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Context-dependent evaluation of climate change policies: competing policies, knowledge and emotions

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Climate change policies can compete with policies on other social and environmental problems for limited economic resources. This paper investigates the potential influence of alternative policies on citizens' preferences for climate change policies. A contingent valuation study was implemented to estimate the impact of observable and unobservable contextual effects of competing polices on climate change valuation. Individuals are also investigated about their endowment of knowledge and emotional reactions to such problems. The results show that citizens' valuation of climate change policies crucially depends on the context-dependent competing policies. The valuation rises as the number of competing policies increases. This increment becomes economically significant when the competing policies are related to specific problems such as forest fires and development. In addition, the valuation also rises with the amount of knowledge endowed by the individual about the climate change problem, and with the experience of negative emotions such as fear and sadness.

Keywords: contingent valuation; climate change; emotions; knowledge; joint evaluation; willingness to pay

1. Introduction

Climate change poses a major challenge to human society, since its management will require a substantial amount of resources. Public knowledge about the problem, its causes and consequences has increased in the past decade (Bord, O'Connor, and Fisher 2000; Lee and Cameron 2008). However, research on public opinion about climate change has revealed that it is not the most important policy priority across society (e.g., Bostrom *et al*. 1994; Leiserowitz 2006; Lorenzoni and Pidgeon 2006). Although these studies proved that there is public awareness of climate change, in most cases it has not led to relevant changes in human behavior or attitudes (Stoll-Kleemann, O'Riordan, and Jaeger 2001; O'Neill and Hulme 2009).

From an economic point of view, the problem of climate change competes with other environmental and social problems for a limited amount of resources. The implication is that the valuation of policies for climate change can be influenced by the context in which the valuation is framed (Spence and Pidgeon 2010). The frame of human decisions includes the number of alternative issues to be considered in the valuation task and competing for scarce economic resources.

In this paper, we investigate to what extent individuals' decisions about climate change policy valuation can be affected by the frame or context of the decision-making

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process (Bettman, Luce, and Payne 1998). We also consider the potential impact on the valuation decision of the amount of knowledge that individuals possess and their emotional reactions to the set of social and environmental problems considered in the decision frame. To this aim we utilize a Bayesian system of equations that allows us to model the data from a contingent valuation (CV) approach that simultaneously elicits individuals' responses to valuation decisions about climate change and other competing public policy problems.

CV is a survey-based method commonly utilized to assess public preferences for environmental policies (e.g., Mitchell and Carson 1989). It involves asking respondents to state their maximum willingness to pay (WTP) for the policy proposal. Stated preference methods such as CV have been utilized to appraise carbon offsets and other climate change policies (e.g., Brouwer, Brander, and Van Beukering 2008; MacKerron *et al*. 2009; Carson, Louviere, and Wei 2010).

Some studies have focused on WTP measurement for market goods that could ameliorate potential trends of climate change, such as the option of using renewable sources of energy (e.g., Hansla *et al*. 2008; Solomon and Johnson 2009). Most of these studies focus on particular policies to deal with the climate change problem; that is, there is no consideration of alternative policy goals that might be of interest to society and that could compete for scarce economic resources. This paper focuses on the investigation of social preferences for climate change policies when other competing goals are also considered in the context or decision frame of the individual.

That is, we investigate whether the decisions people are willing to make for dealing with the potential impacts of climate change can be influenced by alternative public policy actions. Hoehn and Randall (1987) argued the utilization of the CV method without the consideration of alternative environmental policies would result in flawed public policy recommendations. Hoehn and Loomis (1993) noted that an accurate valuation of environmental policies utilizing the CV method should account for potential alternative environmental programs in the decision frame. The NOAA panel on CV (Arrow *et al*. 1993) strongly recommends that respondents be reminded about substitute goods when utilizing the CV method. However, to the best of our knowledge, past research on climate change valuation has not considered the influence of alternative environmental and social goals that might be of interest to society.

The paper is organized as follows. Section 2 presents the literature review on the contextual roles of the choice set, the set of information, and the emotions in human decision making in general, and environmental valuation in particular. Section 3 presents the proposed econometric model aimed at valuing the environmental policies under different contexts. Section 4 presents the data and application. Section 5 discusses the main results and Section 6 summarizes the conclusions and implications of the paper.

2. Background

Research on behavioral sciences (Payne, Bettman, and Johnson 1992; Lowenstein and Lerner 2003) has pointed out that individual valuation decisions on policy proposals can be moderated by the frame or context of the decision. In addition, human decision making in consumption and production can be explained by the dual process of cognition and affection (Angie *et al*. 2011). In the context of climate change decisions, Lorenzoni, Nicholson-Cole, and Whitmarsh (2007) argued that public engagement in climate change relies on the interconnectedness of three aspects of the decision-making process:

cognitive, affective and behavioral. O'Neill and Hulme (2009) highlighted that any policies that seek to induce change in behavior without consideration of cognitive and affective issues are unlikely to lead to meaningful and long-lasting behavioral change.

2.1. Single versus joint evaluation

An important aspect of the context of the decision-making or valuation frames is the consideration of a single versus a set of alternative options in the valuation task faced by the individual in the decision process. Empirical evidence shows that individuals can rate differently the value of products and items when they are valued in isolation than when they are valued in conjunction with other competitive alternatives (Hsee 1996). The implication is that preference orderings are not likely to be the same when goods are valued in isolation (Hsee *et al*. 1999). More recently, Ritov and Baron (2011) show that joint evaluation enhances the evaluability of public policies and acts as moderator of the influence of emotions on judgments.

2.2. Information or knowledge effects

The amount of information or knowledge has been found to influence individual decisions about climate change policies. Bord, O'Connor, and Fisher (2000) found that information about the causes of climate change plays an important role in predicting individuals' behavioral intentions to address climate change, concluding that translating public concern for global warming into effective action requires "real knowledge." Similarly, Sundblad, Biel, and Gärling (2007) found that knowledge about the causes and the consequences of climate change was an important predictor of both cognitive and affective risk judgments related to climate change. The amount of knowledge individuals possess about climate change can also have different impacts on behavior depending on the frame in which this information is encoded. Spence and Pidgeon (2010) reported on experiments in which the formulation of gain and distant frames for climate change resulted in more positive attitudes and impacts being perceived as more severe.

In CV research, there is concluding evidence that the amount and quality of information about environmental goods provided to individuals in a survey can lead to different responses across individuals (e.g., Bergstrom, Stoll, and Randall 1990; Azen, Brown, and Rosenthal 1996; Blomquist and Whitehead 1998; Kenyon and Edward-Jones 1998). In the valuation of climate change policies, Berrens *et al*. (2004) showed that the information has to be assimilated by potential respondents and that this assimilation requires some effort. That is, simply presenting subjects with vast information about climate change effects and policies does not have an impact on WTP for carbon tax financed policies; rather, for information to have an impact there is need of respondents' effort, i.e., information has to be assimilated by individuals and become knowledge.

2.3. Emotions and WTP

Brain scientists have pointed out that emotions can mediate the relationship between cognition and human behavior. Damasio (1994) argued that expected emotions are used to encode the consequences of alternative courses of action affectively, and that such "somatic markers" critically influence decision making. Climate change is an environmental phenomenon capable of prompting emotional reactions in individuals (Doherty and Clayton 2011). Leiserowitz (2006) found support for the hypothesis that public responses to climate

change are influenced by both psychological and socio-cultural factors, while Fischer and Glenk (2011) reported that emotional engagement explains heterogeneity in the valuation of climate change policies. The invocation of dramatic, sensational, fearful, shocking and other representations of climate change has been commonly a useful strategy to capture people's attention to the issue of climate change (e.g., Weingart, Engels, and Pansegray 2000). However, this type of emotional representation may not always motivate a sense of personal engagement with the issue and may trigger the kind of denials about the existence of climate change described by Lorenzoni, Nicholson-Cole, and Whitmarsh (2007). Along this line, O'Neill and Nicholson-Cole (2009) suggest that engagement with climate change actions is more likely with communication approaches that take into account the understanding of individuals' values, attitudes, beliefs, local environments and experiences.

In general, emotions play an important role in individuals' economic behavior alongside other aspects of human psychology (e.g., Elster 1998). This applies to the issues and policies involved in environmental decision making. In the area of CV research, it has been shown that individuals' emotions can play a significant role in the valuation of environmental goods (e.g., Frör 2008), but there is lack of more conclusive evidence for the valuation of climate change policies.

3. Fieldwork

3.1. Data collection

The field work was conducted in Spain from January to November 2008. A random sample of 500 adult individuals (aged between 18 and 65) was selected out of the Spanish population census. The research question from the environmental policy perspective was to elicit citizens´ preferences for a specific carbon consumption tax that was under consideration by the government. The purpose of this specific tax was to raise money to finance a combination of mitigation and adaptation policies that would speed up the transition to a carbon free economy, such as the adoption of non-fossil fuel energy sources and the investment in technological innovation on non-carbon sources of energy.

3.2. The questionnaire

Following the CV method, the research team designed a semi-structured questionnaire that was utilized to in-person interview. All the interviews were conducted "in depth" by trained interviewers with each individual following the objectives of the study, i.e., to ascertain the amount of knowledge about the policy issues discussed in the interview and the emotions potentially raised by these issues. All the interviews were audio recorded for further analysis.

In order to improve the questionnaire in its early stages, the research team conducted two focus groups that allowed it to obtain information for the definition of the valuation scenarios, and check for the correct interpretation of the questions. Three pre-test works, with 40-50 individuals each randomly taken from the population, allowed the team to: i) confirm and identify additional alternative policies that were perceived as more important to citizens while competing for public funding in the community; ii) prove the working of the valuation instrument; iii) and to obtain information for the definition of the prices to be offered in the simulated market scenario.

The semi-structured questionnaire was divided into five parts: (1) questions on information and knowledge, (2) questions on specific emotions, (3) information on public policy programs, (4) questions on WTP for policy programs, and (5) socioeconomic questions. This structure was checked in focus groups, observing that there was no relevant interference between the parts of the questionnaire since each part was perceived as independent from the preceding questions. Although the study focused on climate change valuation, it also considered four alternative problems as potential candidates to be jointly valued: (1) forest fires, (2) poverty in less developed countries, (3) oil spills by large oil tankers and ships, and (4) international terrorism. These problems were chosen based on an extensive qualitative work (focus groups, pre-test surveys and verbal protocols) with citizens, decision makers and local policy analysts. This analysis was aimed at identifying the social importance that they had on the media and public opinion during the period of the fieldwork.

3.3. Measuring climate change information levels

In the first part of the interview, subjects were asked about their knowledge on each of the policy issues considered. In order to elicit the knowledge or information that individuals had about the problems, open-ended questions were posed on both the causes and consequences of each of the problems considered, as perceived by the subject. For instance, for the causes of the problem of climate change the question was: "Please, could you tell me what are your thoughts or knowledge about the causes of the problem of climate change?" The responses to these questions allowed a group of five external qualified experts to rate the knowledge that subjects had when answering the policy valuation questions presented later in the interview.[1]

The experts were completely unaware of the research hypotheses of the study. The conversion of the qualitative information into a quantitative index by experts was approached in three stages. In the first stage, experts were asked to independently rate the information level on the suggested policies of a sample of 50 respondents. They also were asked to provide standard vignettes or examples of responses that they would assign to each level. In the second stage, experts held a meeting to reach agreement on a scale with several examples of how to rate different responses into the unified scale. Thus, the value of one was given to those subjects who were not able to provide any relevant answer for these questions. Table 1 presents examples of the knowledge coding for the scale of the knowledge levels (2, 3, and 4) for each of the social and environmental problems considered in the decision frame. The final stage involved each expert assigning a value from one to four to each respondent based on the unified scale. The final value employed for each respondent was the average of all experts' valuation to her response.[2]

3.4. Measuring climate change emotional load levels

In the second section of the questionnaire, subjects were asked about the level of specific emotions (happy, sad, angry, excited, indifferent and afraid) that were experienced with respect to each of the environmental and social problems being considered in the study. In order to measure emotions, we utilized a scale of self-reported emotions following the wording used in Peters, Slovic, and Gregory (2003). Self-reported scales are the most common method to measure emotions in both psychology and economics literatures (Loewenstein 2000).

Table 1. Examples of knowledge coding for each of the problems discussed.

	Knowledge = 2	Knowledge = 3	Knowledge = 4
Climate change			
Causes	Human beings and society, cars.	Some fossil fuels, human development, carbon dioxide.	Greenhouse effect, fossil fuels, water vapor, carbon dioxide, methane, nitrous oxide, CFCs, technology, economic activities, deforestation.
Consequences	Higher temperature	Temperature, damage to environment, damage to some species.	Temperature variability, evaporation, precipitation, melted glaciers, damage to environment, health, ecosystems, sea level rise, property, droughts, crops changes, famine, migration.
Forest fires			
Causes	Some people set fires	Bad behavior, lack of control.	Poor forest management, lack of resources, bad behavior, lack of responsibility, economic interests.
Consequences	Damage to property	Damage to ecosystems and property.	Damage to ecosystems, deforestation, property, soil erosion, urbanization.
Poverty in less developed countries			
Causes	Lack of solidarity	Lack of human resources and foreign aid, lack of solidarity.	Lack of foreign aid, unfair trade, trade restrictions, inequality, social imbalance, institutions, moral responsibility, human resources, investments.
Consequences	Famine	Hunger, social backwardness.	Lack of development, social unrest, social backwardness, vicious circle, underdevelopment, lack of growth, health problems, malnutrition.
Oil spills			
Causes	Oil tankers	Oil companies, oil tankers, oil traffic.	Oil companies, oil tankers, lack or regulation, corruption, lack of resources, oil business.
Consequences	Damage to coasts		

(*continued*)

Table 1. (*Continued*)

	Knowledge = 2	Knowledge = 3	Knowledge = 4
		Damage to coasts, ecosystems, beaches, species.	Damage to coasts, rivers, ecosystems, species, beaches, tourism, fishing, aquaculture, jobs.
Terrorism			
Causes	Religion	Ignorance, religion, wrong leadership.	Poverty, ignorance, religion, social unrest, lack of control, hate, east–west conflict, marginalization, social exclusion, leadership.
Consequences	Number of deaths	Deaths, damage to property, insecurity.	Deaths, property, insecurity, psychological damage, anxiety, lack of liberty, hate, need to dedicate resources, overregulation.

The question on emotions was as follows:

> We would like you to consider how would you feel when you think about each of the problems we have been discussing. Could you tell us in which intensity would you experience the following emotions, on a scale of 1 to 5, where 1 is very low intensity and 5 is very high intensity?

This question was followed by a random list of specific emotions. The list of emotions was based on previous literature and results from the pilot studies and focus groups on testing specific emotions (Watson and Clark 1994). The order in which emotions were elicited from the participants was randomized in order to minimize potential order effects.

3.5. Valuation scenario

In the third section, the subjects were presented with the policy measures designed to counteract each of the social and environmental problems discussed. The wording of the policy measures is presented in Appendix 1 (online supplemental data).[3] The fourth section focused on the elicitation of the WTP decision for the policy proposals presented in the earlier section. Subjects were presented with a decision on accepting a tax increase that would lead to higher prices for specific products related to the problems considered. The amount collected through this price increase would be dedicated to the implementation of the policy proposal. Thus, the payment vehicle was in all cases a price supplement, or tax over the normal price of the specific product.[4]

For the climate change problem, the product subject to a price or tax increase was a two liter bottle of drinking water; for the oil spill program it was one liter of gasoline; for the problem of forest fires it was a 100-page paper notebook; for the problem of poverty in other countries it was a package of 1 kg of fair trade coffee; and for the problem of international terrorism it was a 100 g loaf of wholegrain bread. These products were selected because they represented general consumption products that shared somewhat similar market values. Some of the products were also related to the problem or policy issues discussed in the interview. In the non-market scenario, the baseline price was defined the same for all products (1 €). Although the products may vary in their price elasticities, the tax or price increase was defined over the environmental or public policy proposal, and not for the consumption of an additional amount of the good in question.[5]

Each of the products defined for the market scenarios was appropriately selected for each of the specific policy programs, in most cases because of the potential link that the consumption of the product could have to the policy program.[6] These products and the policy programs were thoroughly discussed in the focus groups. The results of focus groups and pretests allowed us to conclude that respondents correctly perceived the relationships between the policy proposal and the market good for which the tax increase was going to be asked. In addition, the policy proposals were not defined in terms of risks but with certainty, in order to avoid the problem of risk communication. Thus, the policy proposals were defined under a zero risk scenario. This was the framework that was easier to understand by participants in focus groups.

The valuation question format was a dichotomous yes/no response to a set of price or tax increments that were randomly distributed across the individuals. That is, each subject received a specific price for each of the programs that was randomly chosen from a bid vector. The bid vector was the same for all valuation questions, and was defined as 10, 25, 50, 100 and 160 € cents. This vector was designed with the responses to the open

ended questions on WTP in the pretest survey, and utilizing the optimization techniques developed by Cooper (1993) for a pre-determined number of bids.

3.6. Sampling

The subjects were interviewed in depth following the semi-structured questionnaire and in different subsamples (each of 100 individuals) according to the number of social or environmental problems and policies being assessed. One of the subsamples focused just on the climate change problem, and the others successively and randomly joined one of the other problems until a final subsample with the five problems. When two or more social problems were discussed with the respondent, the order in which the problems and policy programs were treated was randomized in order to reduce potential response order effects. In addition, the alternative policy problems were randomly included with the climate change problem in the decision frame posed to the subjects in the valuation questions.

The actual number of individuals answering each policy question depends on the random process in which policy questions were added to the decision frame. The numbers were 500 observations for the climate change question, since this question was present in all treatments (subsamples), and 250 observations for each of the other policy questions, since they were randomly included in the subsamples for the joint decision frames according to the size of the frame (2,3,4 and 5). Table 2 shows the number of observations in each subsample for each policy issue, according to the experimental design.[7]

4. The econometric model

The single valuation format involves a "yes/no" response to contribute a bid price (B) to implement the proposed climate change policy (Hanemann 1984). Following Cameron's (1988) parameterization, we assume that the latent variable WTP for the proposed policy has two components: a deterministic component μ and a random component ε. Thus, we can define WTP for the climate change policy as the following: $\text{WTP}_i^{CC} = \mu_i^{CC} + \sigma^{CC}\varepsilon_i^{CC}$, where μ_i^{CC} and σ^{CC} are, respectively, the mean and the standard deviation of WTP^{CC}; and ε_i^{CC} is a random error term, which collects all the unobservable side of the WTP^{CC}, and is assumed to follow a standard normal distribution.

Table 2. WTP observations by subsample (decision frame) and policy issue.

		Policy issue					
Subsample	Number of policies	CC	FF	OS	*D*	*T*	Total observations
A	1	100					100
B	2	100	25	25	25	25	200
C	3	100	50	50	50	50	300
D	4	100	75	75	75	75	400
E	5	100	100	100	100	100	500
Total observations		500	250	250	250	250	

Assuming independent answers and fixed covariates, the probability of a positive answer to the climate change policy proposed at a bid price B_i is

$$\text{Prob}(\text{y}_\text{i}=1)=\text{Prob}[\text{WTP}_\text{i}^{\text{CC}}(\mu_i^{CC},\varepsilon_i^{CC})>\text{B}_\text{i}]=\text{F}_\xi[\text{WTP}_{i\,|\,\varepsilon}^{CC\,-\,1}(\text{B}_\text{i},\mu_i)], \tag{1}$$

where $\mu_i^{CC}=\text{x}'_{\ i}\beta$ is the linear predictor associated with a k × 1 regression parameter vector β and a covariate vector x_i, and $\text{WTP}_{i\,|\,\varepsilon}^{CC\,-\,1}$ is the inverse of the climate change policy' WTP function with respect to ε_i. The linear predictor is linked to the probability of a positive response by a known cumulative distribution function $\{F_\xi\}$ or link function. The error distribution can be specified as some parametric form, and the model can be estimated by maximum likelihood (Hanemann and Kanninen 1996).

However, if a subject faces a joint valuation scenario, the distribution function of her WTP^{CC} can be influenced by the environmental and social competing policies under consideration, thereby implying some type of framing effects. For each policy, the subject is asked to pay a given amount of money (B_j: $j = 1,2,\ldots J$) to implement such a policy. The interdependencies among the policies' valuation can be modelled using simultaneous equations with limited dependent variables (SLDV). This approach reduces to a general triangular system (Zellner 1971) for complete data sets. The specific equations are the following:

$$\begin{aligned}
&\text{WTP}_i^{CC}=\mu_i^{CC}+\alpha^{CC}\overline{D}^{CC}+\sigma^{CC}\varepsilon_i^{CC}\\
&\text{WTP}_i^{FF}=\mu_i^{FF}+\alpha^{FF}\overline{D}^{FF}+\sigma^{FF}\varepsilon_i^{FF}\\
&\text{WTP}_i^{D}=\mu_i^{D}+\alpha^{D}\overline{D}^{D}+\sigma^{D}\varepsilon_i^{D}\\
&\text{WTP}_i^{OS}=\mu_i^{OS}+\alpha^{OS}\overline{D}^{OS}+\sigma^{OS}\varepsilon_i^{OS}\\
&\text{WTP}_i^{T}=\mu_i^{T}+\alpha^{T}\overline{D}^{T}+\sigma^{T}\varepsilon_i^{T}
\end{aligned} \tag{1}$$

and

$$(\varepsilon_i^{CC},\varepsilon_i^{FF},\varepsilon_i^{D},\varepsilon_i^{OS},\varepsilon_i^{T})\sim\ \text{MVN}\left(0_\text{m},\sum\right)\ \text{and}$$

$$\sum=\begin{pmatrix}
1 & & & & \\
\sigma_{CC,FF} & \sigma_{FF}^2 & & & \\
\sigma_{CC,D} & \sigma_{FF,D} & \sigma_D^2 & & \\
\sigma_{CC,OS} & \sigma_{FF,OS} & \sigma_{D,OS} & \sigma_{OS}^2 & \\
\sigma_{CC,T} & \sigma_{FF,T} & \sigma_{D,T} & \sigma_{OS,T} & \sigma_T^2
\end{pmatrix} \tag{2}$$

where μ_i^{CC}, μ_i^{FF}, μ_i^{D}, μ_i^{OS}, μ_i^{T} represent the mean of WTP^{CC}, WTP^{FF}, WTP^{D}, WTP^{OS}, WTP^{T}, and are linked to the probability of a positive response by a multivariate normal cumulative distribution (MVN), also known as the "link" function. Superscripts *FF*, *D*, *OS* and *T* stand, respectively, for the competing policies addressing the issues of forest fires, development aid, oil spills, and terrorism, which are the alternative policy issues studied in the empirical application.[8]

5. Results

In order to analyze the results, it should be taken into account that the objective of this paper is not to compare the economic values of the different policy proposals included in the decision frame, but rather to investigate how the value of a climate change policy can be affected by the consideration of other policy proposals in the decision frame, i.e., the potential framing effects in the valuation of a climate change policy due to the consideration of alternative and competing social and/or environmental policies. To this aim, the estimation results focus on the values raised by the question on the policy for climate change, and not on the values that can be obtained from the other alternative policies included in the decision frame, since these other policies' responses are subject to smaller sample sizes that could reduce the comparability and generalization of the results.

The modeling approach is based on the estimation of the Bayesian system of simultaneous equations model for WTP in each of the subsamples answering to the valuation of the policy programs for the social or environmental problems. Protest responses were excluded from the analysis, following standard procedure in valuation studies.[9] Following the model specification outlined in section 4 and detailed in Appendix 2 (online supplemental data), the model pools all responses across the subsamples varying the number of policy problems considered in the policy valuation decision frame.

WTP in each equation depends on mean parameters $\mu = (\mu_i^{CC}, \mu_i^{FF}, \mu_i^{D}, \mu_i^{OS}, \mu_i^{T})$, which can be expanded for a set of covariates influencing individual decision to pay a larger amount for the specific policies proposed in the decision frame. WTP depends also on the interaction terms $\Pi = (\alpha^{CC}, \alpha^{FF}, \alpha^{D}, \alpha^{OS}, \alpha^{T})$, which account for the influence that the inclusion of competing policy programs in the decision frame has on the individual valuation response. For the sake of simplicity in interpreting results, the model parameter estimations are split into Tables 4–6. Table 4 presents the results of parameters μ of the model measuring the impact of several socioeconomic covariates on social preferences for each of the policy programs, as well as the effects of knowledge and emotions. These variables are defined in Table 3. The proposed model presented the best specification model in terms of statistical fit with a logged marginal likelihood of -471.

Table 3. Variable description.

Age	Age of the subject
Income	Annual pre-tax income of the subject.
Education	Years of education of the subject.
Happy	1–5 levels of happiness arisen by the environmental or social problem.
Sad	1–5 levels of sadness arisen by the environmental or social problem.
Angry	1–5 levels of anger arisen by the environmental or social problem.
Indifferent	1–5 levels of indifference arisen by the environmental or social problem.
Excited	1–5 levels of excitement arisen by the environmental or social problem.
Fear	1–5 levels of fear arisen by the environmental or social problem.
Knowcau	1–4 levels of knowledge about the causes of the environmental or social problem.
Knowcons	1–4 levels of knowledge about the consequences of the environmental or social problem.

Table 4. Estimated coefficients of covariates' parameters (μ) for policy programs (standard errors in parenthesis).

		Program				
		Climate change	Forest fires	Develop	Oil Spills	Terrorism
	Constant	−6.303* (2.033)	−0.563 (2.752)	0.421 (2.730)	−4.802* (1.893)	−3.238 (2.831)
	Age	−0.251*	−0.168**	−0.031	0.166**	−0.761*
		(0.096)	(0.082)	(0.033)	(0.056)	(0.265)
Socioeconomics	*Income*	0.192*	0.124**	0.091**	0.483*	0.710**
		(0.082)	(0.071)	(0.051)	(0.128)	(0.362)
	Education	0.731*	0.042	0.309*	0.535**	−0.283
		(0.207)	(0.106)	(0.107)	(0.263)	(0.481)
	Happy	−0.632 (0.532)	−0.421 (0.561)	−0.821 (0.701)	0.071 (0.190)	−0.051 (0.109)
	Sad	0.530***	1.642*	0.681*	0.782**	3.523*
		(0.281)	(0.287)	(0.231)	(0.361)	(1.526)
	Angry	0.473**	−1.035*	−0.259	−0.701	−1.201
Emotions		(0.231)	(0.404)	(0.305)	(0.521)	(0.977)
	Excited	0.264	0.682**	0.562	0.906*	1.764*
		(0.171)	(0.327)	(0.631)	(0.205)	(0.636)
	Indifferent	−0.301	−0.487	−2.671*	−0.941**	0.168
		(0305)	(0.380)	(0.637)	(0.401)	(0.539)
	Fear	0.967*	0.362**	0.362	0.476	1.642*
		(0.173)	(0.180)	(0.291)	(0.365)	(0.588)
	Knowcau	0.802*	0.762	1.891*	0.291	1.153*
Knowledge		(0.140)	(0.638)	(0.398)	(0.732)	(0.504)
	Knowcons	1.287*	1.381*	0.321	1.351*	1.186
		(0.208)	(0.873)	(0.326)	(0.592)	(0.937)

*Significant at 0.01 level; ** Significant at 0.05 level.

5.1. Socioeconomics

WTP responses for the various policy options are significantly explained by some socioeconomic covariates. WTP rises with the level of income of the subject for all policies in the decision frame, although the level of significance is higher for climate change and oil spills programs. WTP also increases with the level of education, although this relationship is only significant for the climate change program and for the oil spill prevention program at the 0.01 levels, and for the oil spills program at the 0.05 level. The age of the individual has a significant negative effect on WTP for the climate change program, the terrorism prevention program and the forest fires program (0.05 level), and a significant positive relationship for the oil spill program (0.05 level).

5.2. The amount of knowledge

The knowledge endowed by the individuals about the causes and consequence of the respective policy programs included in the decision frame has also a significant effect on WTP for some of the policy programs. In the case of the climate change program, knowledge on both the causes and consequences of climate change has a positive impact on WTP. This relationship is also significant and positive for the programs of development and terrorism for the amount of knowledge on the causes of these policy problems, but not for the knowledge on their consequences. For the policies of forest fires and oil spills, only the amount of knowledge on the consequences of these policy problems is significant. In all cases the relationship is positive, i.e., the higher the amount of knowledge on either the causes or the consequences of the policy problems, the higher the WTP.

5.3. Emotions

WTP is also significantly explained by the specific emotions arisen by the problems discussed in the decision frame. As can be seen in Table 4, WTP is higher for those individuals experiencing sadness, anger and fear with the problem of climate change. The emotions of happiness and indifference did not have a significant impact on WTP for the climate change policy. Emotions also played a significant role in the WTP equations explaining individual decisions with respect to the alternative policy programs included in the decision frames. For all programs WTP was higher for those individuals experiencing sadness. The emotion of anger also raised WTP in the case of the problem of forest fires, but was not significant for the other alternative social problems. The emotion of fear raised WTP in the case of the problems of forest fire and terrorism, while the emotion of indifference reduced WTP in the case of the problems of development and oil spills. Finally, the emotion of excitement had a significant and positive impact on the WTP for the programs of forest fires, oil spills and terrorism prevention. Thus, negative emotions, such as fear, sadness and anger had a positive impact on WTP, particularly for the climate change problem, while positive emotions (happiness, excitement) had no effect on WTP in the case of climate change, but some effect on the WTP for the other social programs. However, the only emotion having a negative impact on WTP is indifference for the case of development and oil spill.

5.4. Joint versus single evaluation and decision frame effects

Tables 5–8 present the results of the joint evaluation of a climate change program together with other social and environmental programs according to the interaction and

Table 5. Estimated coefficients of the interaction effects on expected mean WTP in joint valuations for the policy programs (Π) (€ cents) (standard deviations in brackets).

Program frame	Climate change	Forest fires	Development	Oil spills	Terrorism
Climate change	–				
Forest fires	1.327*(0.462)	–			
Development	1.276**(0.605)	4.485*(1.175)	–		
Oil spills	−0.817(0.529)	2.792**(1.143	−1.116(0.938)	–	
Terrorism	−0.397(0.461)	1.175(1.349)	1.368*(0.754)	−1.991(0.824)	–

decision frame effects. Table 5 shows the interaction effects on the expected mean WTP, i.e., parameters $\Pi = (\alpha^{CC}, \alpha^{FF}, \alpha^{D}, \alpha^{OS}, \alpha^{T})$. If the sign of these policy parameters is positive, then the inclusion of both policies in the decision frame raises WTP, i.e., both policies are complements, whereas if the sign is negative then the inclusion of both policies reduces WTP, i.e., both policies are substitutes. The estimated parameters show that there are some significant and positive interaction effects, while the negative signs are not significant.

Climate change valuation rises if the decision frame includes a policy for forest fires and a policy for development. The valuation of the policy of forest fires increases significantly if the decision frame includes the policies of climate change, development and oil spills. The valuation of the policy of development also rises if the decision frame includes policies for climate change, forest fires and terrorism. The policy of oil spills is significantly related in a complementary way only to the policy of forest fires, while the policy of terrorism is complementary only with the policy of development. None of the policies considered in the decision frame shows significant substitution effects, i.e., their joint inclusion in the decision task does not reduce WTP of some of the policies.

Table 6 shows the results of the interaction effects of the unobserved components of WTP, i.e., parameters of the covariance matrix. All off-diagonal parameters are positive and significant, indicating that the unobserved parts or error components of WTP are positively correlated, i.e., on these parts of the WTP functions the valuation policies are complements. In other words, their joint inclusion in the decision frame raises WTP.

Table 7 presents the results of mean WTP for the climate change policy according to the size of the decision frame in which it is included. Mean WTP increases as the number of policies considered in the valuation task rises; since there are four potential policies to

Table 6. Estimated coefficients for the covariance matrix (Σ) (standard errors in parenthesis).

	Covariances (Σ)				
Program frame	Climate change	Forest fires	Development	Oil spills	Terrorism
Climate change	1.000(0.000)				
Forest fires	0.934(0.052)	1.223(0.021)			
Development	1.213(0.022)	1.414(0.058)	1.721(0.025)		
Oil spills	0.981(0.076)	1.337(0.063)	1.486(0.156)	3.266(0.075)	
Terrorism	0.874(0.036)	1.106(0.055)	1.219(0.042)	1.791(0.070)	1.432(0.034)

Table 7. Decision frame size and expected mean WTP for the climate change policy (€ cents).

			Marginal probabilities	
Valuation mode	Decision frame size	*E* (WTP)	5%	95%
Single valuation	1	29.46	23.04	36.52
Joint frame with 2 policies	2	49.07	21.87	69.52
Joint frame with 3 policies	3	64.80	31.81	97.79
Joint frame with 4 policies	4	66.62	30.22	98.62
Joint frame with 5 policies	5	65.33	41.33	94.13

be considered in the decision frame, the results for decision frames with two, three and four policies have been averaged across all potential combinations. This allows us to focus on the size of the decision frame without consideration of the specific policies involved.

Single valuation of the climate change policy leads to a mean value of 29.56 cents of €, which is significantly lower than the mean value when the climate change policy is included in a decision frame together with another policy, i.e., two policies considered in the decision frame. In the latter case, the mean value rises to 49.07 cents of €. This value is still significantly lower than the value obtained when the decision frame involves three alternative policies, which amounts to 64.80 cents of €. This value is not significantly different than the values of the climate change policy when the decision frame is enlarged to include four or five policies. Thus, it is clear that the value of climate change policy in isolation, i.e., under the single evaluation mode is smaller than its value when it forms

Table 8. Expected mean WTP for the climate change policy according to the alternative policies included in the decision frame (€ cents).

				Marginal probabilities	
Decision frame	Size	Policies included	*E* (WTP)	5%	95%
Single valuation	1	*None*	29.46	23.04	36.52
Joint valuation	2	*Forest fires*	76.70	44.70	88.70
		Development	62.13	38.33	79.18
		Oil spills	29.07	16.67	49.15
		Terrorism	28.38	15.98	47.76
Joint valuation	3	*Forest fires, development*	96.11	61.01	141.21
		Forest fires, oil spills	62.39	24.39	100.39
		Forest fires, terrorism	68.94	30.94	106.94
		Development, oil spills	61.59	28.59	94.59
		Development, terrorism	68.15	38.45	97.85
		Oil spills, terrorism	31.62	14.02	49.22
Joint valuation	4	*Forest fires, development, oil spills*	77.75	53.75	101.75
		Forest fires, development, terrorism	88.51	59.71	117.31
		Development, oil spills, terrorism	33.60	22.80	64.00
Joint valuation	5	*Forest fires, development, oil spills, terrorism*	65.33	41.33	94.13

part of a larger decision frame involving competing social and environmental policies. The mean value of the climate change policy rises with the size of the decision frame and stabilizes when it reaches three policies.

Table 8 presents the mean value of the climate change policy depending on the specific frame in which it is included in the valuation task. Although, on average, the mean value of the climate change policy rises with the number of policy issues considered in the decision frame (Table 7), it is clear in Table 8 that this increment depends on the specific programs included.

Looking at the results of the potential combinations of two policies decision frame, it is clear that if the added policy is related to the problems of forest fires or development then the mean value of the climate change policy rises significantly above its mean value in the single evaluation mode. However, if the added policy is designed to address the problems of oil spill or terrorism then the mean value of climate change in the two policies frame is not significantly different than its value in the single evaluation mode. These results suggest that the combination of a climate change policy with either a forest fire policy or a development policy in the decision frame leads to a higher WTP than if the policy is valued in isolation.[10] Thus, these policies have a positive impact on WTP for the climate change policy.

For the potential frames with three policies, it is found that in most cases the value of the climate change policy is larger than its value in the single evaluation mode. Only in the frame that contains both the oil spill and the terrorism policies together with the climate change policy it is observed that the value of the climate change policy is not significantly different than its value in the single evaluation mode. Therefore, the mean value of the climate change policy is significantly higher in the frames with three policies than in the single evaluation mode, if the policies for oil spill and for terrorism are not included together.

A similar result is obtained for the potential combinations of four policies. If the considered policies include the oil spill and terrorism policies then the value of a climate change policy in isolation is not significantly different than its value in a decision frame containing these two policies. In any other frames with three policies, the value of climate change becomes significantly higher than its value in isolation, and somewhat higher but not significantly different than its value in frames with three policies or with five policies.

6. Conclusions

The economic valuation of climate change policies provides useful information for the adoption of more efficient consumption and production decisions across society. It is clear that the resources that society dedicates to climate change might be affected by the competition from other social goals and necessities. In this paper, we have looked at the potential impacts of the consideration of competing social and environmental policies on the valuation of climate change policies. To this aim, we have utilized a Bayesian simultaneous equation modeling approach that allows researchers to evaluate the inclusion of competing policies in the decision frame or context of the decision making of the individual.

The results show that the characteristic of the decision frame regarding the inclusion of competing policies can have an effect on the valuation of a climate change policy. When the latter policy is valued in isolation its value might be lower than when it is valued in a decision frame or context that involves other social or environmental policies.

From the competing polices investigated in this paper, we find that the value of a climate change policy is lower if the decision frame includes also the policies to deal with the problems of oil spills and terrorism. Whenever these two policies are included in the decision frame we find that there is no significant difference between the values of a climate change policy in the single evaluation mode and the joint evaluation mode. However, if the decision frame includes the policies addressing the problems of forest fires and development, then the value of the climate change policy in the single evaluation mode is always lower than the value in the joint evaluation mode.

Thus, our result shows that valuing a climate change policy together with some other environmental and social policy does not reduce its value, but can instead enhance its appeal on individual preferences. The alternative policies considered in this paper have performed either neutral or complementary in value with the climate change policy, and further research should be made on potential substitute policies. A practical implication of these results is that the climate change policies can be more effective if they are framed together with other environmental or social policies. This can be important for the marketing of climate change policies within a frame of policies that enhance its value to consumers.

Among the potential determinants of the value of climate change policies, our results have shown that climate change valuation is significantly influenced by the endowment of knowledge that the individual possesses about the causes and consequences of the problem of climate change. In addition, it has been shown that negative emotions such as fear, sadness and anger play a significant role in raising the value of climate change policies across individuals. These results might be useful to design environmental policies that enhance the support of individuals across society, by influencing emotions and knowledge in ways that improve policy profiles.

However, further research is needed in order to ascertain the appropriate design issues and context effects of climate change policies that might contribute to increase their acceptance in society. For instance, it can be the case that the results of this paper are conditioned on the specific types of programs considered in the decision context of the valuation task. Different results could be obtained for other programs, such as those concerned with social issues, e.g., health and education programs. Thus, further research should explore the impact that the consideration of alternative types of programs (e.g., public vs. private, environmental vs. social) in the decision context could have on the economic valuation of climate change policies. Furthermore, the results of this paper can vary across social groups and stakeholders in society, making it interesting to explore whether certain groups are more prone to the influence of context effects based on the consideration of alternative policy proposals to those dealing with climate change. Along this line, another issue to be considered for further research is the potential influence of the decision context on values elicited from experts on public policy rather than from the general population. Finally, since the results of this paper focus on a specific country, it would be interesting to explore their generalizability to other geographical locations.

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Supplemental data

Supplemental data for this article can be accessed here.

Notes

1. Experts were selected colleague professors in environmental and social sciences. There was a high degree of agreement among experts. For a review of how to employ experts to recode verbal protocols or open ended questions see Chi (1997), Shkedi (2004), Berg, Lune, and Lune (2004), Hopkins and King (2010) and King, Hopkins, and Lu (2012).
2. A detailed discussion of the methods and different alternatives to measure informational levels quantifying qualitative data, and advantages and limitations of each alternative, can be found in Hoffman (1987), Cooke and McDonald (1987) and Evans (1988).
3. The full questionnaire is available from authors upon request.
4. Several vehicle payments were tested in the qualitative phase of the study. This pre-survey analysis showed that using taxes in this specific context significantly reduced the number of protest answers and did not affect the distribution of responses to the experiment for "non-protest" responses.
5. It should be noted that this design for the joint valuation decision frame, based on different payment vehicles for each of the policy issues, was not purported to estimate the relative values of all the policy issues discussed in the interviews, but to investigate how the value of a climate change policy might be affected by the consideration of alternative policy issues.
6. However, since this was not possible for the issue of terrorism we decided to utilize a general consumption good with similar market value to the other goods in the experiment.
7. The random design of the experiment and the use of a bayesian framework to analyze the data guaranteed sampling errors of 3%.
8. A more detailed technical explanation of the econometric model and estimation algorithm can be found in Appendix 2 (online supplemental data).
9. There were 30 protest responses identified in the sample. These are characterized as individuals who declined to pay for any policy because they did reject the valuation scenario for reasons different to low valuation of the policies. The most common responses in this group were related with the government being corrupt and believing that the money would go somewhere else. The question to identify protest responses (i.e., zero WTP motivation) was put to the individual after all valuation questions were answered in the joint valuation treatments.
10. A reviewer raised the question of whether these results can be partially explained by respondents considering that some policies are global rather than local. The qualitative analysis did not show any evidence of this behavior. However, since the experiment was not designed for this, the statistical power of any hypothesis testing on this matter would be very low. Further research focusing on the impact of local vs. global competing policies can be of interest.
11. A general description of GS and its application in Econometrics can be found in Greene (2003).

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