated Choices: Households' Choices of Appliance Efficiency Level." Review of Economics and Statistics **80**(4): 647-657.

Rose, J., et al. (2009). "Ngene 1.0 stated choice experiment design software." University of Sydney.

Suri, S. and D. J. Watts (2011). "Cooperation and contagion in web-based, networked public goods experiments." PloS one **6**(3): e16836.

Taylor, L. O., et al. (2010). "Exchange Rules and the Incentive Compatibility of Choice Experiments." Environmental and Resource Economics **47**(2): 197-220.

Tol, R. S. J. (2011). "The Social Cost of Carbon." Annual Review of Resource Economics **3**(1): 419-443.

Torres, A. B., et al. (2015). "'Yes-in-my-backyard': Spatial differences in the valuation of forest services and local co-benefits for carbon markets in México." Ecological Economics **109**: 130-141.

Train, K. (2009). Discrete Choice Methods with Simulation Second Edition, Cambridge University Press.

Uehleke, R. and B. Sturm (2017). "The Influence of Collective Action on the Demand for Voluntary Climate Change Mitigation in Hypothetical and Real Situations." Environmental and Resource Economics **67**(3): 429-454.

Yamada, K. and M. Sato (2013). "Another avenue for anatomy of income comparisons: Evidence from hypothetical choice experiments." Journal of Economic Behavior & Organization **89**: 35-57.