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Abstract

Unlike current stated preference studies, this paper examines the existence of framing effects from varying information about the environmental features characterizing the decision-making context where respondents are asked to state their preferences. Thus, it adds to the existing literature on framing effects which has usually been focused on analysing the welfare impacts derived from changing information relating to substitute goods and individuals' budget constraint, the attributes defining the good to be valued and the complexity of the choice task. In particular, and through a novel choice experiment design, the paper investigates the impacts on the willingness-to-pay (WTP) from varying information about the degree of uncertainty over an expected global warming-derived increase in the temperature of a traditional summer holiday destination. Results show that the WTP increases with the magnitude of the expected temperature change and its associated probability of occurrence. Thus, they evidence that the degree of uncertainty over an expected environmental phenomenon can affect preferences for policies aimed at adapting to the environmental conditions resulting from such phenomenon. The implications of the results for decision-making in traditional sun and beach tourism destinations are also discussed.

Keywords: environmental uncertainty, global warming, adaptation, welfare, framing effects, choice experiment

JEL codes: Q51, Q54, Q58, C25, C99, D61, Z39.

1. Introduction

Stated preference (SP) methods such as contingent valuation (CV) and conjoint analysis (CA) approaches have been widely used by environmental economists to estimate the value of non-market goods and services (Czajkowski and Hanley, 2009). The CV method allows estimating preferences by asking people directly how much they would be willing to pay for a hypothetical change in the provision of an environmental good (Hanley, Shogren and White, 2013). In contrast, CA allows for preference elicitation by asking people to choose, rate or rank over alternative hypothetical outcomes (Roberts et al., 2008). To make these hypothetical markets realistic and relevant to individuals, the researcher has to design carefully the valuation scenario. This task goes beyond deciding about which attributes can better define the good to be valued. Indeed, designing the valuation scenario involves deciding about the elements framing the hypothetical context where individuals are asked to state their preferences (Hallahan, 1999). In fact, framing is a selection process occurring 'through the *inclusion* and *exclusion* of, as well as *emphasis* on, available information, providing a context that shapes people's perspectives about the world' (Howard and Salkeld, 2009; Kragt and Bennett, 2012). As decision frames might have an impact on individual choice behaviour (Swait et al., 2002; Payne et al., 1999), examining the existence of potential framing effects has captured the attention among valuation researchers over the last years.

In this setting, the SP literature has shown that framing effects exist when individuals are sensitive to one or more elements of the context in which they have to make particular trade-offs (Rolfe et al., 2002; Swait et al., 2002; Kragt and Bennett, 2012). Framing effects have been observed from varying (i) the information about substitute goods and respondents' budget constraint (Loomis et al., 1994; Whitehead and Bloomquist, 1999; Rolfe et al., 2002; Baskaran et al., 2013); (ii) the description of the attributes defining the good to be valued (Kragt and Bennet, 2012; Hallahan, 1999); and (iii) the complexity of the choice tasks (Ohler et al., 2000; DeShazo and Fermo, 2002; Verlegh et al., 2002; Hensher, 2006; Luisetti et al., 2011). Nevertheless, no study to date has analysed the impact on individual choice behaviour derived from changing information about the degree of uncertainty over an expected environmental phenomenon framing the environmental context where individuals are asked to state their preferences for hypothetical policies. However, the degree of environmental uncertainty might determine individual choices. Would individuals view a policy as less desirable under a lower expected probability of occurrence of the environmental phenomenon? Or, would their preferences change with its expected magnitude? Certainly, this issue becomes of special policy relevance in our current environmentally uncertain times where both the magnitude and the probability of occurrence of many environmental phenomena are unknown to the decision maker.

This paper wants to be a first step into this issue and hence analyses the existence of potential effects on the willingness-to-pay (WTP) for policies from varying information about the degree of environmental uncertainty defining the context which the policies pursue to adapt to. To the best of our knowledge, no SP valuation study has treated the degree of environmental uncertainty over an expected environmental phenomenon as an element defining the environmental context where individuals are asked to make choices. Valuation researchers concerned with risk and uncertainty have mainly focused on risk preference analysis where the degree of risk or uncertainty has been treated as an attribute describing the good to be valued.

In this sense, some authors have centred on examining public's preferences for changes in environmental or health risk exposure through measurement of the WTP for risk-reducing policies with risk being one of the policy defining attributes (Alberini et al., 2006; Lew et al., 2010; Brouwer and Shaafsma, 2013; Veronesi et al., 2014). Other researchers have examined the effects on policy's benefits of delivering information about the uncertainty over policy outcomes (Wielgus, 2009; Glenk and Colombo, 2011; 2013; Wibbenmeyer et al., 2013; Rolfe and Windle, 2015).[1]

In particular, the paper focuses on the uncertainty over an expected global warming-derived increase in the temperature of Mallorca (Spain) and examines, through a choice experiment (CE), tourist preferences for policies aimed at addressing the potential deterioration of tourist perceptions about the climatic suitability of the island in such uncertain environmental setting. Specifically, it assesses how changing information about the magnitude and the probability of occurrence of the expected temperature change can affect tourist preferences for such policies. Beyond testing for the existence of framing effects, this analysis will also allow us to draw conclusions about how traditional summer holiday destinations can ensure their long-term sustainability in the face of global warming.

The remaining of the paper is structured as follows. The next section centres on the design of the SP survey. Thus, it first discusses the importance of tourist perceptions about the climatic suitability of a destination. Then, it outlines the main features of the CE designed to measure tourist preferences for the above-mentioned policies. The third section describes the methodology used to test for framing effects. So it first explains how individual choice behaviour is modelled, with a focus on a random parameter logit model property which enables accounting for taste heterogeneity relating to observed variables. Secondly, it discusses the specification of the utility function as well as how welfare measurement is carried out. The fourth section presents the results, followed by a Concluding remarks section which ends the paper.

2. Designing the SP survey

To test for the existence of framing effects from varying information about the degree of environmental uncertainty characterizing the individual decision-making context, we conducted a choice experiment (CE) in the Mediterranean island of Mallorca. We assumed that information about the degree of uncertainty over an expected global warming-derived increase in the island's temperature might affect tourist preferences for policies thought of to counteract the potential loss of destination's competitiveness due to deterioration of visitors' perceptions about the destination's climatic suitability under global warming. Temperature has been proved to be the most important weather determinant of tourist choice of a destination compared to other weather variables such as humidity, precipitation or wind, among others (De Freitas et al., 2008; Maddison, 2001). We chose Mallorca as a study area because it represents one of the most important summer holiday destinations in Europe. Thus, our analysis will also allow us to give guidance to policy makers in other traditional sun and beach tourism destinations threatened by global warming.

[1] See Torres et al. (2017) for a detailed review of this literature.

2.1 Global warming and the climatic suitability of tourism destinations

Many tourism destinations are expected to be negatively affected by global warming (UNWTO, 2008), which represents one of the most challenging global environmental problems today. This is especially true when it comes to sun and beach tourism regions which comprise coastal areas and many small islands attracting high numbers of visitors due to their summer climatic conditions. Indeed, Amelung and Viner (2006) state that such regions are highly vulnerable to global warming impacts such as climate variation and the occurrence of more frequent and severe extreme events (e.g. heat waves, hurricanes). In this context, the literature shows that global warming might make more attractive to tourists the weather conditions of higher latitude and longitude areas (Amelung et al., 2007; Bigano et al., 2005; Lise and Tol, 2002;). Bujosa et al. (2015) evidence how increases in the temperature might lead not only to a geographical redistribution of tourist flows in Spain but also to changes of tourist behaviour temporal patterns. Considering the non-negligible weight of the sun and beach tourism segment on the GDP of traditional summer holiday destinations, global warming might lead to a loss of their competitiveness if no action is undertaken.

In this setting, the fact that the climatic conditions can also vary at a microscale level due to the existence of microclimates resulting from heat accumulation favoured by human developments and/or tourism infrastructures (O'Brien, 2000) offers to decision makers an opportunity to *act* on the regional and local climate performance of an area. Indeed, it allows designing policies oriented to favour the *creation* of microclimates which can help to improve tourist perceptions about the climatic suitability of the destination in the face of global warming. In fact, research shows that the climatic suitability of a destination strongly depends on the tourist perceptions which in turn rely on tourists' socioeconomic features such as their country of origin, age or education background, among others (Olya and Alipour, 2015).

2.2 The choice experiment

To design the choice experiment (CE), three different sets of policies were considered to improve tourist perceptions about the climatic suitability of Mallorca in the face of global warming. The first set involved policies oriented to act on visitors' *thermal comfort*. In specific, the first policy set consisted of three actions pursuing to counteract the thermal discomfort which might be derived from the expected increase in the temperature through the creation of shadow areas (*Create Shadow Areas*). The first action involved putting efforts into the designing of green environments surrounding the buildings (*Green Environments*), while the second one implied increasing such efforts and hence add to designing green environments either urban sponge actions or the design of absorption plans into built-up areas (*Plus Urban Sponge*). A third action involved putting efforts into introducing thermal refrigeration with re-used waste waters besides putting them into designing green environments and undertaking urban sponge actions (*Plus Thermal Refrigeration*).

The second set of policies had to do with actions oriented to diversifying the tourism product in favour of less climate-dependent activities which can also be enjoyed in summer (*Strengthen the Tourism Product*). In this sense, three types of publicly funded actions were considered pursuing to promote the enjoyment of such activities in different contexts. The first policy within this set involved improving the state of Mallorca's natural assets through increasing efforts on conservation strategies (*More Nature Conservation*), while the second one also considered devoting efforts to improve the cultural offer of the island (*Plus More Diverse Cultural Offer*). A third strategy involved promoting the local gastronomy through improving the offer of local cuisine besides increasing efforts on nature conservation and cultural offer diversification (*Plus More Local Cuisine Offer*).

Finally, a third set of policies focusing on actions undertaken by the tourism industry to reduce its carbon footprint was also considered under the assumption that tourist perceptions about the climatic suitability of Mallorca might improve if the tourism industry engages in environmentally-friendly practices (*Reduce the Carbon Footprint*). Accordingly, the engagement of the sector in green purchasing programmes (*Green Purchasing*) was considered as a first action within this policy set, followed by a second action consisting of green purchasing and the sector participation in recycling and reuse schemes (*Plus Recycling and Re-use*). A third strategy involved developing energy efficiency plans together with engaging in green purchasing and participating in recycling and reuse schemes (*Plus Energy Efficiency*). Through the valuation of this third set of policies we attempt to provide some insights into whether tourist perceptions about the climatic suitability of a destination can depend on factors other than tourist thermal comfort. In other words, we want to examine if pro-environmental engagements by the tourism industry in a destination threatened by global warming can also contribute to tourism satisfaction.

Thus, three CE attributes were considered to represent the three sets of policies to be valued with each attribute level representing one of the three before-mentioned actions within each policy set. The attribute levels were combined through an experimental design generated under a D-efficiency criterion by means of the ©Ngene software (version 1.1.1) to create the policy alternatives or *programs* as well as the choice sets. An additional attribute representing the daily extra cost respondents should incur in case they wanted to support a given policy program was also considered to generate the experimental design. The final design resulted in 18 profile combinations which were blocked into three different versions of six choice sets each consisting of two policy improving alternatives and a no policy option involving no cost for the respondents. The three versions were randomly distributed across individuals. Table 1 shows the CE attributes and the attribute levels considered for the analysis.

Table 1. CE attributes and their levels

Attribute	Levels	Level description
Create shadow areas	Green Environments[a]	Green Environments (1)
	Plus Urban Sponge	(1) + Urban sponge (2)
	Plus Thermal Refrigeration	(1) + (2) + Thermal refrigeration
Strengthen the tourism product	More Nature Conservation[a]	More Nature Conservation (1)
	Plus More Diverse Cultural Offer	(1) + More Diverse Cultural Offer (2)
	Plus More Local Cuisine Offer	(1) + (2) + More Local Cuisine Offer
Reduce the carbon footprint	Green Purchasing[a]	Green Purchasing (1)
	Plus Recycling and Reuse	(1) + Recycling and Reuse (2)
	Plus Energy Efficiency	(1) + (2) + Energy Efficiency
Daily extra cost (€)	1, 2, 3, 4, 5, 6	

[a] Key: reference/reference attribute levels.

Information about the degree of uncertainty over the expected global warming-derived increase in the temperature varied across choice sets. In specific, each choice set depicted two ranges of summer average monthly temperature values: one showing current temperature mean values and another one showing values which might be experienced by mid-21st century. Thus, each choice set presented to respondents a given expected temperature increase, which was also associated with a probability indicating how likely it would be that the increase was experienced. Individuals were asked to choose among the policy programs in a context of uncertainty over the expected temperature change.

Compared to the summer average monthly temperature in Mallorca, which ranges from 30ºC to 33ºC, we considered three potential scenarios of temperature change: an expected increase of 4ºC by showing to respondents expected temperature values ranging from 34ºC to 37ºC; an expected increase of 8ºC associated with expected values going from 38ºC to 41ºC; and an expected increase of 12ºC related to expected values varying from 42ºC to 45ºC. To each scenario, we randomly assigned one out of three probability values: 30%, 60% and 90%. This allowed us to assume 9 (3x3) different *degrees of uncertainty* over the expected temperature change which randomly varied across choice sets. For the degrees of environmental uncertainty to vary across choice sets (rather than across the alternatives within each choice set) when generating the experimental design, the framing variables *Temperature* and *Probability* (i.e. the expected temperature change and its probability of occurrence) were treated by Ngene as covariates, thus helping to explain the choice between a policy program and the no policy option.

Figure 2 shows a sample choice set, where visual information was also used to facilitate respondent choice:

[Insert Figure 2]

After further revisions following the focus groups, we pre-tested an entire survey script on some individuals and we then conducted 50 pilot surveys, which led us to make some changes in the questionnaire. The final survey was administered in the terminals of the airport of Mallorca (Son Sant Joan) during the 2014 peak season (between July and August) to maximize the response rate. Taking into account 2013 figures of tourist arrivals, a representative sample of 478 visitors was randomly drawn from tourists waiting at the boarding gates. They were contacted personally and surveyed face-to-face by trained surveyors. Incomplete questionnaires and those responded by visitors protesting against paying for the policy programs were excluded from the analysis. This resulted in a total of 407 valid and complete questionnaires which led to 2,379 observations to be considered in the estimation.[2]

[2] Note that the total number of observations considered for the analysis differed from 2,442 (407 questionnaires *6 choices per respondent). This had to do with the fact that some individuals did not complete the choice part of the survey, which resulted in less than 6 choice observations for these respondents.

3. Testing for the existence of framing effects: Methodology

Our choice experiment design enabled us to use a random parameter logit (RPL) model specification which allows accounting for taste heterogeneity relating to observed variables to test for framing effects.

3.1 The RPL model

The RPL model allows explaining the individual choice of an alternative based upon the attributes describing all the alternatives available to the respondent in a given choice situation. The theoretical foundations of the method originate from both Lancaster's (1966) theory of value and the random utility theory (McFadden, 1973; Manski, 1977). Thus, the level of utility U_{njt} that individual *n* derives from alternative *j* in a choice situation *t* can be decomposed into a deterministic part V_{njt} and a stochastic component ε_{njt}. According to Lancaster (1966), the deterministic component of utility is a function of the vector of attributes in the choice set x_{nt} and possibly other variables such as individual characteristics. The error term is assumed to capture all the unobserved factors affecting individual choice which are unknown to the analyst. The utility can then be represented as:

$$U_{njt} = V_{njt}(x_{jt};\beta) + \varepsilon_{njt} \quad (1)$$

where β is the vector of coefficients to be estimated. Respondents are assumed to maximize their utility by choosing alternative *j* from choice set C_{nt} if the utility derived from alternative *j* is higher than the utility derived from any other alternative *k* in the choice set:

$$P(U_{njt} > U_{nkt}) = P[(V_{njt} - V_{nkt}) > (\varepsilon_{nkt} - \varepsilon_{njt})] \; j,k \in C_{nt};\; j \neq k \quad (2)$$

By assuming random the parameters of the utility specification (McFadden and Train, 2000), the RPL model allows accounting for both preference heterogeneity across respondents (Revelt and Train, 1998) and correlation across the sequence of choices made by the individuals (Kragt and Bennet, 2012) when estimating the probability of preferring alternative *j* over an alternative *k.* In this sense, for each random parameter, a vector of individual-specific coefficients is estimated, where each coefficient β_n is defined as the sum of a population's mean β and an individual-specific deviation from this mean v_n. The vector of individual-specific coefficients is described by means of a continuous random density function,$f(\cdot)$, indicating that the source of parameter heterogeneity is unknown:

$$\beta_n = \beta + \sigma v_n \quad (3)$$

where v_n represents the individual-specific unknown heterogeneity, and σ is the standard deviation of the distribution of β_n around β.

The RPL model also allows for the mean of the parameters' distributions β to vary over individuals. This can help to account for taste heterogeneity relating to observed variables. In this sense, although the estimated coefficients of β are usually assumed to be constant over choice situations for a given decision maker, the panel structure of the RPL model allows specifying them to vary also over the repeated choices of the respondent (Train, 2009). In this way, rather than assuming that tastes are stable over choices, the researcher can explore whether the preferences of the individual change across choice occasions:

$$\beta_{nt} = \beta + \sum_{i=1}^{I} \delta_i z_{int} + \sigma v_n \quad (4)$$

where z_{int} are the observed variables changing across choice occasions.

We focused on the RPL model property permitting to accommodate taste heterogeneity relating to observed variables to test for the existence of framing effects from varying information about the degree of environmental uncertainty. Indeed, given the temperature change and its probability of occurrence varied across choice sets in our choice experiment, we considered that the means of the parameters' distribution might also depend on the value of *Temperature* and *Probability*. Put another way, we assumed *Temperature* and *Probability* as the *observed* variables whose values might help to explain variation of tastes across repeated choices for the same respondent.

3.2 Utility function specification and welfare measurement

The individual choice behaviour was modelled through a utility function being linear and additive in all the attributes:

$$\begin{aligned} U_{njt} = {} & \beta_0 ASC_j + \beta_1 COST_{jt} + \beta_2 PLUS\_URBAN\_SPONGE_{jt} + \beta_3 PLUS\_THERMAL\_REFRIGERATION_{jt} \\ & + \beta_4 PLUS\_CULTURAL\_OFFER_{jt} + \beta_5 PLUS\_LOCAL\_CUISINE\_OFFER_{jt} \\ & + \beta_6 PLUS\_RECYCLING\_\&\_REUSE_{jt} + \beta_7 PLUS\_ENERGY\_EFFICIENCY_{jt} + \varepsilon_{nj} \end{aligned} \quad (5)$$

While the *Cost* attribute was specified as a continuous variable, the remaining policy attributes (*Create Shadow Areas, Strengthen the Tourism product* and *Reduce the Carbon Footprint*) were treated as categorical variables with 3 levels, which led us to create 2 dummy variables for each attribute: *Plus_Urban_Sponge* and *Plus_Thermal_Refrigeration*; *Plus_Cultural_Offer* and *Plus_Local_Cuisine_Offer;* and *Plus_Recycling_&_Reuse* and *Plus_Energy_Efficency* for *Create Shadow Areas, Strengthen the Tourism product* and *Reduce the Carbon Footprint,* respectively. The first level of each attribute (*Green environments*, *More Nature Conservation* and *Green Purchasing)* was considered as the reference level (see Table 1). Thus a policy program involving the three actions represented by this level within each policy set was considered as the reference policy program against which the remaining policy programs were evaluated. Accordingly, the alternative specific constant (ASC), which equalled 1 if the alternative was one of the proposed policy programs and 0 otherwise (i.e. if it was the no policy option), not only captured utility differences between the policy programs and the no policy option but also represented the individual utility derived from the reference policy program (β_0).

To accommodate for taste heterogeneity related to the observed variables *Temperature* and *Probability*, we examined different model specifications where the attribute coefficients were considered random and the means of their distributions to vary with both the magnitude of the temperature change and its associated probability of occurrence:

$$\beta_{nt} = \beta + \delta_1 TEMPERATURE_{nt} + PROBABILITY_{nt} + \sigma v_n \quad (6)$$

where $\delta_1$and δ_2 were the parameters of the framing variables *Temperature* and *Probability*, respectively, entering the heterogeneous means of the random parameter distributions.

To test for the existence of framing effects, we calculated the value assigned to different policy programs described by a combination of actions undertaken within each policy set (i.e. a combination of attribute levels). Thus each policy program represented a combination of three actions, as shown in Table 2:

Table 2. Policy programs under evaluation

Policy programs	Actions
Policy program A[a]	Green Environments More Nature Conservation Green Purchasing
Policy program B	Plus Urban Sponge Plus More Diverse Cultural Offer Plus Recycling and Reuse
Policy program C	Plus Thermal Refrigeration Plus More Local Cuisine Offer Plus Energy Efficiency

[a] Reference policy program

We measured the individual willingness-to-pay (WTP) for each policy program by following Hanemann (1984)'s formula:

$$WTP_n = -\frac{1}{\beta_{1n}}(U_{n2} - U_{n1}) \tag{7}$$

where $U_{n2} - U_{n1}$ represents the change in utility derived from passing from a policy program 1 to a policy program 2, and β_{1n} represents the random cost parameter.

Note that, according to Equation (6), each dummy variable coefficient in Equation (4) (from β_2 to β_7) represented the *increase* in utility derived from a policy program only differing from the reference program in the level of the attribute represented by the dummy variable. For instance, β_2 represented the increase in utility derived from a program described by the levels *Plus Urban Sponge, More Nature Conservation* and *Green Purchasing* compared to the reference program described by the levels *Green Environments*, *More Nature Conservation* and *Green Purchasing.* Similarly, β_3 represented the increase in utility derived from a program described by the levels *Plus Thermal Refrigeration*, *More Nature Conservation* and *Green Purchasing* compared to the reference program. Accordingly, the WTP for such programs calculated through Equation (6) would represent the difference between their value and that of the reference policy program. More generally, the WTP values estimated through Equation (6) for whatever policy program different from the reference program would represent the monetary welfare *gains* resulting from the former with respect to the latter.

For the programs depicted in Table 2, and in case only the cost coefficient was considered random, we would calculate the WTP values using the following expressions:

$$WTP_n^1 = -\frac{\beta_0}{\beta_{1n}} \tag{8}$$

$$WTP_n^2 = -\frac{\beta_2 + \beta_4 + \beta_6}{\beta_{1n}} \tag{9}$$

$$WTP_n^3 = -\frac{\beta_3 + \beta_5 + \beta_7}{\beta_{1n}} \quad (10)$$

We expected that the WTP for the policy programs aimed at counteracting the potential deterioration of visitors' perceptions about the destination's climatic suitability in the face of global warming changed with the magnitude and the probability of occurrence of the expected temperature change. Consequently, we tested the following null hypothesis, whose rejection would imply the existence of framing effects from varying information about the degree of environmental uncertainty:

H01: The WTP for the policy programs in the face of global warming is not affected by the magnitude of the expected temperature increase and its probability of occurrence.

Specifically, we expected that the higher the magnitude of the change in temperature and the higher its probability of occurrence, the higher the WTP for the programs. Thus, we also tested the following second null hypothesis:

H02: The WTP for the policy programs in the face of global warming does not increase with the magnitude of the expected temperature increase and its probability of occurrence.

4. Welfare effects from varying information about *Temperature* and *Probability*: Results

The RPL model was estimated through the NLOGIT 5 (Econometric Software, 2012) using Halton draws with 500 replications accounting for the panel nature of the data. Different model specifications were examined where the attribute coefficients were assumed to be random and the means of their distributions to vary with both the magnitude of the temperature change and its associated probability (see Equation 5). After testing several distributional assumptions for all the attribute coefficients, the best model specification was that where only the cost parameter was considered random with the mean of its distribution being a function of *Temperature* and *Probability*. A constrained triangular distribution was assigned to the cost coefficient to ensure a negative sign across its whole distribution (Greene et al., 2006; Kragt and Bennet, 2012). Such model specification resulted in a significantly improved model fit. Table 3 reports the results from the RPL model for this specification:

Table 3. Results from the RPL model[a]

Variable	Coefficient	b/St.Er.
Random parameter mean		
Cost	-0.955	-13.30
Random parameter spread		
Cost	0.955	13.30
Fixed coefficients		
ASC	4.858	15.80
Plus Urban sponge	0.604	6.72
Plus Thermal refrigeration	0.752	7.52
Plus Cultural Offer	0.408	4.88
Plus Local Cuisine offer	0.449	4.14
Plus Recycling & Reuse	0.258(*)	2.41
Plus Energy efficiency	0.693	7.07
Heterogeneity in random parameter mean		
Temperature	0.050	7.95
Probability	0.537	7.10
Log-likelihood		-1,632.67
Restricted log-likelihood		-2,613.60
AIC		3285.3
McFadden Pseudo R-squared		0.3463
Number observations		2,379

[a]All estimated coefficients are statistically significant at the 1% level except those denoted by (*) which are significant at the 5% level.

As shown in Table 3, all the estimated coefficients were significant and had the expected signs. In this sense, the negative cost parameter (-0.955) showed that respondents preferred less costly policy programs. The positive coefficient of the ASC (4.858) indicated that visitors on average would like to move from a no policy scenario to a scenario where a policy program aimed at improving their perceptions about the climatic suitability of Mallorca in the face of global warming was undertaken. In addition, the parameters of the policy attributes showed that visitors gained utility from passing from the reference program to a program only differing from the former in the level of the attribute represented by the dummy variable. For instance, the utility from a policy program described by *Green Environments*, *Plus More Diverse Cultural Offer* and *Green Purchasing* was 0.408 higher than that of the reference program represented by the ASC coefficient. Similarly, the utility *gain* from a program described by *Green Environments*, *Plus More Diverse Cultural Offer* and *Plus Recycling & Reuse* was 0.666 (0.408+0.258) compared to the reference program. In general, results showed that policy programs involving more actions within each policy set were more likely to be chosen by visitors (0.752>0.604; 0.449>0.408; 0.693>0.258).

Interestingly, tourists gained utility from actions implying the tourism industry increasing efforts on engaging in pro-environmental practices in a context of global warming, as shown by the coefficients of *Plus Recycling and Reuse* and *Plus Energy Efficiency*. In this sense, the increase in utility from an action involving the sector engaging in green purchasing, recycling and reuse schemes and developing energy efficiency plans was much higher than that from an action implying the industry only engaging in green purchasing and recycling and reuse schemes (0.693>0.258).

The significant random cost parameter spread (0.955) and the coefficients of *Temperature* and *Probability* (0.050 and 0.537, respectively) evidenced that information about the degree of uncertainty over the expected temperature change had an effect on tourist preferences. In particular, we observed that the higher the magnitude of the expected temperature change, the lower the individual-specific cost coefficient and hence the lower the disutility associated with paying €1 for a policy program. Similarly, the higher the probability of occurrence, the lower the cost coefficient and hence the lower the disutility associated with paying €1.[3]

To test for the existence of welfare effects from varying information about the degree of environmental uncertainty, we calculated the individual willingness-to-pay (WTP) for the three programs reported in Table 2 following Equations (8), (9) and (10), where only the cost parameter was considered random. To do it, we used Krinsky and Robb (1986) parametric bootstrapping procedures[4]. In addition, given the mean of the random cost coefficient (β_{1n}) was assumed to depend on *Temperature* and *Probability*, we considered six possible *framings* to calculate the welfare measures: three scenarios involving an increase of 4ºC in the temperature associated to each of the three probability values considered (30%, 60% and 90%); and three scenarios representing the three temperature rises considered (4ºC, 8ºC and 12ºC) each associated to a probability of occurrence of 30%. Table 3 reports the mean WTP estimates for each of the policy programs together with their 95% confidence intervals:

Table 3. Mean WTP estimates (in euros) for the policy programs under different framings[a]

	Δ Temp. = 4ºC			Prob. = 30%		
Policy programs	**Prob. = 30%**	**Prob. = 60%**	**Prob. = 90%**	**Δ Temp. = 4ºC**	**Δ Temp. = 8ºC**	**Δ Temp. = 12ºC**
Policy program A[b]	11.30 (9.46, 13.95)	15.75 (12.73, 20.59)	25.34 (17.67, 38.36)	11.30 (9.46, 13.95)	17.26 (13.68, 22.16)	37.35 (22.43, 68.74)
Policy program B	2.97 (2.05, 3.94)	4.11 (2.83, 5.69)	6.61 (4.20, 10.074)	2.97 (2.05, 3.94)	4.51 (3.00, 6.29)	9.69 (5.19, 19.04)
Policy program C	4.41 (3.33, 5.73)	6.15 (4.66, 8.41)	9.86 (6.70, 15.20)	4.41 (3.33, 5.73)	6.72 (4.90, 8.94)	14.40 (8.30, 27.70)

[a] Mean WTP estimates and the 95% confidence intervals calculated by using Krinsky and Robb (1986) parametric bootstrapping procedures.
[b] Reference policy program.

The values reported in Table 3 suggested that the WTP was affected by the degree of uncertainty over the expected increase in the temperature. However, to draw robust conclusions about it, we tested for the WTP differences by applying the Complete Combinatorial approach suggested by Poe et al. (2005), which tests the null hypothesis that the difference between two WTP distributions is equal to zero (H_0: $WTP_1 - WTP_2 = 0$). We compared differences between the WTP distribution under each scenario depicted in Table 3 and the WTP distribution corresponding to a baseline scenario defined by an increase in the temperature of 4ºC with an associated probability of occurrence of 30%. Results showed that the null hypothesis of equivalence between the two distributions was rejected in all the cases. For instance, findings showed that, if the temperature increased by 4ºC, the WTP for the reference program under a scenario of 60% probability was statistically different from the WTP for the same program under a probability of 30% (i.e. the baseline scenario). Table 4 reports the significance level at which the null hypothesis was rejected under each scenario, which was, for our example, equal to 1.40%.

[3] Note that the parameters of the framing variables entered positively the negative mean of the random cost parameter distribution (see Equation 5).

[4] The simulated WTP distributions used in this application were constructed by generating 1,000 pseudo-random draws from the unconditional distribution of the estimated parameters and calculating the simulated estimates for each draw.

Table 4. Complete Combinatorial approach by Poe et al. (2005)[a]

	Δ Temp. = 4ºC[b]		Prob. = 30%[b]	
Policy program	**Prob. = 60%**	**Prob. = 90%**	**Δ Temp. = 8ºC**	**Δ Temp. = 12ºC**
Policy program A[c]	1.40%	0.00%	0.39%	0.00%
Policy program B	8.02%	0.12%	4.31%	0.01%
Policy program C	4.72%	0.04%	2.05%	0.00%

[a] The table reports the significance level at which the null hypothesis of equivalence between the WTP distribution under each scenario and the WTP distribution associated with the baseline scenario was rejected.

[b] Values of the baseline scenario against which the remaining scenarios were compared.

[c] Reference policy program.

Consequently, our findings led us to reject the null hypotheses *H01* and *H02* and confirmed the existence of framing effects from varying the degree of uncertainty over the expected temperature increase. In particular, if we look at Table 3, the WTP for program A, B and C increased with the probability under an expected temperature rise of 4ºC (11.30<15.75<25.34; 2.97<4.11<6.61; 4.41<6.15<9.86, respectively). In other words, the higher the probability of occurrence of the temperature change, the higher the value assigned to the program. Similarly, under a probability equal to 30%, the WTP increased with the magnitude of the temperature change, this suggesting the existence of scope effects (11.30<17.26<37.35; 2.97<4.51<9.69; 4.41<6.72<14.40).

5. Concluding remarks

This paper provides evidence that the degree of uncertainty over an expected environmental phenomenon affects preferences for policies aimed at adapting to the environmental conditions resulting from such phenomenon. Unlike current stated preference studies, it examines the existence of framing effects from varying information about the environmental features characterizing the decision-making context where respondents are asked to state their preferences. Thus, it adds to the existing literature on framing effects which has usually been focused on analysing the welfare impacts derived from changing information relating to substitute goods, individuals' budget constraint, the attributes defining the good to be valued and the complexity of the choice task.

In this sense, and through a single choice experiment (CE) study, the paper investigates the welfare effects from varying information about the degree of uncertainty over an expected global warming-derived increase in the temperature in Mallorca by mid-21st century. In particular, it estimates tourist preferences for policy programs oriented to counteract a potential deterioration of tourist perceptions about the climatic suitability of the island in a context of global warming. Rather than using a traditional split sample experiment where each split sample faced a given expected temperature change associated with a probability of occurrence, we used a novel CE design according to which information about the degree of environmental uncertainty varied across choice sets. Thus, each respondent was asked to choose among alternative adaptation policy programs under different degrees of environmental uncertainty resulting from the combination of three potential increases in the temperature over current summer average monthly values (4ºC, 8ºC, 12ºC) with three levels of probability of occurrence (30%, 60%, 90%). This innovative CE design allowed us not only to consider many degrees of environmental uncertainty (9) without increasing costs significantly, but also to test for the existence of framing effects through the use of a random parameter logit (RPL) model specification which allows accounting for taste heterogeneity relating to observed variables.

Accordingly, we considered that the means of the distributions of the random attribute parameters varied with the values of the *observed* variables *Temperature* and *Probability.* Thus, we assumed that the statistical significance of the framing variable coefficients would serve to justify that information about the magnitude of the expected temperature change and its probability of occurrence affected tourist preferences. We tested for different RPL model specifications and found that the specification best fitting the data was the one where *only* the cost parameter was assumed to be random with the mean of its distribution varying with the value of *Temperature* and *Probability.* In this sense, results evidenced that, under higher expected temperature changes and higher probabilities indicating how likely those changes would be, visitors experienced a lower disutility associated with paying €1 for an adaptation policy program. The existence of welfare effects from varying information about the framing variables was confirmed by applying the Poe et al. (2005)'s test. Thus, the findings suggested that it was *less painful* for visitors to pay for a policy under worse environmental scenarios.

Therefore, overlooking the existence of welfare effects from varying information about the degree of uncertainty over an expected environmental phenomenon which policy makers are concerned with is not a minor issue. It could lead to biased adaptation policy's benefits and hence poorly-informed decision makers. Despite information contained in our WTP estimates can benefit adaptation policy planning in many environmental settings, a focus on the uncertainty over an expected global warming-derived increase in temperature serves to enhance the contribution of this paper. Indeed, global warming represents one of the most challenging global environmental problems today. Thus, in our current environmentally uncertain period of urgent warning about the socio-economic impacts which might result from global warming, research on analysing its effects on individual preferences for adaptation policies undoubtedly becomes policy relevant. It can serve to *stimulate* today action.

We cannot end the paper without making a reference to the interesting policy implications that can be drawn from our focus on the potential global warming impacts on the tourist perceptions about the climatic suitability of a traditional summer holiday destination. Indeed, coastal regions and small islands attracting high number of visitors are especially vulnerable to such impacts. These areas might experience an important loss of competitiveness if no action is undertaken. In this sense, our findings show that visitors were willing to pay for policies oriented to address their potential *thermal discomfort* through both the creation of microclimates and the diversification of the tourism product in favour of less climate-dependent activities. Even more importantly, our results also indicate that adaptation policies involving more sustainability-oriented strategies by the tourism industry could also improve tourist perceptions about the climatic suitability of the destination. They evidence that, in a context of global warming, visitors valued positively policy programs implying the tourism sector engaging in pro-environmental practices, this suggesting that tourism satisfaction not only depends on individual thermal comfort. Such results become of great relevance in a framework characterized by the growing deterioration of residents' perceptions about tourists due to the contribution of tourism activities to environmental degradation. The engagement of the tourism industry in environmentally-friendly practices could serve to improve residents' perceptions about tourism.

Such a finding should not be overlooked by decision makers who, beyond attempting to ensure the destination's long-term sustainability, want to guarantee the *right* of current and future generations to enjoy the destination's natural resources.

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Figure 1: Sample choice set