Understanding Public Support for International Climate Adaptation Payments: Evidence from a Choice Experiment

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Abstract

While the importance of climate change adaptation is not in doubt, adaptation funding in developing countries remains scarce. Therefore, climate finance institutions and national decision-makers face difficult trade-offs when allocating funds. While not a substitute for expert judgement, we argue that understanding how the public thinks could play a role in building support. Using a representative sample of the UK population, we use a discrete choice experiment to explore in particular the way in which distributional considerations drive respondent decisions in two dimensions: (a) amongst recipients of adaptation finance in recipient developing countries, and (b) amongst those who contribute to this finance (via taxation). We categorise our results as follows. First, respondents show strong distributional preferences for funds to reach the poorest individuals, supporting adoption of egalitarian policy mandates among climate adaptation funds. Secondly, respondents prefer an 'ability-to-pay' approach over the 'polluter-pays-principle' as a way of funding. Thirdly, our results suggest that a focus on communicating future benefits to UK residents can increase policy support. Overall, however, our findings also reveal that public support for global climate adaptation payments is insufficient. Yet we provide means of understanding how to allocate all-too-scarce funds and how to increase support for adaptation finance.

Keywords: Climate Policy; Choice Modelling; Climate Change Adaptation; Public Acceptability

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1 Introduction

The Paris Agreement undoubtedly added further force to commitments on adaptation to climate change by the international community.[1] Funding of up to USD100 billion per year was pledged by 2020, to come from public, private, bilateral and multilateral sources (Klöck et al., 2018; Westphal et al., 2015). This is all the more important given the gap between required emission reductions and submitted nationally determined contributions (and additionally the lack of ambition, so far, in meeting these targets). Yet even if the international community succeeds in limiting climate change to 1.5 or 2.0°C warming, adaptation remains critical especially in developing countries.

Existing pledges for adaptation funding, however, are likely to fall far short of what will be required (Buchner et al., 2017; Barr et al., 2010; Fankhauser, 2010; Parry et al., 2009). For 2020, the latest available estimates suggest that funding has fallen well short of the USD100 billion target. The Organisation for Economic Co-operation and Development (OECD) estimates that approximately USD67 billion in climate finance have been mobilized in 2020 by developed countries. However, the absence of clearly established accounting rules can allow countries to follow different reporting standards, potentially inflating their commitments (OECD, 2020; Roberts et al., 2021). A much lower estimate is stated by Oxfam (2020), which counts only USD19-22.5 billion in public climate finance for the time 2017-2018, which is two thirds lower than what was reported by developed countries. While it is difficult to provide an exact estimate of mobilized climate finance, a large gap remains between the pledged and the mobilized amounts. A key challenge is how to boost funding ambitions rapidly in the years to come, especially in an environment where budgets for overseas development assistance (ODA), such as in the UK, are shrinking.[2] An important finding in this respect is O'Garra and Mourato (2016). Using a contingent valuation survey, that study estimated a substantial shortfall between the UK share of a plausible global target for adaptation finance and what UK respondents stated, on average, they would pay. This is a salutary reminder that public support for providing the necessary funding for climate adaptation around the world cannot be taken for granted.

Nonetheless, it is well known from the literature on the public acceptability of *domestic* climate policy that the extent of public support depends, in no small part, on possibly multiple aspects of policy

[1] It is worth noting that recognition of these commitments is long-standing, for example in the 2007 Bali Action Plan (UNFCCC, 2007) and in the 2009 Copenhagen Accord where the international community first agreed upon the target to spend USD100 billion per year by 2020 to address climate change related needs of developing countries. The target was further strengthened in the Cancun Agreements in 2010 where the Green Climate Fund (GCF) was established to act as a key delivery mechanism.

[2] For example, in the UK Spending Review in late 2020, a reduction in ODA from 0.7% of GDP to 0.5% was announced: `https://commonslibrary.parliament.uk/spending-review-reducing-the-aid-commitment/` [Accessed: 08/04/2021]

design (see e.g. Drews and van den Bergh, 2016; Douenne and Fabre, 2020). We might also expect this to be so in the adaptation context. Our contribution in the current paper is to explore whether this is actually the case. Specifically, using a discrete choice experiment (DCE) of a sample of UK households, we examine how people make choices about fund contributions (via their own tax payments) based on two broad dimensions. One relates to priorities in how funds are disbursed within those countries implementing adaptation projects, and how these benefit people. The other relates to principles of fairness in how the costs of financing adaptation are allocated across households. Importantly, the DCE format allows us to explore also trade-offs between these dimensions of adaptation policy. This, we argue, is important for two reasons.

First, as we have discussed, it is the public in donor countries that ultimately finances adaptation in many instances: e.g. via increased taxation. If, in turn, the willingness of the public to provide adaptation finance is contingent on what this policy looks like, then understanding these determinants is a critical element of unlocking greater public support. In other words, this is arguably one way of bridging the apparent gap between funding needs and what people are prepared to contribute.

Secondly, but relatedly, our findings also reveal the extent of public support for principles which might be used by donor institutions and recipients for disbursing adaptation finance. For example, the Green Climate Fund (2018) (GCF) and the Adaptation Fund (2011) (AF) both include in their mandates the requirement to protect the most 'vulnerable' from the detrimental impacts of climate change. High level principles by Fankhauser and Burton (2011) – building upon Stern (2008, 2009) – define 'good' adaptation to be (1) *e*fficient in achieving results at lowest costs, (2) *e*ffective in reducing or adapting to negative impacts of climate change, and (3) *e*quitable in its distribution to target populations.[3] Our study provides a complementary perspective on what the public judges (albeit a preliminary given this refers to one particular country) to be important principles guiding decision-making for making use of adaptation finance.

Of course, subservience to what the public thinks needs to be placed in context, especially given the moral dilemmas and complex factors that such policy decisions inevitably present. There are inherently complex trade-offs involved in allocating scarce adaptation finance and presumably this necessitates a critical role for expert judgement to arbitrate these challenges. Notwithstanding this

[3]Nonetheless, initial evidence suggests scope for political interests to dominate and for substantial discretion regarding interpretation more generally (Horstmann, 2011; Barrett, 2014; Stadelmann et al., 2014). As an illustration, in a study of the distribution of subnational adaptation finance in Malawi, Barrett (2014, p.131) finds a tendency for adaptation finance to be allocated towards locations with greater capacity to manage assistance and where aid workers were already established and away from poorer, more marginalised and climate vulnerable locations (see also (Stadelmann et al., 2014)). Fankhauser and Burton (2011) suggest such outcomes might arise, amongst other reasons, from a preference for 'concrete' and visible projects in areas with sufficient capacity.

point, the emphasis in the current paper on public preferences is essentially the same as that for the more extensive literature on public support for domestic climate policy. There it is argued that understanding what people think – and how they view trade-offs – is one key to building public support for action on domestic climate mitigation. It strikes us that further investigation of public preferences in the adaptation context is similarly relevant for helping to ensure that funding gaps are bridged and that this support is sustained.

In doing so, our findings indicate that: (a) in terms of how to disburse adaptation funds – respondents in our sample have strong preferences for matters such as effectiveness in delivering the adaptation project outcome that we focus on (i.e. reductions in mortality) in the context of wanting to prioritize the most vulnerable in recipient countries; and (b) in terms of the costs of paying for adaptation finance in donor countries, respondents also appear to be concerned with how these costs are distributed, notably characterized by a preference for 'ability to pay' as a guiding principle. That said, how respondents can be characterized, on average, does disguise a substantial degree of heterogeneity that we also discuss.

The remainder of the paper is structured as follows. In the section immediately below, 2, we situate our study within a broader body of literature notably about the public acceptability of climate policy. In Section 3 we adopt a systematic approach for the choice experiment attribute selection and elaborate on our survey design. Section 4 describes the methodology of Multinomial Logit, Random Parameter Logit, and Latent Class Models, which we apply in the analysis. In Section 5 we present the results of the choice experiment and the accompanying survey. Section 6 discusses the findings and concludes.

2 Literature Review

The observation that public acceptability is crucial for climate policy is not new. Indeed, lack of public support is recognised as a substantial barrier to ambitious climate mitigation actions, and a growing literature has emerged – using survey methods – to understand, on the one hand, what characteristics of policy matter most to people and, on the other hand, how different people (e.g. different publics) perceive and respond to given policy proposals. Examples include: Hovi et al. (2009); Geels (2013); Wiseman et al. (2013); Drews and van den Bergh (2016); Douenne and Fabre (2020) revealing the importance of factors such as policy design and outcomes (see e.g. Huber et al., 2020), trust in processes and implementing institutions (see e.g. Carattini et al., 2017b; Huber and Wicki, 2021) and perceived or actual distributional issues (see e.g. Drews and van den Bergh, 2016) and individual (respondent)

proximity to the policy issue (see e.g. Huber and Wicki, 2021) as well as the characteristics of 'publics' being asked about their support for different policies (see e.g. Nowlin et al., 2020).[4]

Support for carbon pricing is a particularly notable area of research in this respect. On the face of it, a carbon tax has a number of attractive features especially from an economic perspective. The fact that genuine carbon taxes are relatively few is perhaps telling with contributions such as Wicki et al. (2019) amongst others, noting a key reason might be the salience or visibility of costs (i.e. tax burdens) in comparison to regulatory measures. However, as these authors also note, the composition of this policy and the way it is packaged may be one element to boost public acceptance.

In the case of a carbon tax this includes the way in which carbon revenues are used. For example, Klenert et al. (2018) examine how earmarking of revenues influences public support and, in doing so, place this in a broader context of tax reform (see also e.g. Kenny, 2018). An earlier contribution by Bernauer (2016) also explores a more positive framing for carbon pricing as perhaps contributing to an innovative and healthier economy and social community, and the way in which a carbon tax might be one means to attain such transformative possibilities. Aasen and Vatn (2018) assess public support for a low carbon transition in Norway and the way in which support and intended behaviours by individuals are influenced by notions of social responsibility and contributions to a societal, indeed a global, objective. In some instances findings are sobering, not least in pointing to the importance of political preferences and priors which withstand attempts to nudge public support by reframing climate policy (Bernauer, 2016). A recent study for the US, Nowlin et al. (2020), also emphasises that public support of climate policy, specifically carbon pricing and revenue recycling, depends on political identity and allegiances of respondents.

Notwithstanding these insights about heterogeneous publics, how policy outcomes are distributed also appears to be critical. Jagers et al. (2019), for example, explore these distributional concerns – in the context of policy costs – in a survey of respondents in Sweden, a country where the carbon tax is amongst the highest in the world (Andersson, 2019). A general finding seems to be that public support for a domestic climate *mitigation* policy tends on average to increase if the mechanism allocating cost burdens is based on the 'polluter-pays principle' (Hammar and Jagers, 2007; Lee and Cameron, 2008; Dietz and Atkinson, 2010; Bechtel and Scheve, 2013). There are important nuances to this: policies are also more likely to be accepted if poorer individuals bear relatively less of the overall burden or are exempt (e.g. Atkinson et al., 2000; Gevrek and Uyduranoglu, 2015; Carattini et al., 2017a).

[4]It is also worth noting that all of these studies examine public support, rather than the way in which that support might actually influence the policy process. An interesting exception, however, is Hager and Hilbig (2020) which examines the causal affect of public opinion on political speeches in Germany, albeit in a non-climate policy context.

The extent to which effective communication might boost public support is also an important question.[5] Fesenfeld et al. (2021) explore this – in the context of behavioural changes to achieve 'sustainable consumption' – using a large-scale survey (of almost 10,000 respondents) across China, Germany and the United States. An important finding is that there appear to be limits to the extent to which public support (on a variety of metrics) is susceptible to influence on the basis of incremental changes in the way a policy is strategically framed for respondents. The study authors attribute this to the nature of the decision to lend support: that is, ultimately it is costly and entails wholesale changes to deep-seated consumption habits and norms (see also Tjernström and Tietenberg (2008) in the context of support for 'disruptive' (transport) policy packages in urban Austria).

A handful of relevant studies have used stated preference studies in order to estimate the money value of the benefits that people place on climate policy (e.g. Dietz and Atkinson, 2010; Bakaki and Bernauer, 2017). Aldy et al. (2012), for example, estimate the willingness to pay (WTP) of US respondents for national standards for clean power generation in electricity sector. These stated WTP values summarise unspecified multiple and complex policy benefits, and moreover are elicited using a contingent valuation method which estimates only the total value of (the change in) these policy benefits. However, a strength is that these values can be compared with estimated policy costs and represent a useful accompaniment to more familiar referenda-type metrics of public support (Kotchen et al., 2013, 2017). As an illustration, the values in the study by Aldy et al. (2012) are used to simulate the likelihood of climate legislation passing into law, if it can be assumed that elected representatives vote according to the median WTP of their respective electorates.

All of these existing studies offer important insights, although it is worth noting that the focus of this literature is primarily domestic, albeit recognising that the rationale for climate policy typically is a response to an inherently global challenge. A number of empirical studies have focused more explicitly, however, on this international dimension. For example, when asked about the beneficiaries of climate policy or the victims of climate impacts, overall support tends to increase if benefits accrue disproportionately to the world's poor (see e.g. Cai et al., 2010; Lee and Cameron, 2008).

A handful of studies have looked at climate adaptation policies, although most contributions so far have focused on strategic interactions between countries rather than on individual or household preferences. Gampfer et al. (2014), for example, examine the extent to which individuals respond to fairness in the distribution of costs between countries. In doing so they find that support increases with higher

[5] Within stated preference surveys, for example, while there is a general expectancy that the way in which information is framed can have an important bearing on respondents choices, studies such as Kragt and Bennett (2012) show that this cannot be taken for granted. See also Shapanskz et al. (2008) and O'Garra and Mourato (2016).

burdens being allocated to *other* countries. Bechtel and Scheve (2013) find that respondents were indifferent between a policy design in which countries pay according to their current emissions, their historic emissions or their income level. A crucial driver of policy preferences, however, was overall policy cost: people were more likely to support costly policies if the burden is shared across a larger group of countries and where compliance is independently monitored.

An important contribution which does focus on individual or household preferences is O'Garra and Mourato (2016). That study uses a contingent valuation survey to provide an assessment of public WTP in the UK for international climate adaptation transfers. Respondent WTP, on average, is found to be substantially below – i.e. about one-third of – what the authors calculate is broadly needed per person as the UK share of a global target of £70 billion (or roughly USD100 billion in 2016). Moreover, an emotive information treatment, appealing to respondents' feelings about scale and urgency, did not significantly affect WTP.

What seems clear, however, is that these initial contributions on climate adaptation policy, in combination with the relatively larger literature on domestic climate policy does provide a valuable basis for building further understanding – as we do in the current paper – of how different aspects of policy design influence public support in the climate adaptation context. Moreover, it is also clear that there are possibly challenging trade-offs between these aspects of design of policy options. And so while metrics of simple levels of support for different policy designs provides valuable insights, assessing respondent views on these trade-offs also strikes us as crucial. In the section that follows, therefore, we describe the stated preference method – specifically, a discrete choice experiment – that we will use to assess public acceptance for a climate adaptation levy and show potential trade-offs that may exist between characteristics of this policy.

3 Attribute Selection and Research Design

3.1 Systematic Attribute Selection and Hypotheses

Since the literature on public acceptance of climate *adaptation* policies is still in its relative infancy, the selection of policy attributes for a discrete choice experiment (DCE) is a major challenge and at least partly exploratory. Nevertheless, we take a systematic approach to attribute selection, informed by the findings from related literature on climate *mitigation* policies. Yet, since climate adaptation is a multi-dimensional and often less clearly defined concept, the precise selection of attributes is less

obvious. As such, for our DCE, we make relative judgements for each attribute between how realistic and important the attribute is within the context of climate adaptation and how straightforward it is for a respondent to understand an attribute's meaning (Champ et al., 2017).

We also comment, in what follows, on our hypotheses in relation to these selected attributes. In some cases, the expected interpretation of how respondents might view attributes is straightforward. Metrics of policy effectiveness might be one example here, assuming a suitable metric can be found. For other attributes, while relatively speaking the case for a particular attribute might be straightforward, respondents might reasonably think differently in terms of how they respond to levels in this attribute. As we will see below, attributes where levels reflect distinct distributional principles are an example of this.

On balance, we argue that there is merit to looking at how preferences for such attributes influence public support (and willingness to pay) for climate adaptation. There is, however, a general caveat to bear in mind as we make that argument. In the current study, we have chosen a wide focus to look at the breadth of the adaptation policy challenge: how adaptation funds might be raised in donor countries, and how these funds might be disbursed in recipient countries. The cost of this breadth is arguably a sacrifice of detail, and generality, in specific attributes. While we argue that this sacrifice is worthwhile to provide a better initial understanding of the overall challenge with regard to public support for climate adaptation, we do not pretend that a more targeted approach (e.g. focusing on a small subset of attributes such as adaptation effectiveness) would not yield more fine-grained insights about those target objects. This is an important qualification to our approach that we will refer in what follows in setting out our attribution selection.

This important consideration notwithstanding, we take a three-step approach to attribute selection, illustrated in Figure 1. First, and on the basis of the discussion in previous sections, we list the attributes identified as most relevant in the context of climate *mitigation* policies. Secondly, we translate the meaning of these attributes to the context of climate adaptation policies.[6] Thirdly, we conducted focus groups and piloted the survey to test and select different attribute framings in this adaptation context. Following an analysis of the results of this last step, we determined the final set of attributes and their precise wording. The final attributes and levels included in the DCE, as well as their underlying rationale are summarised in Table 1 and discussed in the remainder of this section.

Our first variable – *policy effectiveness* – is, as mentioned, one attribute which we might clearly expect

[6]This step reveals the increased complexity of climate adaptation policies. For example, it necessitates consideration of the distributional dimension among both the individuals paying for and the individuals receiving transfers.

respondents to value positively. That is, other things being equal, people would be expected to place a higher value on adaptation policy the more effective it is. The critical question, of course, is how effectiveness is defined for the purposes of our DCE. Indeed, for adaptation policy identifying an attribute is a challenging task (in contrast to climate mitigation, where typically emission reductions are specified in absolute or relative terms). Climate change outcomes are likely to be wide-ranging, including but not restricted to premature mortality (or illness) arising from various causes as well as diverse risks to livelihoods and subsequent impacts on development, migration and so on. In principle then there might be numerous ways in which effectiveness can be understood via many different categories of adaptation project that are relevant to a climate fund.

Whether it is possible to reflect this multiplicity within a DCE is arguable. An alternative possibility is to specify a deliberately vague term such as: 'a moderate increase in resilience'. However, this leaves ample room for individual interpretation especially with regards to what resilience means.[7] In the current study, however, we focus on one attribute only describing effectiveness. This is the extent of 'prevented deaths' or actual 'lives lost'. In doing so, we draw upon designs to elicit preferences for different policy options used commonly in other fields such as health economics (Dolan and Tsuchiya, 2009; Robson et al., 2017), transportation (Rheinberger, 2009; SWOF, 2012; Tsuge et al., 2005), terrorism research (Viscusi, 2009), or landmine clearance (Gibson et al., 2007) among others.

This allows us to use a clearly quantifiable variable with arguably little ambiguity about precise meaning. While we acknowledge that climate change impacts are undoubtedly far broader than this, prevented deaths themselves might stem from a variety of climate-related outcomes and using this as a metric of effectiveness perhaps represents a balance between clarity and salience for respondents on the one hand and the breadth of potential impacts on the other hand.

However, we acknowledge that given the breadth of categories of adaptation project this is unlikely to be a comprehensive metric to base our understanding of respondent preferences for effectiveness on. This breadth is not surprising given the many ways in which climate change impacts might affect wellbeing and livelihoods. Indeed, it would be interesting to investigate how people might rank and choose these different categories and character of adaptation projects involving different development outcomes across different people, a point we return to in the conclusions. Given the approach that we take here, it is an empirical judgement about how general our emphasis on health, and specifically

[7] There may be trade-offs in the DCE design, in this respect. An important task of international climate adaptation payments is to increase the overall resilience of communities. Resilience, however, is itself a complex and multi-dimensional concept. Using such an attribute in a DCE would increase the cognitive burden for respondents and might lead to biased responses depending on individual perceptions of what the concept means.

health outcomes involving mortality is. In the absence of this generality, our study findings remain relevant to understanding public support for adaptation which involve reductions in mortality risks as the sole or main impact.

With respect to *distributional dimensions*, we incorporate a number of different types of policy characteristics as illustrated in Table 1. The first of these refers directly to the distribution of benefits among eligible recipients and captures the share of deaths prevented among the extremely poor. This enables us to contrast purely 'utilitarian' approaches (valuing the total number of deaths prevented) from more 'egalitarian' preferences (concerned about the type of individuals protected and their level of poverty). Where people stand on these choices, of course, is a matter for them. Nonetheless, our expectation is that respondents may judge there to be a trade-off between effectiveness (extent of prevented deaths) and distribution (how those prevented deaths broadly are distributed), at least on average and to unknown degree.

Our remaining distributional attributes focus on how the cost burden of paying for adaptation is shared. Two of these attributes explore hypotheses about: (a) whether an additional levy on donor country industries and businesses and (b) whether making donor country household contributions conditional on an additional tax levied by a *recipient government* each has a significant impact on an individual's likelihood of contributing to adaptation finance? This is essentially a co-financing issue between actors. For both of these hypotheses, what we are interested in is the degree to which possibilities for co-financing amongst these actors is associated with potential 'crowding-in' or 'crowding-out' of individual payments (e.g. Andreoni et al., 2014; Zhang and Maruyama, 2001). That is, to what extent will individuals' WTP differ according to the contributions made by others?

A priori the effect of third party contributions on one's own payment is ambiguous, however, making it harder to form expectations regarding to how respondents will react to these attributes. Payments made by others could boost the willingness to contribute for a specific individual perhaps by enhancing the credibility of projects and imposing moral pressure (crowding-in). Alternatively, this may shrink a specific individual's contribution if that person thinks in terms of a fixed total amount required to meet a project target (crowding-out). Moreover, the relative strength of each effect may be specific to the policy context and therefore it seems useful to explore respondent perspectives in the adaptation context.

Our last distributional dimension captures the preferred payment principle for donor country individuals for sharing contributions across households. In line with the existing literature we have sought to

distinguish between an 'ability-to-pay', a 'polluters-pay' and an 'equal-shares' principle (for a related application see for example Dietz and Atkinson (2010)). For example, climate adaptation is needed to address impacts for which some people in donor countries might be more responsible for than others (e.g. perhaps in terms of their implied carbon footprint). But while we might expect respondents – as a result – to have a preference for a 'polluters-pay' principle, other criteria are possible. Hence, our attribute here allows us to identify the preferred policy design for this aspect of the adaptation choice and to compare our results to findings in the related climate mitigation literature.

The fact we are seeking to do this via one dimension of our DCE means that this attribute has to do a lot of work. Most importantly perhaps, making the polluter pay might be correlated with 'ability-to-pay'. This is especially the case for the example we use – fuel consumption – which is likely to be a normal good and a necessity. For a discussion see for example (Teixidó and Verde, 2017) and in the context of Sweden's carbon tax (Andersson and Atkinson, 2020). Making the polluter pay would equate (in some way) with imposing cost burdens which could well be regressive in income. That is, our attribute level which are claiming reflects a polluter pays principle has other (implicit) distributional consequences that respondents may or may not be thinking about when making their choice. If so, then – as an illustration – choosing "households with higher carbon emissions from fuel consumption pay more" rather than "households with higher income pay more" in otherwise identical options might be construed as a negative preference for income equity or, perhaps more likely, a preference for polluter-pays, regardless of the implication for income distribution. Put another way, these linkages between distributional principles do mean that interpretations of actual choices made by respondents need to be made with care.

We also recognise, for example, that contrasting payment principles are implied by these rather different practical payment vehicles. For example, to capture preferences for our 'ability-to-pay' principle we specify this occurs via a change to a progressive income tax. For 'polluters-pay' this is a fuel tax on household carbon emissions.[8] Moreover, the practical means of payments (and its frequency) clearly will be different in each case. In respect of this latter fact, however, our cost attribute provides a means for ensuring that respondents think about their individual contribution in a consistent fashion. Put another way, it presents respondents with the yearly payment they would face for any option with a given combination of attributes and levels, including those for the UK household payment scheme.

Additionally, this final attribute for *policy cost* allows us to conduct the usual 'sanity' check on whether

[8]While we do not specify the exact details of this fuel tax, plausibly it could apply to transport fuel and household energy use such as, for example, the Swedish carbon tax (see e.g. Andersson, 2019).

individual responses are credible, in that we would expect to see negative coefficients on this payment attribute. Relatedly, when eliciting respondent choices between adaptation options we also contribute to those existing studies on public support for climate policy which use explicitly individual payment vehicles rather than a cost attribute not aligned with a respondent's household budget.

3.2 Information Treatment

As part of the DCE, we want to test to what extent the framing of the issue can impact support for climate adaptation payments. From the literature on the acceptance of climate *mitigation* policies as discussed in Section 2, we know that direct benefits to the taxpayer in the form of revenue recycling can significantly increase public support for a carbon price for instance (Carattini et al., 2017b; Drews and van den Bergh, 2016). Since the literature on preferences for climate adaptation support is still relatively young, choosing a particular framing perspective is exploratory in nature. Existing work has shown that emotive language, appealing to the urgency of the problem, does not seem to have an effect (O'Garra and Mourato, 2016). Moreover, it was noted earlier (e.g. Fesenfeld et al. (2021)) that issue framing may not significantly influence public support, depending on the extent to which preferences and norms for the behaviours targeted by climate policy are long-standing and deep-rooted. Whether decisions to contribute to an adaptation fund are an example of this is arguable. However, the point stands that it cannot be presumed that the degree of climate support is amenable to discrete differences in the way a policy package is framed.

Notwithstanding this important point, we have sought to explore the degree to which appealing to self-interest on potential benefits to the UK (of contributions to an adaptation fund) influences WTP.[9] In the case of climate adaptation payments, direct benefits to the UK taxpayer are not immediately obvious. Such benefits can take the form of larger and more prosperous markets to sell UK goods and services, more stable global food prices, as well as relatively improved global stability and economic growth. Yet, in a choice experiment the researcher faces the trade-off between providing a realistic scenario and one that is easily understandable for respondents. The benefit therefore needs to be as tangible as possible.

We decided to use an assessment of the donor country's Security Forces, which identified climate change as a potential threat to its national security (HM Government, 2015). Much time was devoted to selecting the right phrasing of the information treatment. Climate change can be a highly polarising

[9] Limited funding only allowed us to use one information treatment and not to test multiple framing versions.

topic. For example, in our empirical application the donor country is the UK. While more than 90% of people in the UK believe that climate change is happening, only 36% believe that it is entirely or mainly due to human activities. In fact, more than 50% believe that natural processes and human activity cause it equally (Phillips et al., 2018). Hence, it is important to select an institution that is respected within the population and not believed to have a vested interest in commenting on climate change. Our decision was influenced by opinion polls suggesting that the UK's Security Forces enjoy a highly positive reputation and are highly trusted by British nationals (YouGov, 2014).

To test potential framing effects we randomly divided participants into a treatment and a control group. Individuals in the treated group saw an additional paragraph summarising the assessment of the UK's Security Forces. It states that climate change may pose an additional risk to the UK's national security and may exacerbate instability overseas through resource stresses, migration, impacts on trade, and global economic and food insecurity, which may result in violent conflict. The information treatment furthermore states that international support to help countries adapt to the negative impacts of climate change can reduce such negative effects.

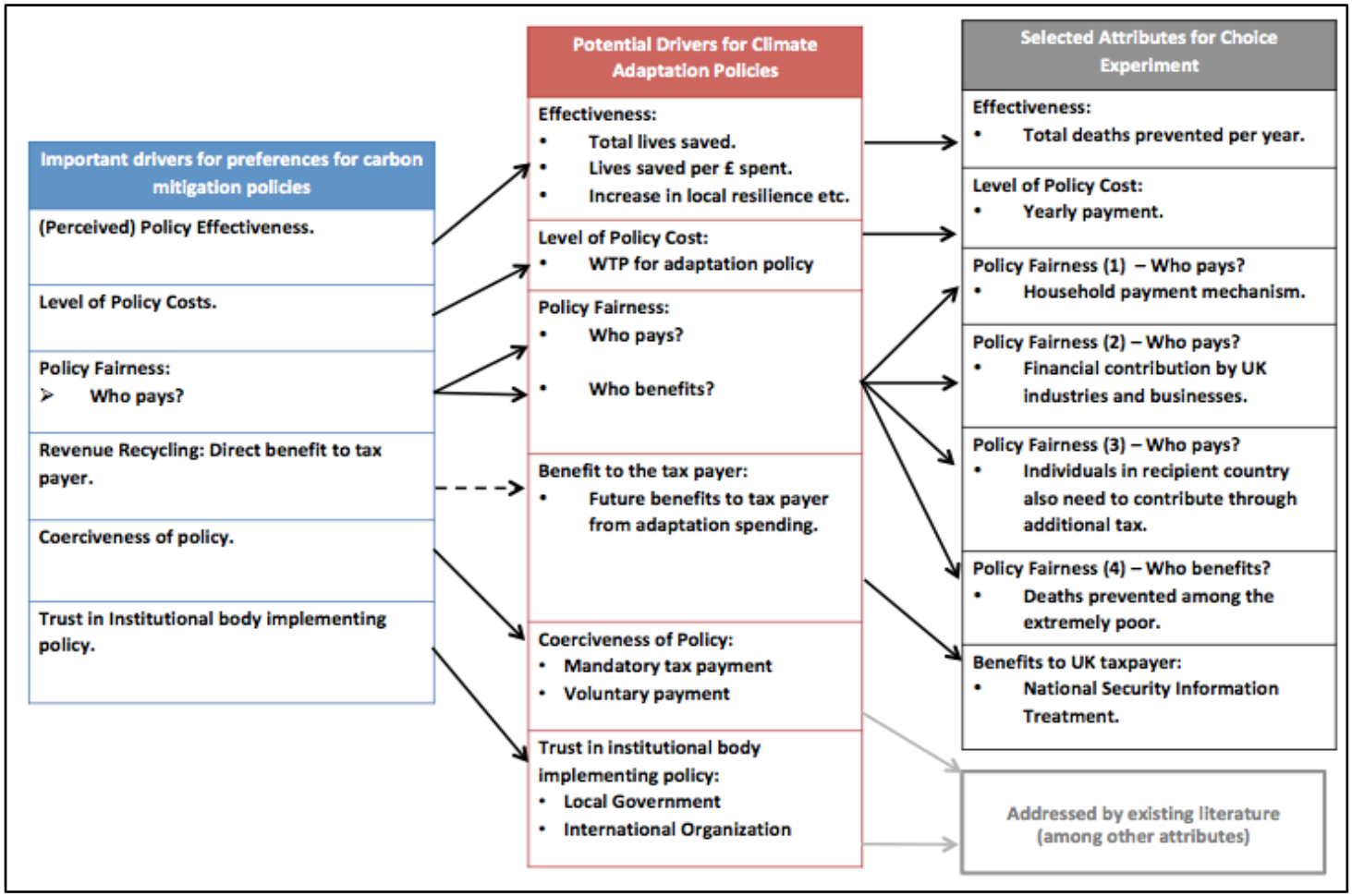


Figure 1: Systematic Attribute Selection based on knowledge from climate mitigation literature

Attributes	Levels	Rationale for Attribute
Total deaths prevented per year.	10,000; 20,000; 40,000	**Distributional dimension 1:** How are the payments distributed among recipients?
Share of deaths prevented among the extremely poor.	20%, 50%, 80%	
The project is conditional on local government in the recipient country to also raise taxes to contribute to the project.	No (0), Yes (1),	**Distributional dimension 2:** Co-financing: Who contributes apart from UK households?
UK industries and businesses contribute as well through an additional levy.	No (0), Yes (1)	
UK household payment scheme.	(0) Every household pays the same amount. (Collected through an additional lump-sum household tax). (1) Households with higher carbon emissions from fuel consumption pay more. (Collected through and increase in fuel tax). (2) Households with higher income pay more. (Collected through a proportional increase in income tax).	**Distributional Dimension 3:** How should the burdens be shared among UK households?
Your yearly payment.	£5, £20, £50, £70, £120	/

Table 1: Attributes and Levels and Underlying Conceptual Meaning

3.3 Survey Design and Implementation

Focus groups and an initial survey design testing took place in October and November 2017. We went through extensive testing among colleagues before piloting the choice experiment. We then conducted two separate (roughly representative) online pilots with 100 respondents each with the second of these pilots building on feedback resulting from the first. Based on this improved design, the second online pilot was conducted in February 2018. It appeared however that an additional comprehension question, which we included in the second pilot, drew too much attention to the first two attributes, which meant that other attributes were neglected. This observation illustrates that the researcher needs to make a relative judgement between (a) ensuring that respondents understand the choice cards correctly and (b) priming respondents to focus too much on a particular attribute which might not reflect their true preferences.

For the full survey, lessons from the pilot resulted in particular in an improved colour coding for choice cards, which makes the distinction between the different household groups clearer (see the Appendix A1 to this paper for a final example Choice Card). We also dropped an additional comprehension question to reduce priming concerns. The survey still contained two comprehension questions, which tested if respondents had read and understood the overall scenario (see Appendix B for the scenario.)

Each respondent in our final survey had to read the one-page scenario description, explaining the basic concept of climate change and adaptation support for developing countries as agreed by the Paris Agreement. This was followed by two comprehension questions, which tested that respondents had actually read and understood the scenario.[10] Respondents had to answer both questions correctly. Otherwise, they were immediately redirected and did not complete the survey. This test proved to be an important filter with nearly one thousand respondents being excluded from these testing questions. Respondents were also not able to attempt the survey more than once.[11]

We use the preferred Bayesian efficient design rather than the random designs for discrete choice experiments, which have been employed in the handful of existing studies (for example in Bechtel and Scheve (2013); Gampfer et al. (2014)). The results of the second pilot were used to generate a Bayesian

[10] The comprehension questions asked respondents in a multiple choice setting to select the correct answers. Question 1: "Based on the previous description: For what reason are additional financial resources required?"(Correct Answer: To help poor countries adapt to climate change.). Question 2: "According to the previous description: What is climate change expected to cause?" (Correct Answer: Rising average temperatures, rising sea-levels and more severe natural disasters).

[11] The "Qualtrics" survey setting 'prevent ballot box stuffing' prevented individuals from taking the survey multiple times.

D-Efficient design for the full survey using the software *Ngene*.[12] For the Bayesian efficient design, the coefficient and standard errors of the pilot were used to generate the final experimental design. Using both the standard error as well as the coefficient estimate is preferred relative to using an efficient design, which may be more prone to be affected by outliers in the pilot.[13] Each respondent faces 8 choice tasks, with 2 policy options each and one opt-out option of 'No additional policy'. Respondents are randomly assigned to either a treatment or control group. We use two blocks, which allows us to have 16 different choice cards within each the treatment and control group. For the final DCE, we collect a nationally representative sample based on quotas for gender, age, education level, income, and region. Responses are collected through the panel of an online survey company. The final survey was conducted between June and August 2018. All respondents who were not filtered out by the quota settings and answered the comprehension questions correctly also completed the survey.

4 Methodology

4.1 MNL and RPL Models

The Choice Experiment (CE) methodology is built upon the Random Utility Theory established by McFadden (1974). In this framework, utility (U) is built up of two components: a deterministic or observable part V and a random or stochastic component ϵ. Thus, individual i chooses alternative j among n alternatives if $U_{ij} > U_{in}$. In the Random Utility Framework, the utility of individual i choosing alternative j can therefore be written as:

$$U_{ij} = V_{ij} + \epsilon_{ij} \tag{1}$$

[12] We used 29,760 iterations to generate the final design. The mean Bayesian MNL D-error is 0.101537.

[13] For the pilots we generated efficient designs using a combination of small and zero priors. When generating efficient designs, the researcher has to take a decision between 0 priors (in which case the design becomes an orthogonal design) and very small positive and negative priors, which allows the researcher to exclude dominant alternatives from the design. This is not generally possible within orthogonal designs, as it would result in a loss of orthogonality of the design. The researcher faces a trade-off in this case: including dominant alternatives gives the researcher one additional tool to check that respondents answered 'rationally' and did not select clearly dominated alternatives, perhaps by selecting choices randomly. Yet, including such dominated options also bears the risk that respondents become irritated, which can lead to an increase in protest responses. The currently conventionally preferred option tends to be to use very small positive and negative priors where the researcher has good reason to believe that the relationship is either positive or negative and use zero priors for coefficients, where this is not the case. With small priors and a Bayesian efficient design, the risk of inserting bias into the design is minimised, while being able to exclude irritating dominant alternatives.

The deterministic or observable component V_{ij} can be written as:

$$V_{ij} = \sum_{k=1}^{K} \beta_{ikj} X_{ikj} \tag{2}$$

The choice probability P at each choice occasion t is given by:

$$P_{ijt} = \frac{exp(\beta_k X'_{kjt})}{\sum_j exp(\beta_k X'_{kjt})} \tag{3}$$

where X is a vector of k attributes in levels, and β is a vector of utility parameters to be estimated. In the Multinomial Logit Model (MNL) the error terms are assumed to be independently and identically distributed (IID) with an extreme value type 1 distribution (also known as Gumbel distribution). This model implies independence of irrelevant alternatives (IIA). Furthermore, it assumes taste homogeneity across respondents, since the utility coefficient of an attribute k is the same for all individuals $\beta_{ik} = \beta_k$ (see e.g. Strazzerra et al., 2012). The restrictive taste homogeneity assumption is relaxed in the Random Parameter Logit Model (RPL), also known as Mixed Multinomial Logit (MMNL). The RPL model allows variation among individuals for the utility coefficients by assuming a continuous distribution of parameter vectors (Revelt and Train, 1998; Hensher and Greene, 2003). An alternative model also relaxing the taste homogeneity assumption is the Latent Class Model (LCM), which also allows for variation among individuals by assuming a discrete distribution with individual parameters clustered in classes (Boxall and Adamowicz, 2002; Greene and Hensher, 2003).

The RPL model is our preferred specification for the analysis. It allows for taste heterogeneity at the individual level, as opposed to at the group level. It also does not require the researcher to specify the number of classes, but only the parameter distributions, which is less prescriptive. While the RPL model is our main specification, we additionally also estimate LCMs to try to recognize and characterize heterogeneous socio-economic groups. Characterizing such groups can be particularly useful to assess the magnitude of support for specific policy characteristics to inform policy designs in democratic decision-making processes.

In the RPL the utility function of individual i is characterised by an additional idiosyncratic random deviation η_{ik} from the mean value of β_k for each attribute k. The utility of individual i for alternative

j at choice occasion t is (see e.g. Revelt and Train, 1998; Contu et al., 2016):

$$U_{ijt} = \beta_k X'_{kjt} + \eta_{ik} X'_{kjt} + \epsilon_{ijt} \tag{4}$$

The distribution must be specified by the analyst. Normal and (negative) log-normal distributions are the most common in this context, depending on prior expectations on the sign of the coefficient. Without strong priors on the sign of a coefficient, using the normal distribution allows full flexibility on the sign and is the preferred option. In this context the choice probability is given by:

$$P_{ijt} = \int \frac{exp(\beta_{ik} X'_{kjt})}{\sum_j exp(\beta_{ik} X'_{kjt})} f(\beta_i|\Theta) d\beta_i \tag{5}$$

where $f(\beta_i|\Theta)$ represents the density function for the vector of taste coefficients β, which could allow for some fixed elements as well as correlation between individual random elements (Contu et al., 2016). This now allows the vector β to follow a random distribution with parameters Θ.

All the random parameters were set to be distributed using a normal distribution, except for the monetary attribute and the interaction of the information treatment with the monetary attribute, which are assumed to be fixed (i.e. non-random). We chose a fixed coefficient for the payment attribute for several reasons discussed in the literature. Assuming a cost coefficient with a distribution that has a positive probability mass at zero (e.g the normal distribution) is problematic because this would imply division by zero for WTP values of attributes. Furthermore, with a normal distribution a proportion of the sample would be predicted to have a positive cost coefficient. Alternative distributions such as the log-normal distribution has heavy tails, which can bias results Cirillo and Hetrakul (2010). For these reasons and in line with several papers in the literature Revelt and Train (1998); Ruud (1996); Goett et al. (2000); Masiero and Maggi (2010); Contu et al. (2016); Hynes et al. (2021), we assume the cost coefficient to be fixed. It should be noted that with a fixed cost coefficient we do not capture heterogeneity in the cost coefficient, which is further reason for the LCM that analyses heterogeneities across classes (For further information on the discussion of the cost parameter, see (Bliemer and Rose, 2013; Daly et al., 2012)). Hence, for the RPL model we assume a normal distribution for all parameters, except for the payment attribute and the interaction of the information treatment with the payment attribute. In RPL models the number of draws used in the estimation can impact the stability and precision of results significantly. It is important to estimate RPL models with sufficiently

large numbers of draws to obtain stable coefficients (see for example the discussion in Czajkowski and Budzinski (2019) for further details). Our main random parameters model is estimated with a simulated maximum likelihood estimation using 5,000 inter-person Halton-draws. In a robustness check we also estimate the model with 10,000 inter-person Halton draws to ensure the stability of results. In addition, we also estimate the model specified that the random parameters are correlated and results remain robust, which relaxes the assumption that all explanatory variables are independent.

Once the parameters have been estimated in the respective models, we can compute the monetary valuations (MV). These are given by the absolute value of the ratio of the respective non-monetary coefficient (the marginal utility of each coefficient) over the coefficient of the monetary attribute. Throughout the paper we use the commonly applied delta method to compute monetary valuations (Contu et al., 2016):

$$MV = \left| \frac{\beta_{non-monetary}}{\beta_{monetary}} \right| \tag{6}$$

4.2 Latent Class Models (LCM)

While the RPL captures heterogeneity at the individual level, the Latent Class Model (LCM) accommodates taste heterogeneity at the group-level. It can be seen as a semiparametric version of the RPL, as the analyst does not have to make assumptions about the distribution of the parameters, but instead has to restrict the number of classes and estimates a computationally simpler MNL (Greene and Hensher, 2003). The motivation for the LCM is the idea that the population can be divided into a discrete number of s segments and that preferences within these segments are relatively homogeneous, but differ across segments. In the LCM individuals are assigned probabilistically into the segments based on socio-economic variables and attitudes. Utility is then modelled as: (Boxall and Adamowicz, 2002; Strazzerra et al., 2012).

$$U_{ij|s} = V_{ij|s} + \epsilon_{ij|s} \tag{7}$$

The utility parameters β_k can now be divided into s segments. Hence, we now have $\beta_{k|s}$ which means that we have a parameter β_k for each segment s. The unconditional choice probability of individual i choosing alternative j becomes the weighted average of all $\beta_{k|s}$ (Strazzerra et al., 2012; Contu et al.,

2016)

$$PR_{ij} = \sum_{s=1}^{S} h_s PR_{j|s} \tag{8}$$

where $PR_{j|s}$ is the probability of choosing alternative j conditional on being a member in class s[14]. It is expressed as:

$$PR_{ij|s} = \frac{exp(\beta_{i1|s}X_{i1j} + \beta_{i2|s}X_{i2j} + ... + \beta_{ik|s}X_{ikj})}{\sum_{n=1}^{N} exp(\beta_{i1|s}X_{i1n} + \beta_{i2|s}X_{i2n} + ... + \beta_{ik|s}X_{ikn})} \tag{9}$$

The segment membership probabilities $h_1, ..., h_n$ are estimated using a multinomial logit model, assuming a logistic distribution. By conditioning h on socio-economic covariates, attitudes or perceptions, collected alongside the choice experiment, the classes can be characterised (Strazzerra et al., 2012). The membership probabilities can be expressed as:

$$h_s = \frac{exp(\delta_s W_c)}{\sum_{s=1}^{S} exp(\delta_s W_c)} \tag{10}$$

where W_c is a vector of c covariates, and δ_s is a vector of coefficients that is specific for class s. After estimating the model, it is possible to calculate within each class the marginal rates of substitution between the attributes. The monetary value (MV) for a change in attribute k in class s becomes:

$$MV_{k|s} = \left| \frac{\beta_{k|s}}{\beta_{m|s}} \right| \tag{11}$$

where β_m is the utility coefficient of the monetary attribute in class s and β_k is the non-monetary coefficient in class s (see e.g. Gevrek and Uyduranoglu, 2015; Strazzerra et al., 2012).

[14]From here on we drop the subscript t for each choice occasion to improve readability

5 Results

5.1 Descriptive Results

We collect a sample of 1,140 individuals representative of the UK in terms of gender, age, income, education and 12 UK regions (see Appendix C1 for demographic summary statistics compared to the UK population). Each respondent answered 8 choice tasks, resulting in a total of 9,120 observations for the choice analysis. We slightly oversample individuals with lower levels of income (which is a common problem in online surveys), resulting in a slightly lower average sample income (£36,732 vs. £38,291 in the population). We also have slightly more individuals with a university degree (29% vs. 27.2%), and fewer individuals with low levels of educational attainment (up to 4 GCSEs) (30.4% vs. 36%).

Overall, we observe an average willingness-to-pay of £27.5 (median £5), which supports the results obtained by O'Garra and Mourato (2016).[15] In our sample about 10% of the respondents always choose the option 'No Additional Policy', whereas 50% never chose that opt-out option (Figure 2). It provides a first indication of some support for additional policies.

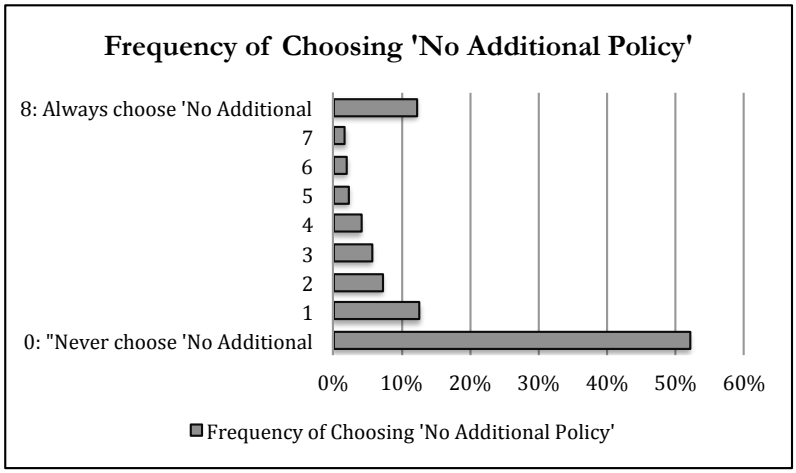


Table 2: Frequency of Choosing 'No Additional Policy'

In addition to the choice experiment we asked for respondents' opinions on topics such as climate change and social justice. In our sample 80% of respondents state that they think climate change is already happening, and 65% state that climate change is happening and GHGs such as CO_2 are its main cause. We have a little less than 10% of individuals not thinking that climate change is

[15] We observe a slightly higher mean WTP of £28.4 in the group receiving the information treatment compared to a mean WTP of £26.6 in the 'control' group which does not see the information treatment.The WTP amounts are the average and median values of the payment attributes for the selected choices. Hence, these are the average and median values that were part of the actually chosen policy option across respondents.

happening and 15% disagreeing with the statement that "Climate change is happening and mainly caused by CO_2 emissions". In our sample 60% disagree with the statement that climate change is largely caused by *nature*, while 20% agree with it and 17% don't know. The opinions are overall similar to what is reported by other UK surveys, although there seems to be a somewhat stronger belief in non-natural reasons for climate change compared to other UK surveys, although the different question phrasing might partially account for this difference (Phillips et al., 2018). Overall, 65% of our sample thinks that it is either extremely likely or somewhat likely that their children's generation will be negatively impacted by climate change.

Furthermore, we asked people what they thought is the main reason for why people live in poverty globally today. We find that slightly more than 20% of the sample thinks that "people are not doing enough to help themselves out of poverty", while about 65% believes that "circumstances beyond people's control" are the main cause (see Appendix D for descriptive results on the opinion questions). We use the information from these opinion questions to inform our Latent Class Analysis.

5.2 Main Results

The results of the Random Parameter Logit (RPL) are reported in Table 3. This is our preferred specification and the main focus of our analysis. We also, in what follows later in this section, complement this with findings from our Latent Class Model (LCM) as well as report results from the simpler Multinomial Logit Model (MNL) are in Appendix F1. As a robustness check we also estimate the RPL model with 10,000 Halton draws to ensure the stability of results (Appendix E1) As a further robustness check we also estimate the model specified so that the random parameters are correlated and results remain robust (see Annex H1).

In terms of Table 1, Column 1 contains the estimated coefficients and standard errors, which we focus on for the interpretation. Column 2 reports the standard deviations. Column 3 reports the monetary valuations, which are computed using the delta method.

We see as expected a negative coefficient on the payment attribute. Higher levies clearly imply lower acceptability. This emphasises again, similar to the climate mitigation literature, the public's sensitivity to costs from policies related to climate change. Of course, this statement holds assuming all else is constant. Ultimately what matters is what people are willing to pay given combinations of attributes and levels relevant to funding and disbursing assistance for poor countries to adapt to climate change.

Importantly, we see that respondents positively value the effectiveness of projects, i.e. at least insofar as it relates to the number of people protected, but that they also value the share of extremely poor individuals protected. This provides first evidence that applying a strictly utilitarian framework when allocating adaptation support might not be the preferred strategy. As a robustness check and to identify potential non-linearities, we also estimate the model using factor variables for the first two attributes (See Appendix G1). The factor-variable specification allows us to explore potential non-linearities in the effects. For the coefficients on the absolute number of individuals protected, we observe positive and significant coefficients for larger number of individuals protected. This suggests that respondents have strong preferences for protecting larger groups of people over smaller groups. Interestingly, for the share of individuals protected among the extremely poor, we observe a levelling-off effect. Respondents strongly prefer an equal share of extremely poor individuals protected to a distribution where only 20% of the protected individuals belong to the most vulnerable group. Yet, they do not significantly prefer the baseline outcome to a distribution, in which 80% of the individuals protected belong to the extremely poor group (see Appendix G1). This suggests that respondents are concerned about the distribution of resources towards the poorest individuals but that there is a diminishing effect. Alternatively, the finding might also imply preferences for an equal allocation between individuals protected among the group of extremely poor and the lower-middle income households.

Interestingly, we observe that the support for a climate change adaptation policy significantly increases when projects are co-financed by an additional levy on *donor* country industries and businesses. In addition, support also increases when making donor country household contributions conditional on an additional tax levied by a *recipient country's government*. Thus, we do not observe evidence of 'crowding-out' of individual payments. On the contrary, co-financing by industry and commitments by recipient governments to contribute and share the financial burden help ensure larger support for climate change adaptation policies in donor countries.

We observe that respondents' preferred payment mechanism is an ability-to-pay approach, meaning that individuals explicitly pay proportionally to their income levels. This is significantly preferred to a flat household levy as payment mechanism (the baseline category). The least preferred mechanism is to have a payment mechanism based on emissions. This reveals, that an 'ability-to-pay' approach is valued more relative to an 'equal-shares principle', which is in turn preferred to a 'polluter-pays-principle'. Hence, respondents would least support a payment mechanism based on own emissions.

The results from the Latent Class Model discussed in more detail in Section 5.3, as well as the standard

deviations for our RPL result, indicate there is heterogeneity amongst respondents. Specifically in the case of the LCM results these show that a relevant group of 24% of the sample prefers a payment mechanism based on emissions. Nonetheless, the RPL model shows that achieving public support for international climate finance in donor countries, payment mechanisms proportional to income are more likely to be supported across the population, on average. This is an important finding, given it appears to contrast with the results in the literature on *domestic* mitigation policies. What explains this result is, however, open to interpretation (see Section 3.1). Nevertheless, it is suggestive that respondents do not see a strong link between individual emissions and their potential responsibility to contribute to adaptation payments. Hence, using carbon pricing to collect revenues to support a global adaptation fund might be expected to be less popular compared to a progressive fee based on income.

Dependent variable: Choice	(1) PRL	(2) RPL	(3) RPL
	Coeff (S.E.)	S.D.	Monetary Valuation (£)
Variable			(95% C.I.)
Total Deaths Prevented (thds.)	0.0493***	0.0592***	1.99
	(0.0031)	(0.0040)	(1.68; 2.29)
Share of Deaths Prev. among	0.7840***	-1.2095***	13.17
extremely poor	(0.1383)	(0.3292)	(2.84; 23.49)
Payment Conditional	0.1752***	-0.6922***	7.07
	(0.0504)	(0.0996)	(3.00; 11.14)
Industry Co-Finance	0.1185***	0.0101	4.78
	(0.0356)	(0.0071)	(1.86; 7.70)
Richer HHs pay more	0.1974***	-0.0663	7.97
	(0.0573)	(0.1495)	(3.37; 12.56)
HHs with higher carbon	-0.1224**	-0.6858***	-4.94
emissions pay more	(0.0539)	(0.0901)	(-9.14; -0.74)
Annual Payment (£)	-0.0248***[b]	/	/
	(0.0015)		
Information*Payment	0.0032*[b]	/	0.13
	(0.0018)		(-0.01; 0.26)
ASC 1 (Policy 1)	-0.0358	-0.5086***	-1.45
	(0.0367)	(0.0760)	(-4.37; 1.48)
ASC 2 (Status-quo)	-2.0072***	4.1745***	-80.99
	(0.1803)	(0.2410)	(-96.29; -65.69)
Log-likelihood	-6621.25		
Observations	9120		

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.
Omitted category: All households pay the same. b: Non-random fixed coefficients. The sign of the standard deviations are not relevant for interpretation.

Table 3: Main Results (RPL Model)

Lastly, it is interesting to note that our information treatment has a positive and significant (at 10%), impact on respondents' willingness-to-pay (WTP) (it is significant at 5% in the MNL model, reported in Appendix F1). Although the effect is small in terms of actual payment, this provides the first – albeit tentative – evidence of a significant information treatment within the context of public support for climate adaptation payments. It suggests that framing the issue in a way that also emphasises potential future benefits to the UK may be a promising strategy forward. Using assessments from government institutions that are widely respected within the population and perceived to be impartial on the topic of climate change may help to improve public acceptance. Nevertheless, the small magnitude of the effects (also in terms of monetary valuations) demonstrates the enormous challenge. If even information treatments that focus on specific national (security) interests result only in marginal improvements in support, efforts to communicate such benefits (and the costs of inaction) may need to be further reinforced or in other ways. ~~This finding may also raise difficult moral concerns. Further work is required to better understand the underlying motivations, for why such a framing may positively impact individuals' contributions. The additional information may have convinced some people that urgent action is necessary, that climate change is a serious problem and that additional financial resources are required. It may however also be regarded as a relatively easy way to 'buy your way out' of any international responsibilities to deal with complex issues such as global food insecurities, conflicts or migration. It would therefore need to be communicated very clearly and carefully that any support for climate adaptation is additional and not instead of other international responsibilities and commitments.~~

5.3 Latent Class Results

Finally, as previously mentioned given that some of the standard deviations in our RPL results were indicative of heterogeneity in respondent choices for certain attributes, we consider further how exploiting heterogeneity across individuals may provide additional information on their preferences for climate adaptation payments. Latent class analysis can be particularly useful to recognize and characterise socio-economic groups with relatively homogeneous preferences (within the group) for specific policy designs. The size and composition of such groups can be useful to inform decision-making in democratic processes for example by identifying policy characteristics that are supported by a majority. Nevertheless, it is important to note that LCMs rely on stronger assumptions, compared to RPL models as outlined in Section 4.

Similarly to Gevrek and Uyduranoglu (2015) and Carattini et al. (2017a) in the climate mitigation

Number of Classes	BIC	AIC
2	13981.01	13839.92
3	13342.97	13111.19
4	13009.98	12687.51
5	12647.88	12234.70

Table 4: Criteria for selecting preferred number of classes

literature we apply a Latent Class Model (LCM) to explain heterogeneous preferences. To construct our classes we use a combination of socio-economic variables and opinion-based questions on climate change and poverty (see Appendix I1 for summary statistics of variables used to construct the latent classes).

Latent Class Models (LCM) require the researcher to make an informed decision on the number of classes to be chosen. The Bayesian Information Criterion (BIC) and the Aikaike Information Criterion (AIK) are the most commonly used. Both information criteria are designed for model selection and both incorporate a penalty for additional parameters. We choose a model with 5 classes as it has the lowest BIC and AIC values (Table 4).[16] Results from the LCM are reported in Table 5. Panel A in the table displays how preferences change across classes. Panel B shows the characteristics of respondents, which describe the composition of classes. The latent class model is estimated using a multinomial logit model (MNL), using 5,000 iterations. We summarise the results from this analysis for each class respectively below. The monetary valuations of the latent class results are shown in Appendix J1. [17]

Membership in class 1 is associated with being relatively less likely to believe that climate change will have a negative impact on future generations. Secondly, members of this class are more likely to believe that individuals hold the main responsibility for living in poverty.[18] They are also less likely to have an above average income. 10% of our sample falls into this group. Members of this class are more likely to support policies, which involve industry co-financing. They do not have strong distributional preferences, which is in line with their view on the underlying reasons for poverty.

Nearly one quarter of our sample falls into class 2. Membership in this class is characterised by a relatively lower income and educational level.[19] They are relatively less likely to choose the status-quo

[16] Selecting LCMs with even more classes can become problematic, as the estimates become imprecise and potentially misleading. It is convention in the literature to not estimate models with more than 5 classes unless for studies with much larger sample sizes.

[17] We do not estimate the LCM with factor variables, as the estimates in LCMs can become unstable, meaning less precise and potentially misleading, with too many parameters and classes. As we already estimate the model with 5 classes, we want to avoid adding further parameters through factor variables.

[18] This is equivalent to the following statement: Membership in class 1 is associated with being significantly less likely to believe that the main reasons why some people live in poverty lies in reasons beyond their control.

[19] Based on the exact variable specifications, it is expressed as: Membership in class two is associated with a lower likelihood of having above average income and a lower likelihood of having a higher educational level.

option of no additional policy (ASC_Status-quo). Hence, members in this class are more likely to support additional policy measures. Individuals in this class are relatively more likely to be a member of an environmental organisation. They are less likely to support a policy, which requires the recipient country to also issue additional measures to raise funds.

Approximately 15% of our sample belongs to class 3. Individuals in this class are relatively sceptic about the existence of anthropogenic climate change and do not have strong distributional concerns. More precisely, membership in this class is associated with a lower likelihood to believe that carbon emissions are the main reason for climate change and that climate change will have a negative impact on future generations. Members in this class are also more likely to believe that individuals hold the main responsibility for living in poverty. In line with their relative disbelief in anthropogenic climate change they are more likely to chose the status-quo option of no further policies. Furthermore, when choosing between additional policies they appear to prefer a payment mechanism, in which individuals contribute based on their income levels and not proportional to their emissions, (but the difference is not statistically significant).

Members of class 4 can be categorised as having relatively strong distributional and fairness concerns and by being concerned about the negative impacts of climate change. It consists of nearly 25% of our sample. Membership in this class is characterised by a higher likelihood of being a member in an environmental organisation, believing that climate change will have negative impacts on future generations and believing that the main reason for poverty lies beyond individuals' control. In line with such believes they are more likely to support projects targeted towards a larger share of extremely poor individuals. Furthermore, they dislike if projects are conditional on financial contributions by the recipient country. But they support co-financing by UK industries and businesses. They are significantly more likely to support policies where households with higher emissions pay more, compared to the baseline flat household levy. This suggests that members of class 4 see a relationship between own emissions and a responsibility to pay for climate change adaptation in developing countries, even though the difference between a payment mechanism based on emissions and a payment mechanism based on income are not statistically significantly different from one another.

Individuals attributed to class 5 can be characterised as having strong preferences on the burden-sharing of additional policies. In particular they care about the distribution of the burden between donor and recipient countries as well as between households and industry in donor countries. Nearly 28% of our sample belongs to this class. Individuals in this class are more likely to support policies, which are conditional on the recipient country also contributing and involve industry co-financing.

They also prefer a policy design in which richer households pay more. They are less likely to choose the status-quo option, which suggests that they are willing to contribute to additional policies and are relatively more likely to acknowledge the need for additional policy measures.

One way to summarise the results from the Latent Class Analysis is by grouping the classes 1 and 3 together. Respondents in these groups are sceptical about the existence or the negative impacts of climate change. Furthermore, they appear to not have strong distributional preferences. They tend to support the view that individuals are largely responsible themselves for living in poverty. Approximately 25% of our sample belongs to this group. Convincing individuals from this group to contribute to climate adaptation payments is likely to be challenging. They appear to be opposed to the two main underlying ideas that may results in a willingness to support such policies: (1) believing in the existence of climate change, and (2) international solidarity to help individuals move out of poverty. Yet, reversely this also means that about 75% of our sample belongs to any of the other classes. This allows potentially for a more optimistic view that a substantial majority believes both in the negative impacts of climate change and acknowledges that poverty can be caused by reasons' beyond individuals controls. The combination of these two factors appears to be somewhat necessary for being willing to contribute to climate adaptation in the long-run.

Variable	Class 1	Class2	Class 3	Class 4	Class 5
Panel A	Coeff. (S.e.)				
Total Deaths	0.032***	0.015***	0.008	0.220***	0.023***
prevented (thds.)	(0.009)	(0.003)	(0.017)	(0.024)	(0.005)
Share of deaths	-0.285	0.284	-0.663	3.300***	-0.194
prevented among	(0.465)	(0.205)	(0.830)	(0.646)	(0.410)
the extremely poor					
Payment	0.237	-0.188**	-0.017	-0.620**	0.348***
Conditional	(0.233)	(0.087)	(0.456)	(0.241)	(0.130)
Industry Co-finance	0.751***	0.087	-0.823	0.449***	0.154*
	(0.208)	(0.067)	(0.559)	(0.128)	(0.089)
Richer HHs pay	-0.093	0.037	0.676	0.349	0.464***
more	(0.233)	(0.100)	(0.580)	(0.267)	(0.159)
HHs with higher	-0.368	0.064	-0.370	0.458**	0.127
emissions pay more	(0.230)	(0.097)	(0.570)	(0.190)	(0.123)
Annual Payment	-0.086***	-0.001	-0.021**	-0.032***	-0.036***
	(0.007)	(0.001)	(0.009)	(0.006)	(0.036)
Information *	-0.002	-0.000	-0.010	0.002	-0.002
Payment	(0.010)	(0.001)	(0.013)	(0.003)	(0.003)
ASC_Status quo	-0.800	-0.350*	3.107***	-0.298	-3.837***
	(0.532)	(0.189)	(0.883)	(0.627)	(0.335)
ASC_option 2	0.386**	0.295***	0.112	-0.171	-0.164*
	(0.168)	(0.056)	(0.436)	(0.130)	(0.084)
Panel B					
Class Membership Function					
High Income	-0.755**	-0.517**	-0.414	0.248	0[a]
	(0.294)	(0.254)	(0.264)	(0.229)	
A-level & above	0.187	-1.108***	-0.294	0.120	0[a]
	(0.254)	(0.236)	(0.236)	(0.216)	
CO2 main cause	0.004	-0.277	-0.980***	0.313	0[a]
	(0.274)	(0.236)	(0.247)	(0.255)	
CC negative impact	-0.710**	-0.069	-1.545***	0.549*	0[a]
	(0.275)	(0.250)	(0.254)	(0.296)	
Cause Poverty	-0.764***	-0.223	-0.882***	0.873***	0[a]
beyond control	(0.260)	(0.232)	(0.234)	(0.278)	
Member in Env.	0.480	1.699***	-1.004	0.995*	0[a]
Org.	(0.725)	(0.516)	(1.113)	(0.527)	
Car ownership (2 or	0.451	0.319	0.314	0.062	0[a]
more)	(0.281)	(0.248)	(0.261)	(0.247)	
Constant	-0.057	0.574**	1.289***	-1.745***	0[a]
	(0.307)	(0.278)	(0.252)	(0.394)	
Average Class Probability	0.104	0.234	0.145	0.239	0.278
Log-likelihood	-6035.35				
Observations	9120				

Table 5: Latent Class Results

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%. Omitted category: Payment mechanism where all households pay the same amount is omitted. a: constrained values.

6 Discussion and Conclusion

Climate change adaptation is increasingly focal to global policy responses particularly as current emission-reduction commitments in the Paris Agreement are expected to lead to almost 3°C of global warming, rather than the planned 1.5- 2.0°C (UNEP, 2017; Met Office, 2019). Even a strengthening of current pledges will require large-scale financing to help developing countries adapt to climate change. The estimated (lower-bound) requirement of 100 billion USD that are required annually, at least until 2050, for global climate adaptation will need to be mobilised largely from developed countries (IBRD/The World Bank, 2010). Currently mobilised funds in 2020 fall well short of the pledged amounts (OECD, 2020; Roberts et al., 2021). Ensuring public support for this over the long-term is crucial to sustain acceptance and to avoid policy reversal.

The allocation of scarce financial resources presents difficult moral judgements with respect to the relative benefits of individual projects. This may involve trade-offs between efficiency considerations (protecting the largest amount of people) and equity principles (protecting the most vulnerable) (e.g. Le Grand, 1990, 1991). Such trade-offs arise for instance when additional infrastructure or capacity building is necessary for allocating funds to the poorest or most vulnerable groups. Existing (suggestive) evidence is that some adaptation institutions have allocated financial resources not to the most marginalised, but to projects with sufficient capacity and past experience, which tend to have relatively higher incomes (Stadelmann et al., 2014; Barrett, 2014). Fear of project failure or a need to report tangible outcomes may potentially drive such decision-making. Knowledge about public preferences for the allocation of scarce public financial resources might be a further way of arbitrating these moral judgements, especially if an objective is to avoid or respond to potential public concerns about wasteful use of public funds. That said, it is important to see this in context: this is a complement to, not a substitute for, political or expert judgement.

Given this motivation, our starting point – in this paper – is the role of understanding public perceptions of, and preferences for, international climate adaptation finance to complement efforts that anticipate these climate adaptation challenges. We examine a representative sample of the UK population, an important donor country. In doing so, we draw from previous work on preferences for climate change *mitigation* policies. In particular, this existing work has shown that distributional outcomes are particularly salient and drive public perception. As such, in the adaptation context, we elicit: (a) preferences with respect to burden-sharing principles among contributors; and, (b) distributional preferences with respect to the allocation of financial resources across projects.

To the best of our knowledge this is the first paper to show that payment mechanisms based on 'ability-to-pay' appear to be preferred over a 'polluter-pays-principle' in the context of climate adaptation. If so, this is a key result as it contrasts with findings from the *mitigation* literature. Our finding suggests that respondents do not make a strong link between individuals' emissions and their potential responsibility in deciding to contribute to adaptation payments. We would therefore expect that using carbon pricing to collect revenues for a global adaptation fund would be less popular compared to using a progressive fee based in some way, for example, on incomes.

Furthermore, we show that combining household fees together with donor country industry co-financing is a promising route to increase public support. In addition, people in donor countries are also concerned about efforts being undertaken by governments in recipient countries. Efforts in recipient countries to complement donations with additional locally raised levies strengthens support for such policies in donor countries. Thus, combining separate payment channels (industry co-financing in *donor* countries and contributions from governments in *recipient* countries) and communicating those efforts effectively could help increase public support and improve the political feasibility of such policies.

In addition, we also test the effectiveness of a policy framing (novel in this sub-field of adaptation preferences) that emphasises potential benefits to the UK arising from assisting developing countries adapt to climate change. Using a randomised information treatment, we show that this policy framing can lead to statistically significant increases in public support, although the magnitude of the effect is modest. ~~This finding provides an interesting avenue for future research to test similar framings that focus on donor country benefits from adopting climate policies. Such effects may also be observable beyond this specific context and could be tested further for climate mitigation or development policies.~~

Our results also suggest that individuals have strong preferences for distributing resources to the most vulnerable individuals. On average, projects supporting the most marginalised receive larger public support amongst our sample. That is, respondents care not only about the absolute number of people protected but also about the vulnerability of those people, at least up to a point. Such findings imply the presence of egalitarian principles, and favour allowing adaptation funds to make trade-offs in favour of supporting the most marginalised communities.

Nevertheless, it is important to note that our findings especially our latent class analysis shows there is a high degree of heterogeneity in preferences and perceptions of climate change adaptation among individuals in the UK. We observe that 25% of our sample is either sceptical about the existence of

climate change or sceptical about concepts of solidarity towards people living in poverty. These are minority perspectives, but clearly a non-trivial group would prove hard to mobilising any support at all from. Of course, the flip side of this it that a sizeable majority (i.e. 75%) does not think in this way and would be more willing to contribute to international climate adaptation funds. As a practical matter, the overall picture is the one that matters. In this respect, our conclusions on the face of it are not optimistic: we find that public support for international climate adaptation projects remains substantially insufficient to meet international commitments.

A number of avenues for future research are arguably suggested by our findings. Testing additional policy framings and to probing greater detail in policy attributes that can help to increase public acceptance of – and willingness to contribute to – climate adaptation finance. The latter seem especially important. This includes further probing of support, and trade-offs that respondents see, between distributional principles which might guide how adaptation funds are raised. Moreover, our focus on mortality reductions – in exploring "effectiveness" of adaptation interventions as an attribute – while arguably focal to climate adaptation is not necessarily comprehensive, given the range of ways in which different adaptation projects might protect development and livelihoods in recipient countries. As climate impacts encroach on these outcomes, and the need to adapt becomes increasingly evident, better understanding of public support for international action is becoming evermore crucial.

References

Aasen, M. and Vatn, A. (2018). Public attitudes toward climate policies: the effect of institutional contexts and political values. Ecological Economics, 146:106–114.

Adaptation Fund (2011). Adaptation Fund Board 15th Meeting: Background of the Adaptation Fund. Adaptation Fund. accessible from: `https://www.adaptation-fund.org/wp-content/uploads/2015/01/Background%20of%20AF%20Final.pdf`, access on 10 June 2018.

Aldy, J., Kotchen, M., and Leiserowitz, A. (2012). Willingness to pay and political support for a US national clean energy standard. Nature Climate Change, 2:596–599.

Andersson, J. (2019). Carbon taxes and CO2 emissions: Sweden as a case study. American Economic Journal: Policy, 11(4):1–30.

Andersson, J. and Atkinson, G. (2020). The distributional effects of a carbon tax: The role of income inequality. Grantham Research Institute on Climate Change and the Environment Working Paper No. 349, London School of Economics and Political Science, London.

Andreoni, J., Payne, A., and Smith, S. (2014). Do grants to charities crowd out other income? Evidence from the UK. Journal of Public Economics, 114:75–86.

Atkinson, G., Machado, F., and Mourato, S. (2000). Balancing competing principles of environmental equity. Environment and Planning A, 32:1791–1806.

Bakaki, Z. and Bernauer, T. (2017). Citizens show strong support for climate policy, but are they also willing to pay? Climatic Change, 145(1-2):15–26.

Barr, R., Fankhauser, S., and Hamilton, K. (2010). Adaptation investments: a resource allocation framework. Mitigation and Adaptation Strategies for Global Change, 15:843–858.

Barrett, S. (2014). Subnational Climate Justice? Adaptation Finance Distribution and Climate Vulnerability. World Development, 58:130–142.

Bechtel, M. and Scheve, K. (2013). Mass support for global climate agreements depends on institutional design. PNAS, 110:1376–1378.

Bernauer, T. McGrath, L. (2016). Simple reframing unlikely to boost public support for climate policy. Nature Climate Change, 6(7):680–683.

Bliemer, M. and Rose, J. (2013). Confidence intervals of willingness-to-pay for random coefficient logit models. Transportation Research Part B: Methodological, 58:199–214.

Boxall, P. and Adamowicz, W. (2002). Understanding heterogeneous preferences in random utility models: a latent class approach. Environmental and Resource Economics, 23:421–446.

Buchner, B., Oliver, P., Wang, X., Carswell, C., Meattle, C., and Mazza, F. (2017). Global Landscapes of Climate Finance 2017. Climate Policy Initiative (CPI). accessible from: `https://climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2017/`, access on 10 June 2018.

Cai, B., Cameron, T., and Gerdes, G. (2010). Distributional Preferences and the Incidence of Costs and Benefits in Climate Change Policy. Environmental and Resource Economics, 46:429–458.

Carattini, S., Baranzini, A., Thalmann, P., Varone, F., and Voehringer, F. (2017a). Green Taxes in a post-Paris World: Are million of Nays inevitable? Environmental and Resource Economics, 68(1):79–128.

Carattini, S., Carvalho, M., and Fankhauser, S. (2017b). How to make carbon taxes more acceptable. GRI Policy Report. accessible from: `http://www.lse.ac.uk/GranthamInstitute/publication/make-carbon-taxes-acceptable/`.

Champ, P., Boyle, K., Brown, K., and Thomas, C. (2017). A Primer on Nonmarket Valuation. Springer, Heidelberg, Germany.

Cirillo, C. and Hetrakul, P. (2010). Continuous random coefficient logit modelsÃ A comparison of parametric and non-parametric methods to estimate individual preferences over Cybernetic Transportation Systems. Presented at the 89th Annual Meeting of the Transportation Research Board, Washington DC.

Contu, D., Strazzera, E., and Mourato, S. (2016). Modelling individual preferences for energy sources: the case of IV generation nuclear energy in Italy. Ecological Economics, 127:37–58.

Czajkowski, M. and Budzinski, W. (2019). Simulation error in maximum likelihood estimation of discrete choice models. Journal of Choice Modelling, 31:73–85.

Daly, A., Hess, S., and Train, K. (2012). Assuring finite moments for willingness to pay in random coefficient models. Transportation, 39:19–31.

Dietz, S. and Atkinson, G. (2010). The Equity-Efficiency Trade-off in Environmental Policy: Evidence from Stated Preferences. Land Economics, 86(3):423–443.

Dolan, P. and Tsuchiya, A. (2009). The social welfare function and individual responsibility: Some theoretical issues and empirical evidence. Journal of Health Economics, 28:210–220.

Douenne, T. and Fabre, A. (2020). French attitudes on climate change, carbon taxation and other climate policies. Ecological Economics, 169:106496.

Drews, S. and van den Bergh, J. (2016). What explains public support for climate policies? A Review of empirical and experimental studies. Climate Policy, 17(7):855–876.

Fankhauser, S. (2010). The Costs of Adaptation. Wiley Interdisciplinary Review: Climate Change, 1(1):23–30.

Fankhauser, S. and Burton, I. (2011). Spending Adaptation Money Wisely. Climate Policy, 11:1037–1049.

Fesenfeld, L., Sun, Y., Wicki, M., and Bernauer, T. (2021). The Role and Limits of Strategic Framing for Promoting Sustainable Consumptions and Policy. Global Environmental Change, 68(102266).

Gampfer, R., Bernauer, T., and Kachi, A. (2014). Obtaining public support for North-South climate funding: Evidence from conjoint experiments in donor countries. Global Environmental Change, 29:118–126.

Geels, F. (2013). The impact of the financial-economic crisis on sustainability transitions: Financial investments, governance and public discourse. Environmental Innovation and Societal Transitions, 6:67–95.

Gevrek, Z. and Uyduranoglu, A. (2015). Public preferences for carbon tax attributes. Ecological Economics, 118:186–197.

Gibson, J., Barns, S., Cameron, M., Lim, S., Scrimgeour, F., and Tressler, J. (2007). The Value of Statistical Life and the Economics of Landmine Clearance in Developing Countries. World Development, 35(3):512–531.

Goett, A., Train, K., and Hudson, K. (2000). Customer choice among retail energy suppliersÃ the willingness-to-pay for service attributes. The Energy Journal, 21(4):1–28.

Green Climate Fund (2018). Mapping of elements related to project or programme eligibility and selection criteria. Green Climate Fund, Meeting of the Board Publication. available from `https://www.greenclimate.fund/sites/default/files/document/gcf-b19-38.pdf`.

Greene, W. and Hensher, D. (2003). A latent class model for discrete choice analysis: contrasts with mixed logit. Transportation Research Part B, 37(8):681–698.

Hager, A. and Hilbig, H. (2020). Does Public Opinion Affect Political Speech. American Journal of Political Science, 64(4):921–937.

Hammar, H. and Jagers, S. (2007). What is a fair CO2 tax increase? On fair emission reductions in the transport sector. Ecological Economics, 61(2-3):377–387.

Hensher, D. and Greene, W. (2003). The mixed logit model: the state of practice. Transportation, 30:133–176.

HM Government (2015). National Security Strategy and Strategic Defence and Security Review 2015: A Secure and Prosperous United Kingdom. available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/555607/2015_Strategic_Defence_and_Security_Review.pdf., accessed on 10 June 2017.

Horstmann, B. (2011). Operationalising the Adaptation Fund: challenges in allocating funds to the vulnerable. Climate Policy, 11(4):1086–1096.

Hovi, J., Sprinz, D., and Underdal, A. (2009). Implementing Long-term Climate Policy: Time Inconsistency, Domestic Politics, International Anarchy. Global Environmental Politics, 9(3):20–39.

Huber, R. and Wicki, M. (2021). What Explains Citizen Support for Transport Policy? The Roles of Policy Design, Trust in Government and Proximity among Swiss Citizens. Energy Research Social Science, 75(101973).

Huber, R., Wicki, M., and Bernauer, T. (2020). Public support for environmental policy depends on beliefs concerning effectiveness, intrusiveness, and fairness. Environmental Politics, 29(4):649–673.

Hynes, S., Chen, W., K., V., Armstrong, C., and O'Connor, E. (2021). Valuing the ecosystem service benefits from kelp forest restoration: A choice experiment from Norway. Ecological Economics, 179(106833).

IBRD/The World Bank (2010). Economics of Adaptation to Climate Change –Synthesis Report. available from http://documents.worldbank.org/curated/en/646291468171244256/pdf/702670ESW0P10800EACCSynthesisReport.pdf.

Jagers, S., Martinsson, J., and Matti, S. (2019). The impact of compensatory measures on public support for carbon taxation: An experimental study in Sweden. Climate Policy, 19(2):147–160.

Kenny, J. (2018). The role of economic perceptions in influencing views on climate change: An experimental analysis with British respondents. Climate Policy, 18(5):581–592.

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., and Stern, N. (2018). Making carbon pricing work for citizens. Nature Climate Change, 8(8):669–677.

Klöck, C., Molenaers, N., and Weller, F. (2018). Responsibility, capacity, greenness or vulnerability? What explains the levels of climate aid provided by bilateral donors. Environmental Politics, 27(5):892–916.

Kotchen, M., Boyle, K., and Leiserowitz, A. (2013). Willingness to pay and policy instrument choice for climate change policy in the United States. Energy Policy, 55:617–625.

Kotchen, M., Turk, Z., and Leiserowitz, A. (2017). Public willingness to pay for a US carbon tax and preferences for spending the revenue. Environmental Research Letters, 12:094012.

Kragt, M. and Bennett, J. (2012). Attribute Framing in Choice Experiments: How Do Attribute Level Descriptions Affect Value Estimates. Environmental and Resource Economics, 51:43–59.

Le Grand, J. (1990). Equity versus Efficiency: The Elusive Trade-off. Ethics, 100(3):554–568.

Le Grand, J. (1991). Equity and Choice: An Essay in Economics and Applied Philosophy. Routledge, London.

Lee, J. and Cameron, T. (2008). Popular Support for Climate Change Mitigation: Evidence from a General Population Mail Survey. Environmental and Resource Economics, 41:223–248.

Masiero, L. and Maggi, R. (2010). Accounting for WTP-WTA Discrepancy in Discrete Choice Models: Discussion of Policy Implications Based on Two Freight Transport Stated Choice Experiments. In Ben-Akiva, M., M. M. and Van de Voorde, E., editors, Freight Transport Modelling. Emerald Group Publishing Limited, Bingley.

McFadden, D. (1974). Conditional Logit Analysis of qualitative choice behaviour. In Zarembka, P., editor, Frontiers in Econometrics. Academic Press, New York.

Met Office (2019). Mauna Loa carbon dioxide forecast for 2019. accessible from: https://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/forecasts/co2-forecast, accessed on 10 August 2019.

Nowlin, M., Gupta, K., and Ripberger, J. (2020). Revenue use and public support for a carbon tax. Environmental Research Letters, 15(8):084032.

OECD (2020). 2020 Projections of Climate Finance Towards the USD 100 Billion Goal: Technical Note. available on: https://www.oecd.org/environment/cc/Projecting%20Climate%20Change%202020%20WEB.pdf.

O'Garra, T. and Mourato, S. (2016). Are we willing to pay what it takes? Willingness to pay for climate change adaptation in developing countries. Journal of Environmental Economics and Policy, 5:249–264.

Oxfam (2020). Climate Finance Shadow Report 2020: Assessing Progress Towards the USD 100 Billion Commitment. available on: https://bit.ly/3qLQLV9.

Parry, M., Arnell, N., Berry, P., Dodman, D., Fankhauser, S., Hope, C., Kovats, S., Nicholls, R., Satterthwatie, D., Tiffin, R., and Wheeler, T. (2009). Assessing the costs of adaptation to climate change. A review of the UNFCCC and other recent estimates. International Institute for Environment and Development and Grantham Institute and Climate Change, Imperial College London.

Phillips, D., Curtice, J., Phillips, J., and Perry (2018). British Social Attitudes: The 35th Report. The National Centre for Social Research, London, UK.

Revelt, D. and Train, K. (1998). Mixed logit with repeated choices: households' choice of appliance efficiency level. The Review of Economics and Statistics, 80:647–657.

Rheinberger, C. (2009). Paying for Safety: Preferences for Mortality Risk Reductions on Alpine Roads. Fondazione Eni Enrico Mattei Working Paper, available on: http://ageconsearch.umn.edu/bitstream/54350/2/77-09.pdf. accessed 9 October 2017.

Roberts, J., Weikmans, R., Robinson, S., Ciplet, D., Khan, M., and Falzon, D. (2021). Rebooting a failed promise of climate finance. Nature Climate Change, 11:180–182.

Robson, M., Asaria, M., Cookson, R., Tsuchiya, A., and Ali, S. (2017). Eliciting the Level of Health Inequality Aversion in England. Health Economics, 26:1328–1334.

Ruud, P. (1996). Approximation and Simulation of the Multinomial Probit Model: An Analysis of Covariance Matrix Estimation. Working Paper Department of Economics, University of Berkeley, available on: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.208.8116&rep=rep1&type=pdf, accessed 9 November 2017.

Shapanskz, B., Adamowicz, W., and Boxall, P. (2008). Assessing Information Provision and Respondent Involvement on Preferences. Ecological Economics, 65:626–635.

Stadelmann, M., Persson, A., Ratajczak-Juszko, I., and Michaelowa, A. (2014). Equity and cost-effectiveness of multilateral adaptation finance: are they friends or foes? International Environmental Agreements: Politics, Law and Economics, 14:101–120.

Stern, N. (2008). The economics of climate change. American Economic Review, 98(2):1–37.

Stern, N. (2009). A Blueprint for a Greener Planet. Bodley Head, London, UK.

Strazzerra, E., Mura, M., and Contu, D. (2012). Combining choice experiments with psychometric scales to asses the social acceptability of wind energy projects: A latent class approach. Energy Policy, 48:334–347.

SWOF (2012). The Valuation of human losses of road deaths . SWOV Fact Sheet, Institute for Road Safety Network, Leidschendam, the Netherlands, available on `https://www.swov.nl/en/publication/valuation-human-losses-road-deaths`, accessed on 7 September 2017.

Teixidó, J. and Verde, S. (2017). Is the Gasoline Tax Regressive in the Twenty-First Century? Taking Wealth into Account. Ecological Economics, 138:109–125.

Tjernström, E. and Tietenberg, T. (2008). Do differences in attitudes explain differences in national climate change policies. Ecological Economics, 65:315–324.

Tsuge, T., Kishimoto, A., and Takeuchi, K. (2005). A Choice experiment approach to valuation of mortality. The Journal of Risk and Uncertainty, 31(1):73–95.

UNEP (2017). The Emissions Gap Report 2017. United Nations Environment Programme, available from `https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf?sequence=1&isAllowed=y`, accessed on 7 September 2018.

UNFCCC (2007). Climate Change: Impacts, Vulnerabilities, and Adaptation in Developing Countries. Bonn, Germany.

Viscusi, W. (2009). Valuing risk of death from terrorism and natural disasters. Journal of Risk and Uncertainty, 38:191–213.

Westphal, M., Ballesteros, A., Morgan, J., and Canfin, P. (2015). Getting to $100 billion: Climate Finance Scenarios and Projections to 2020. World Resources Institute Working Paper, May 2015. Accessible from `https://www.wri.org/publication/getting-100-billion-climate-finance-scenarios-and-projections-2020`, accessed on 9 July 2017.

Wicki, M., Huber, R., and Bernauer, T. (2019). Can policy-packaging increase public support for costly policies? Insights from a choice experiment on policies against vehicle emissions. Journal of Public Policy, pages 1–27.

Wiseman, J., Edwards, T., and Luckins, K. (2013). Post carbon pathways: A meta-analysis of 18 large-scale post carbon economy transition strategies. Environmental Innovation and Societal Transition, 8:76–93.

YouGov (2014). Report on British Attitudes to Defence, Security and the Armed Forces. accessible from `https://yougov.co.uk/news/2014/10/25/report-british-attitudes-defence-security-and-arme/`, accessed on 15 July 2017.

Zhang, Z. and Maruyama, A. (2001). Towards a private-public synergy in financing climate change mitigation projects. Energy Policy, 29(15):1363–1378.

Appendix

Understanding Public Support for International Climate Adaptation Payments: Evidence from a Choice Experiment

Appendix A Example Choice Card

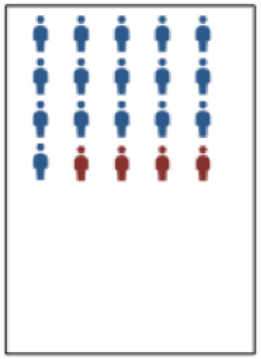
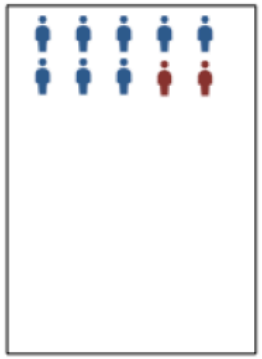
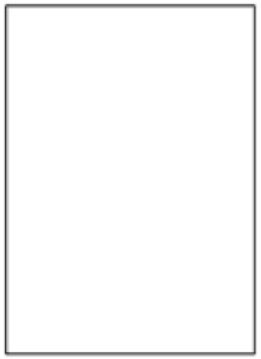
	Climate Adaptation Project 1	Climate Adaptation Project 2	No Additional Policy
Total **deaths prevented** per year – Blue: Deaths prevented among the **middle-income households** Red: Deaths prevented among the **extremely poor.**	 Total **deaths prevented** (blue & red): 20,000 **Deaths prevented** among **the extremely poor** (red): 4,000 (20%)	 Total **deaths prevented** (blue & red) 10,000 **Deaths prevented** among the **extremely poor** (red): 2,000 (20%)	 Zero deaths prevented Zero deaths prevented among the extremely poor.
UK's financial contribution is **conditional** on people in recipient country also paying an additional adaptation tax.	No	Yes	
UK industries and businesses contribute through an additional levy	Yes	Yes	
UK household payment scheme	Households with higher income pay more. (Collected through a proportional increase in income tax).	Every household pays the same amount (Collected through an additional lump-sum household tax).	
Your yearly payment	£20	£5	£0

Figure A1: Example Choice Card

Appendix B Scenario Description

Developed countries, including the UK, are responsible for most of the historic greenhouse gas emissions such as carbon dioxide (CO_2) that cause climate change. Global climate change is a serious environmental problem faced by humankind. It is caused by greenhouse gas emissions (GHG) such as CO2 that originate from burning of fossil fuels like coal, oil or natural gas. Climate change is expected to cause rising average temperatures, rising sea-levels and more severe natural disasters. The World Health Organization estimates that climate change will cause additional 250,000 annual deaths across the world by 2030. To prevent any of these deaths, financial resources are required from now on to gradually improve the resilience of affected people.

The developed countries have committed themselves to help poor countries adapt to the impacts of climate change. Globally, approximately £75 billion per year will be required to help poor countries adapt. Contributions for these climate adaptation programmes will come from all advanced economies, based on GDP and population size.

The UK Department for International Development (DFID) requires additional financial resources, to implement such climate change adaptation projects. These projects focus on preventing deaths from droughts, floods, and heatwaves for example by building flood barriers, and distributing drought-resistant crops and air-conditioning units.

Project Characteristics: Projects available to DFID differ along a set of characteristics. One such characteristic is the distribution of resources within the recipient country. Two groups are eligible to receive funding:

1. The extremely poor: These people live in shanty towns on less than £515 per year. These groups are particularly vulnerable to any natural disasters and climatic changes. (For comparison, the average annual household income in the UK is £26,000).

2. Middle-income households: These people live in basic but solid housing on approximately £5000 per year. These people do not live in poverty but are still vulnerable to climate change events (for comparison, the average annual household income in the UK is £26,000).

Yet, without support climate change induced deaths will occur in both groups. Depending on the distribution of the resources across these groups the total cost may differ. However, the surviving members of the extremely poor face greater difficulties in managing the impact of a death on their household compared to middle-income households. Extremely poor families experiencing such a climate change induced death are expected to receive less support from the community and friends, as they are also poor. The extremely poor also have less access to social safety nets and formal financial tools (e.g. savings, credit, insurance) to help them manage these negative impacts resulting from the death of a family member compared to middle-income households.

You will be asked to give your preferred choice on a sequence of policy alternatives. Each set of policy alternatives is completely independent of any preceding or following alternatives. The policies differ in their characteristics and you can only choose one of them. You can also choose the "no additional policy" scenario, in which case no additional costs would be incurred and zero deaths would be prevented.

I'd like you to think how much each of these programmes are worth to you. Then please consider whether you would be willing to pay a surcharge, to support either of these programmes.

You will now be asked two comprehension questions on the above description.

Appendix C Demographic Summary Statistics

Variable	Statistic	Overall Sample	UK Population Statistics
Gender	% Male	47.0	49.3
Mean Age	Mean	47.7	46.9
	S.D.	19.2	/
Income (£)	Mean	36732	38291
	S.D.	33341	/
Education	% University Degree	29	27.2
	% 2 or more A-levels or equiv.	13.4	12.3
	% 5 or more GCSEs or equiv.	16.7	15.3
	% Up to 4 GCSEs	30.4	36
	% Apprenticeship	3.9	3.6
	% Other	6.1	5.7
Region	%South East	15.2	13.7
	% London	12.0	13.4
	% North West	10.7	11.0
	% East	10	9.3
	% West Midlands	8.7	8.8
	% South West	8.3	8.4
	% Yorkshire and the Humberlands	9.1	8.3
	% East Midlands	7.6	7.2
	% North East	4.5	4.0
	% Wales	4.7	4.7
	% Scotland	7.2	8.2
	% Northern Ireland	1.9	2.8

Table C1: Demographic Summary Statistics

[20]Note on Sources UK Population Statistics: Geographic Statistics: (For England: `https://www.statista.com/statistics/294681/population-england-united-kingdom-uk-regional/` ; for Wales and Northern Ireland: `https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates#timeseries`. Gender Statistics: `https://www.ons.gov.uk/visualisations/nesscontent/dvc219/pyramids/index.html` (Based on predictions for 2017 based on last Census). Age Statistics: `https://www.ons.gov.uk/visualisations/nesscontent/dvc219/pyramids/index.html` (based on predictions for 2017 based on last Census). Education Statistics (only available for England and Wales): `http://webarchive.nationalarchives.gov.uk/20160105191238/http://www.ons.gov.uk/ons/rel/census/2011-census-analysis/local-area-analysis-of-qualifications-across-england-and-wales/rpt---local-area-analysis-of-qualifications-across-england-and-wales.html#tab-Overview-of-Qualifications-in-Engla` Income Statistics (ONS, 2017): `https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/adhocs/006770grosshouseholdincomebyincomedecilegroupukfinancialyearending2`

Appendix D Summary of Survey Results of Respondents' Opinions on Climate Change and Distributional Questions

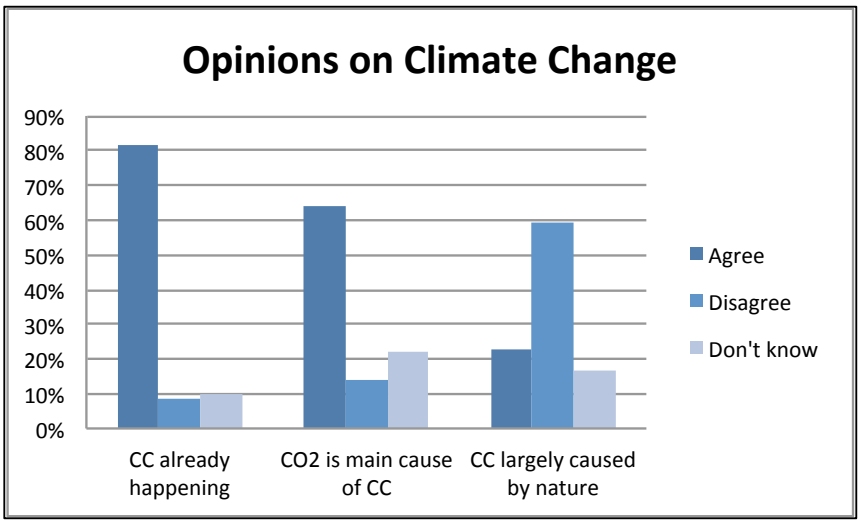


Figure D1: Opinions on Climate Change

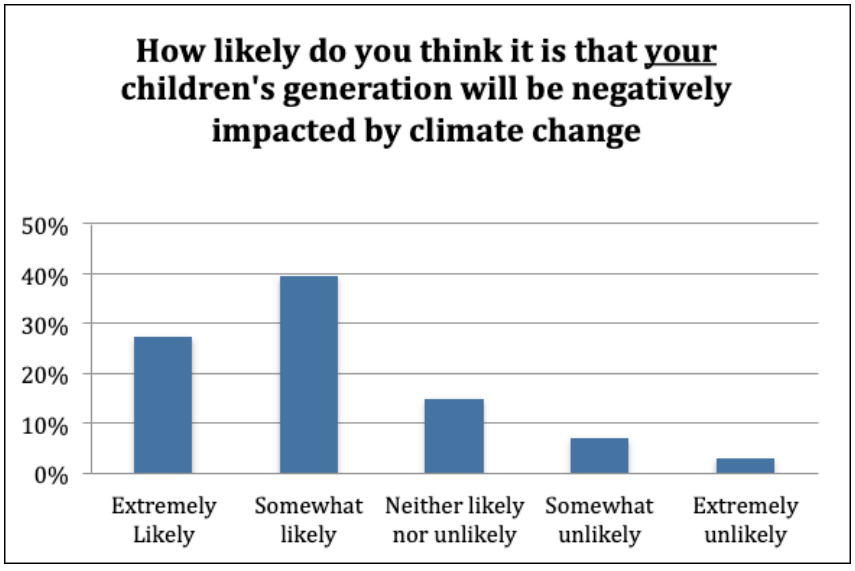


Figure D2: Opinions on Future Impacts of Climate Change

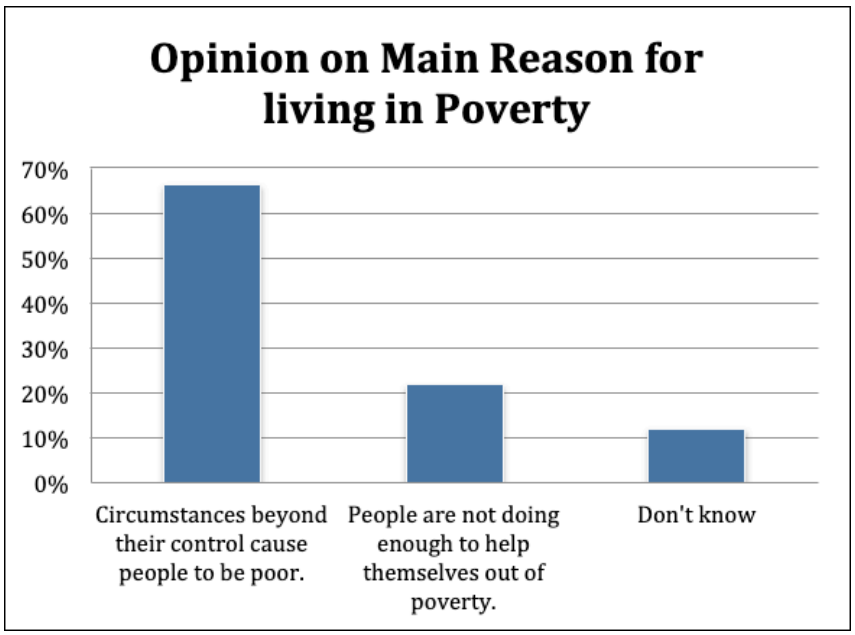


Figure D3: Opinions on Main Underlying Reasons for why People Live in Poverty

Appendix E RPL results with 10,000 draws

Dependent variable: Choice	(1) PRL_EC	(2) RPL_EC	(3) Monetary Valuation (£) (95% C.I.)
	Coeff (S.E.)	S.D.	
Total Deaths Prevented (thds.)	0.0493***	0.0588***	1.20
	(0.0031)	(0.0041)	(1.69; 2.30)
Share of Deaths Prev. among extremely poor	0.3258***	-1.2073***	13.19
	(0.1274)	(0.3095)	(2.87; 23.51)
Payment Conditional	0.1771***	0.6819***	7.17
	(0.0505)	(0.1007)	(3.09; 11.25)
Industry Co-Finance	0.1185***	0.0001	4.80
	(0.0355)	(0.0044)	(1.88; 7.71)
Richer HHs pay more	0.1971***	0.1171	7.98
	(0.0571)	(0.1851)	(3.38; 12.58)
HHs with higher carbon emissions pay more	-0.1212**	-0.6743***	-4.91
	(0.0538)	(0.0903)	(-9.11; - 0.70)
Annual Payment (£)	-0.0247***[b]	/	
	(0.0015)		
Information*Payment	0.0032*[b]	/	0.13
	(0.0018)		(-0.01; 0.26)
ASC 1 (Policy 1)	-0.0357	-0.5018***	-1.45
	(0.0366)	(0.0760)	(-4.37; 1.48)
ASC 2 (Status-quo)	-2.0144***	4.1858***	-81.56
	(0.1798)	(0.2501)	(-96.78; -66.33)
Log-likelihood	-6621.96		
Observations	9120		

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%. Omitted payment category: All households pay the same amount.

Table E1: RPL results with 10,000 inter-person Halton draws

Appendix F Results of the Multinomial Logit Model (MNL)

Dependent variable: Choice	(2) MNL	(3) MNL
Variable	Coeff (S.E.)	Monetary Valuation (£) (95% C.I.)
Total Deaths Prevented (thds.)	0.031***	2.07
	(0.002)	(1.75; 2.39)
Share of Deaths Prev. among extremely poor	0.272***	17.93
	(0.067)	(9.15; 26.71)
Payment Conditional	0.174***	11.45
	(0.034)	(6.76; 16.14)
Industry Co-Finance	0.136***	9.00
	(0.026)	(5.44; 12.56)
Richer HHs pay more	0.021	1.37
	(0.038)	(-3.60; 6.34)
HHs with higher carbon emissions pay more	-0.010	-0.68
	(0.035)	(-5.26; 3.89)
Annual Payment (£)	-0.015***	/
	(0.001)	
Information*Payment	0.002**	0.15
	(0.001)	(0.01; 0.29)
ASC 1 (Policy 1)	-0.024	-1.55
	(0.025)	(-4.82; 1.72)
ASC 2 (Status-quo)	-0.093	-6.15
	(0.092)	(-17.79; 5.49)
Log-likelihood	-8888.76	
Observations	9120	

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%.

Omitted payment category: All households pay the same amount.

Table F1: Multinomial Logit Model (MNL)

Appendix G RPL results with factor variables

Dependent variable: Choice	(1) RPL	(2) RPL	(3) RPL
Variable	Coeff (S.E.)	S.D.	Monetary Valuation (£) (95% C.I.)
Total Deaths Preventend: 20K	0.5914***	-0.0017	25.26
	(0.0572)	(0.0041)	(19.78; 30.74)
Total Deaths Preventend: 40K	1.4114***	1.1437***	60.29
	(0.0832)	(0.0841)	(51.27; 69.31)
Share of Deaths Prev. among extremely poor: 50%	0.5549***	-0.5472***	23.70
	(0.0873)	(0.1873)	(15.86; 31.54)
Share of Deaths Prev. among extremely poor: 80%	0.0907	-0.0137	3.87
	(0.0727)	(0.0233)	(-2.27; 10.02)
Payment Conditional	0.1737***	0.7866***	7.42
	(0.0495)	(0.0862)	(3.22; 11.62)
Industry Co-Finance	0.0979***	0.0005	4.18
	(0.0351)	(0.0050)	(1.17; 7.19)
Richer HHs pay more	0.3313***	0.0862	14.15
	(0.0704)	(0.0912)	(8.12; 20.18)
HHs with higher carbon emissions pay more	-0.1528***	-0.6364***	-6.53
	(0.0531)	(0.0914)	(-10.90; -2.15)
Annual Payment (£)	-0.0234***[b]	/	/
	(0.0014)		
Information*Payment	0.0028[b]	/	0.13
	(0.0017)		(-0.01; 0.26)
ASC 1 (Policy 1)	-0.0657*	-0.4313***	-2.81
	(0.0355)	(0.0803)	(-5.80; 0.19)
ASC 2 (Status-quo)	-2.4189***	4.5412***	-103.33
	(0.1851)	(0.2443)	(-120.49; -86.16)
Log-likelihood	-6658.86		
Observations	9120		

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%. Omitted category: Total Deaths prevented: 10k, Share of deaths prevented among the extremely poor: 20%, Payment mechanism: All households pay the same. b: Non-random fixed coefficients.

Table G1: RPL Model with Factor Variables

Appendix H RPL results (specified that the random coefficients are correlated)

Dependent variable: Choice	(2) PRL	(3) RPL
Variable	Coeff (S.E.)	Monetary Valuation (£) (95% C.I.)
Total Deaths Prevented (thds.)	0.0461***	1.81
	(0.0039)	(1.48; 2.13)
Share of Deaths Prev. among extremely poor	0.4678***	18.36
	(0.1445)	(7.05; 29.68)
Payment Conditional	0.0577	2.27
	(0.0592)	(-2.30; 6.83)
Industry Co-Finance	0.0608	2.38
	(0.0451)	(-1.14; 5.91)
Richer HHs pay more	0.1469**	5.77
	(0.0626)	(0.87; 10.66)
HHs with higher carbon emissions pay more	-0.2347***	9.21
	(0.0538)	(-13.77; -4.65)
Annual Payment (£)	-0.0255***[b]	/
	(0.0015)	
Information*Payment	0.0036**[b]	/
	(0.0018)	
ASC 1 (Policy 1)	-0.0867**	3.40
	(0.0416)	(-6.67; -0.13)
ASC 2 (Status-quo)	-2.4821***	-97.43
	(0.1952)	(-114.13; -80.73)
Log-likelihood	-6509.82	
Observations	9120	

Note: Robust Standard errors reported in parentheses. *** denotes significance at 1%, ** at 5%, and * at 10%. Omitted payment category: All households pay the same amount. This specification was run using 1000 draws instead of the 5000 draws used in the main specification because the model did not converge with the larger number of draws because the model with correlation between the random parameters is computationally more demanding.

Table H1: RPL Model correlation between the random coefficients

Appendix I Descriptive statistics of class membership functions in LCM

Variable	Mean	Std. Dev.	Min	Max	Observations
Income above average (yes=1)	0.3368	0.4727	0	1	9120
A-level or above (yes=1)	0.4289	0.4950	0	1	9120
GHGs are the main cause of climate change (yes=1)	0.6412	0.4797	0	1	9120
Climate Change is likely to have negative impacts on future generations (yes=1)	0.6702	0.4702	0	1	9120
Biggest reason for poverty lies in reasons beyond individuals' own control (yes=1)	0.6632	0.4727	0	1	9120

Table I1: Descriptive Statistics of Variables to Characterise Class Membership Functions in LCM

Appendix J Willingness-to-pay values for LCM results

	Class 1	Class 2	Class 3	Class 4	Class 5
Total Deaths prevented (thds.)	0.373*** (0.16; 0.58)	19.639 (-51.34; 90.62)	0.375 (-1.24; 1.99)	6.771*** (5.30; 8.24)	0.647*** (0.37; 0.93)
Share of deaths prevented among the extremely poor	-3.332 (-13.91; 7.27)	368.675 (-993.32; 1730.67)	-32.239 (-116.85; 52.37)	101.705*** (60.99; 142.42)	-5.340 (-27.39; 16.71)
Payment Conditional	2.761*** (-2.57; 8.09)	-244.002 (-1106.55; 618.54)	-0.820 (-44.12; 42.48)	-19.119** (-33.87; -4.37)	9.58*** (2.43; 16.74)
Industry Co-finance	8.74*** (3.93; 13.55)	112.95 (-350.01; 575.91)	-39.99 (-95.55; 15.56)	13.85*** (3.98; 23.71)	4.23* (-0.64; 9.10)
Richer HHs pay more	-1.08 (-6.41; 4.24)	47.81 (-260.29; 355.91)	32.85 (-26.29; 91.99)	10.75 (-7.77; 29.28)	12.79*** (4.06; 21.52)
HHs with higher emissions pay more	-4.28 (-9.65; 1.09)	82.44 (-365.21; 530.08)	-17.97 (-72.41; 36.47)	14.12** (2.33; 25.90)	3.51 (-3.25; 10.26)
Information * Payment	-0.02 (-0.26; 0.21)	-0.05 (-3.95; 3.85)	-0.472 (-1.94; 1.00)	0.062 (-0.14; 0.26)	-0.058 (-0.22; 0.10)
ASC_Status quo	-9.31 (-21.32; 2.71)	-453.98 (-1950.69; 1042.73)	150.99* (-19.96; 321.93)	-9.20 (-47.96; 29.56)	-105.66*** (-124.44; -86.88)
ASC_option 2	4.49** (0.58; 8.39)	382.28 (-976.07; 1740.64)	5.46 (-36.34; 47.25)	-5.27 (-12.48; 1.93)	-4.51** (-8.92; -0.10)

Table J1: Willingness-to-pay valuations of the Latent Class model (with 95% confidence intervals)