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Testing Convergent Validity in Choice Experiments: Application to Public Recreation in Spanish Stone Pine and Cork Oak Forests

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Testing convergent validity in choice experiments:
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Testing convergent validity in choice experiments:
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Abstract

We perform two convergent validity tests in a choice experiment applied to public recreation in Stone pine and Cork oak forests in Spain. We compare choice and ranking recoded as a choice in an experiment with three alternatives plus status quo. Our results show convergent validity for both structural models and willingness to pay estimates. The same experiment includes two payment-vehicles, an entrance-fee to access the forest and an increase in trip-expenditures due to an increase in gas prices, simultaneously in the choice sets. We obtain significant differences in willingness to pay values, which are 2.6-2.7 times higher when using the latter. Our empirical results present compensating variations and the (simulated) exchange value that the forest owner would obtain if a payment system for accessing these forests were established. The latter values fall below the former ones.

JEL classification: Q26, Q51, Q56
Key words: Compensating variation, exchange value, non-market values, stated preferences

1. Introduction

Forests provide many goods and services that are important to society, including public (free-access) recreation and open-space leisure activities. Efforts in the integration of non-market benefits in economic analysis have developed several valuation techniques, which have been applied to economically value forest public recreation (Scarpa et al., 2000; Christie et al., 2007; Huhtala and Pouta, 2008; Bartczak et al. 2008; Rosenberger et al., 2012; Abildrup et al., 2013; Saelen and Ericson, 2013). Recent environmental accounting applications in Mediterranean forests suggest that public recreation is part of the social total income generated by these forests (Caparrós et al., 2003; Campos and Caparrós, 2006). However, there is still need of more specific cases and ways to integrate reliable non-market values in extended economic analysis.

Choice experiments (CE) have attracted attention in non-market valuation as a response to the critiques of the contingent valuation method (CVM). Yet, CE are also hypothetical exercises, which raises issues about their validity (Hausman, 2012) and makes difficult to discern if stated choices would be actual choices in real markets. One way to validate CE is to test for construct validity, which includes theoretical and convergent validity (Whitehead, et al., 1995; Whitehead, et al., 1998). In this paper we focus on convergent validity, which assesses whether non-market values obtained using different techniques converge to similar estimates (Hausman, 1993). This has been assessed by comparing CE with revealed preferences and actual market decisions (Adamowicz et al., 1994, 1997; Haener et al., 2001; Whitehead et al., 2008), different elicitation formats (Boyle et al., 2001; Mogas and Riera, 2001; Caparrós et al., 2008; Akaichi et al., 2013) or payment-vehicles (Biénabe and Hearne, 2006; Swallow and McGonagle, 2006; Nunes et al., 2008; Rai and Scarborough, 2012; Kaczan et al., 2013).

We perform two convergent validity tests in a CE applied to the valuation of public recreation in Stone pine (*Pinus pinea*) and Cork oak (*Quercus suber*) forests in Spain. These native Mediterranean tree species are found mostly on managed forests used for the production of commercial goods, but also with an increasing interest in the production of non-market services such as public recreation and conservation of endangered species (e.g. the Iberian lynx). In this context, we compare the results from two elicitation formats (choice and ranking recoded as a choice) in an split-sample design experiment with three alternatives plus the status quo, and the results from two payment-vehicles that are included simultaneously in the choice sets (an entrance-fee to the forest and an increase in trip-expenditures due to an increase in gas prices).

We also discuss the implications of these methodological tests for WTP estimations and to present the empirical results of the valuation of forest public recreation. We focus on compensating variation estimates and on the value of the potential earnings of the forest owner that would result of establishing a payment system for accessing these forests. The latter result follows the simulated exchange value method proposed by Caparrós et al. (2003).

Our results show convergent validity between elicitation formats while present significantly divergent results between the two payment-vehicles, with WTP estimates around 2.6-2.7 times higher when using the increase in trip-expenditures. Our empirical results show a significant difference in WTP between visiting Stone pine and Cork oak forests, and a positive WTP for the presence of recreation infrastructures and for the possibility of sightseeing animals and picking-up mushrooms. Concerning the aggregate economic values of public recreation, we obtain that the ones resulting from applying the simulated exchange value method are between 35% and 51% of the ones derived from estimating compensating variation values.

The remainder of the paper is structured as follows. The next section presents the background. Section 3 explains the valuation scenario, the survey design and the econometric analysis and tests performed. Section 4 shows the results from the experiment and the tests, and section 5 discusses the implication of these results for practitioners. Section 5 concludes.

2. Background

In CEs, the elicitation format is an important element in the design of the valuation scenarios as it offers to respondents the way to state their preferences about a certain good or service. The main goal for practitioners is using those formats providing more information, less non-responses and that are incentive compatible (Mitchell and Carson, 1989). It is often argued that closed-ended formats offering ordinal measures of preferences are the most appropriate in stated choice as they better resemble a real market situation where one or multiple choices need to be done (Roe et al., 1996). Applied research using these methods in recent years shows that choice and ranking are the most widely used formats and both meet these requirements. Several studies have compared them, showing divergent results in early studies (Boyle et al., 2001; Mogas and

Riera, 2001) and convergent validity in later studies that focused on the choice and the ranking recoded as a choice (Caparrós et al., 2008; Akaichi et al., 2013). The main implication of the latter finding is that you can get additional information from a ranking recoded as a choice without losing the results from an equivalent choice and that people make consistent choices in these hypothetical experiments. All these previous studies, except Boyle et al. (2001), were performed for an experiment of two alternatives plus the status quo. As differing complexity and the information provided in CEs can affect respondent's decisions (Hensher, 2006; Hoehn et al., 2010; Alevy et al., 2011), we extend previous studies by comparing choice and ranking recoded as a choice in an experiment using three alternatives plus status quo. We test if the presence of an additional alternative changes the convergent validity results obtained in previous research.

The payment-vehicle offers the context for payment and affects how the respondent answers stated preference questions (Morrison et al., 2000). Payment-vehicles have been compared in split-sample designs in CE. Swallow and McGonagle (2006) and Nunes et al. (2008) compare tax reallocation and tax introduction regimes whilst Biénabe and Hearne (2006) and Kaczan et al. (2013) compare taxes, various types of cash payment and voluntary contribution to a fund. In these studies each respondent faces one valuation question with a single payment-vehicle and different payment-vehicles are randomly assigned to each respondent. Rai and Scarborough (2012) include labor contribution and a membership fee in the same choice set, though the former is not measured in monetary units. In analyzing forest public recreation, Campos et al. (2007) confirm previous results using CVM.

We extend previous works in two ways. First, we compare in a CE the same two payment-vehicles as in Campos et al. (2007): an entrance-fee and an increase in trip-expenditures[1]. Second, we include in the choice sets these two payment-vehicles simultaneously, giving respondents the opportunity of evaluating them simultaneously. We intend to minimize the possible effects of each payment-vehicle that could arise when valued in isolation and test whether respondents perceive the marginal utility of income from them differently than when they are presented to separate samples. An additional advantage is that we do not have to use several valuation questions in the same questionnaire, as this poses risk of endogeneity across answers.

[1] From now on, payment-vehicles will be renamed as entrance-fee (ENT) and increase in trip-expenditures (EXP).

3. Material and methods

Stone pine and Cork oak forests are native from the Mediterranean region and can be found mainly in the Iberian Peninsula. In Spain, the forest area where these species are dominant are located mainly in the southwest, west and northeast (Figures 1a and 1b). They can be found either in pure stands or mixed with other pine and oak species. Both species have commercial interest, being the main products cork for the production of cork stoppers and pine nuts for the food sector. Cattle grazing and hunting is also common, with properties usually leased out to livestock keepers and hunters clubs for carrying out these activities. There are also other non-market services associated to these forests, such as biodiversity conservation, landscape, carbon sequestration and public recreation (Caparrós et al., 2010; Ovando et al., 2010).

[Figures 1a and 1b]

3.1 Survey design and implementation

The survey was made with Spanish adults (> 18 years old) from 14 provinces located in southwestern Spain (*Cádiz*, *Málaga*, *Sevilla*, *Córdoba*, *Huelva*, *Badajoz*, *Cáceres*, *Valladolid*, *Madrid*, *Segovia*, *Toledo*, *Salamanca*, *Zamora* and *Ávila*). These provinces were selected considering that they contain or are adjacent to regions with Stone pine and Cork oak forests so that respondents know or are familiar with them. We may be missing potential respondents from Barcelona and Gerona (northeast Spain in Figures 1a and 1b), but we could not include this area because it would have implied an important increase in the number of questionnaires needed. However, the Stone pine and Cork oak forest areas in this region are relatively small respect to their total areas in Spain (8% and 14%, respectively) (MAGRAMA, 2014c).

The survey was made by a professional surveying company to 750 individuals. The sample was stratified by provinces, considering the population of each province, and randomly selected within each province. The interviews were face-to-face and performed with people at their homes from April to July 2008. The survey presented the CE with the valuation scenario of public recreation in 604 questionnaires. Two focus groups were used to identify the main attributes of the recreation visit. A preliminary design for the valuation exercise was tested as well. A pre-test survey was used to obtain the vector of monetary values to be offered in the CE of the definitive survey and to evaluate the extent to which the information presented was understood. The pre-test was done with 50 individuals.

The forest public recreation valuation scenario started asking respondents if they had made a recreation visit to a forest in Spain at least once in the past 12 months. Those answering affirmatively faced the CE. Out of the 604 respondents, 336 qualified as forest recreationists and represent our sample of respondents. The CE asked respondents first to think in the next visit they were planning to make to a forest and to imagine that, eventually, the expenses they incurred in the visit increase because the forest owner/manager (a private party or a public institution) establishes an entrance-fee for accessing the forest and because there is an increase in trip-expenditures. This created the context for the valuation in the subsequent choice task. Respondents then faced two choice sets including three forest visit alternatives plus the status quo, which was described as "I prefer to stay at home". Half of the sample had to choose one alternative and half of the sample had to rank them from most preferred to least preferred. The alternatives were characterized by the attributes presented in Table 1.

[Table 1]

Given these attribute and their levels, we obtained 16 treatments forming a main effects design from the universe of 256 combinations ($4^2 \times 2^4$). Then we developed an orthogonal design of combinations of these treatments in 16 choice sets of three alternatives plus the status quo with an efficiency of 100%. Appendix 1 presents an example of a choice and a ranking card.

3.2 Econometric analysis

We analyze the choice results (CH models) and the ranking recoded as a choice results (RC models). We use conditional (CL) and mixed logit (ML) models (Train. 2009). We assume a linear-in-parameters utility function for individual i and alternative j in a choice set of J alternatives with a systematic (V_{ij}) and a random component (ε_{ij}):

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \sum_{k=1}^{K} \beta_k{}' X_{ijk} + \varepsilon_{ij} \, , \qquad [1]$$

where β_k represents the regression coefficient for attribute k, X_{ijk} is the value of attribute k in alternative j for individual i; and ε_{ij} are random errors. The k attributes included in our models are a constant specific to forest recreation visit alternatives (ASC-REC), the type of forest visited (TREE), the presence of infrastructures (INS), the presence of domestic animals (ANI), the possibility of freely collecting mushrooms (MUSH) and two payment-vehicles as explained above: entrance-fee (ENT) and increase in trip-expenditures (EXP). The values of the two latter attributes in an alternative represent the total additional payment that the respondent would incur when choosing that alternative for the next visit.

This additional payment would include the respondent plus other persons that usually go with her in these visits and for whom she pays. Participants in the focus groups stated that it was easier to think in terms of total additional payment rather than in terms of per person additional payment. Thus, this way of presenting the additional payment is easier to understand for those respondents usually paying for more people, while it is neutral for those respondents usually paying only for themselves. As our goal is to obtain a model that estimates the WTP per visit per person, we asked respondents the number of people for which they usually pay in their visits and recoded the offered bid to a bid per person. The β_k and X_{ijk} vectors in the models are:

$$\beta_k' = \left(\beta_{ASC-REC}, \beta_{TREE}, \beta_{INS}, \beta_{ANI}, \beta_{MUSH}, \beta_{ENT}, \beta_{EXP}\right), \quad [2]$$

$$X_{ikj}' = \left(x_{iASC-RECj}, x_{iTREEj}, x_{iINSj}, x_{iANIj}, x_{iMUSHj}, x_{iENTj}, x_{iEXPj}\right). \quad [3]$$

Given the previously defined utility function, the probability that the respondent i chooses alternative j (P_{ij}) over any alternative h ($\forall\ h \in J$) is:

$$P_{ij} = P\left[V_{ij} + \varepsilon_{ij} > V_{ih} + \varepsilon_{ih}\right] = P\left[V_{ij} - V_{ih} > \varepsilon_{ih} - \varepsilon_{ij}\right] \forall j, h \in J \quad [4]$$

The probability that each random term $\varepsilon_{ih} - \varepsilon_{ij}$ is below $V_{ij} - V_{ih}$ is a cumulative distribution. Different assumptions about the density function of random terms $f(\varepsilon_i)$ (the unobserved portion of utility) gives different discrete choice models (Train, 2009). We start with a baseline model, the CL, and develop further our analysis and results with a more flexible model, the ML.

In the CL model, errors are assumed to be independently and identically distributed with an extreme value distribution across the h alternatives ($\forall\ h \in J$) and i respondents. The probability model gives:

$$P_{ij} = \frac{\exp^{\mu\beta_k' X_{ijk}}}{\sum_{h\in J} \exp^{\mu\beta_k' X_{ihk}}}, \qquad [5]$$

where μ is the scale factor, which is normalized to 1. The random term distribution implies that the ratio of the probabilities of choosing any two alternatives is independent of the remaining alternatives; that is, that the unobserved component of the alternative *j* function is independent of the unobserved error of alternative *h* function when choosing alternative *j*. This is known as the independence of irrelevant alternatives (IIA) hypothesis. The violation of this assumption may arise when some alternatives are qualitatively similar to others, as in our experiment.

The ML model is constructed on the assumption that some attribute parameters consist of a component that is independently and identically distributed with an extreme value distribution and is common to all individuals and of an individual specific component that follows a distribution specified by the researcher (θ). The utility function U_{ij} takes the following form:

$$U_{ij} = \left(\bar{\beta}_k' + \tilde{\beta}_{ik}'\right) X_{ijk} + \varepsilon_{ij}. \qquad [6]$$

The ML has the advantage of allowing correlated errors terms between alternatives and not assuming the IIA hypothesis. In addition, as parameters vary in the population, unobservable heterogeneous preferences are modeled.

In the ML model, the probability that individual *i* chooses alternative *j* over any alternative *h* ($\forall\, h \in J$) is the integral of the CL probabilities in [5] over a density of parameters according to the selected distribution θ. This integral have not a closed-form solution but can be evaluated through simulation for any value of θ. Being R the number of draws from θ (in our models we use R=500), the unbiased estimator of P_{ij} in the ML is defined as (Train 2009):

$$\breve{P}_{ij} = \frac{1}{R}\sum_{r=1}^{R} \frac{\exp^{\mu\beta_k' X_{ijk}}}{\sum_{h\in J} \exp^{\mu\beta_k' X_{ihk}}} \qquad [7]$$

We assume normal distribution for random parameters, except for the payment attributes that are assumed to have fixed parameters. This allows that the WTP for each attribute follows the same distribution than its random coefficient (Revelt and Train, 1998)[2].

In the specified models in our application, the payment attributes (ENT and EXP) are coded as continuous variables, introducing their values for x_{iENTj} and x_{iEXPj} in [3]. The attributes INS, ANI and MUSH are dummy-coded (1 for the presence of the attribute level and 0 otherwise for x_{iINSj}, x_{iANIj} and x_{iMUSHj} in [3]). The attribute TREE is effect-coded (-1 for Stone pine and 1 for Cork oak for x_{iTREEj} in [3]) to differentiate the effect of choosing any of the two possible forests for the visit from the status quo. The ASC-REC is dummy-coded (1 for forest visit alternatives and 0 otherwise for $x_{iASC\text{-}RECj}$ in [3]). The status quo levels are normalized to zero. We use LIMDEP version 9.0 for estimating the parameters through maximum likelihood for the CL and though simulated maximum likelihood for the ML.

From these models, we generate empirical distributions for the individual parameters of each *k* attribute through the Krinsky and Robb (1986) bootstrapping technique, using 1,000 random draws from the presumed asymptotically multivariate normal distribution of the maximum likelihood parameters and variance-covariance matrix. Using these distributions, we estimate the mean marginal WTP for each k attribute using the formula $-\beta_k/\beta_{bid}$ and the mean WTP for a recreation visit to a forest given the values of the attributes characterizing that specific visit. The standard deviation and the 95% confidence interval of these estimated are calculated using the percentile approach (Efron and Tibshriani, 1993).

3.3 Comparing choice and ranking recoded as a choice

We use a Likelihood Ratio test to find out whether CH and RC provide similar parameter vectors. We follow the proposal by Swait and Louviere (1993) as it makes possible to test whether divergences are due to differences in taste or in scale parameters. Our null hypothesis (H_A) is:

[2] The option of setting the parameters for the payment attributes as random and specifying a normal distribution for them could imply behaviorally inconsistent WTP values. Alternatively, setting a different distribution for these parameters will make more difficult the interpretation of WTP values. In addition, empirical identification of the model becomes more challenging when all coefficients are set as random.

$(\mu_{CH}\beta_{CH})=(\mu_{RC}\beta_{RC})$. To falsify this hypothesis, the test separately examines two hypotheses. In hypothesis (H_{A1}): $(\beta_{CH})=(\beta_{RC})$ the relative scale parameter is set as μ_{CH}/μ_{RC}. If H_{A1} is rejected, H_A is also rejected and differences derive from taste parameters. If H_{A1} is not rejected, we test hypothesis (H_{A2}): $(\mu_{CH})=(\mu_{RC})$, where the scale parameters are constrained to be equal under the null hypothesis. If H_{A2} is rejected, H_A is also rejected and the differences derive from scale parameters. If H_{A2} is not rejected, the hypothesis H_A cannot be rejected either. If both H_{A1} and H_{A2} are not rejected, then H_A is not rejected.

To test the equality of WTP values obtained through different formats, we employ the complete combinatorial test (Poe et al., 2005). We compare the mean marginal WTP obtained from the bootstrapping for attributes ASC-REC, TREE, INS, ANI and MUSH, and the mean WTP obtained for a visit to either a Stone pine or a Cork oak forest when all other attributes are not present; that is, considering only ASC-REC and TREE when defining the forest visit. As two payment-vehicles are included in the experiment, WTP values are estimated separately for ENT and EXP; that is, in each case the β parameters of the attributes are divided by the β parameter of the corresponding payment-vehicle. This tests the hypothesis (H_B): $(WTP_{CH,k,pv})=(WTP_{RC,k,pv})$, where *k* corresponds to an attribute or to any of the forest visits previously defined, and *pv* corresponds to the payment-vehicle used in the estimation of these WTP values.

3.4 Comparing payment-vehicles

In this test, we first compare the parameter of ENT with the parameter of EXP from the preferred model using a *t-test*. These parameters represent the marginal utility of money when making a decision about the next recreation visit to a forest given the alternatives offered in the experiment. Thus, we test the hypothesis that this marginal utility of money is equal for both payment-vehicles (H_C): $(\beta_{ENT})=(\beta_{EXP})$.

We also use the complete combinatorial test to compare, in the preferred model, the WTP obtained with each payment-vehicle for each attribute and forest visits defined for H_B. Thus, we test the hypothesis that forest recreationists give the same marginal utility to one euro spent as an entrance-fee and to one euro spent as an increase in trip-expenditures (H_D): $\left(WTP_{ENT,k}\right)=\left(WTP_{EXP,k}\right)$, where k corresponds to an attribute or to the forest visit.

4. Results

Our valid sample was split-up in 174 respondents facing the CH sample and 162 facing the RC sample. We identify 10 protest responses in CH (6% of the sample) and 12 protest responses in RC (10% of the sample). A chi-square test shows no significant difference between the proportion of protest responses across formats (χ^2 statistic = 2.646). For the remaining sample, we identify 2 respondents in CH (1% of the remaining sample) and 7 respondents in RC (5% of the remaining sample) that did not state the number of people for which they pay in their forest visits. Similarly than with the protest responses, a chi-square test shows no significant difference between the proportion of these non-responses across formats (χ^2 statistic = 0.099). Thus, the final valid sample for the models is 162 respondents in CH and 143 respondents in RC (324 and 286 observations, respectively, as each respondent faced two choice/ranking sets).

4.1 Choice versus ranking recoded as a choice

Table 2 shows the regression results of the CL and ML models for the CH and RC samples[3]. All mean parameters, with the exception of TREE in the RC sample, are significant. The ASC-REC shows a positive sign, implying a preference for forest visits rather than staying home. The negative sign of TREE indicates a preference for visiting Stone pine forests versus Cork oak forests. This is expected *a priori* as the former forests receive more visitors in Spain than the latter forests. The attributes INS, ANI and MUSH have positive signs, meaning that respondents are willing to pay more for a visit that includes any of the features associated to these attributes.

[3] Chi-square statistics for the IIA tests when removing the first, second and third alternative are 8.347, 23.620***, and 20.067*** respectively in the CH sample, and 12.555*, 8.400, and 9.555 respectively in the RC sample (asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively). IIA tests for the case where the status quo alternative is removed cannot be computed (Hessian matrix is not positive).

ENT and EXP both offers negative signs, indicating that the probability of choosing a recreation visit alternative decreases for higher values of the two bids offered in the alternative.

[Table 2]

Standard deviation parameters are specified for attributes TREE, INS, ANI and MUSH and are significant in all cases. The highest values of these parameters are found for ANI in CH and INS in RC. This indicates more heterogeneity for preferences toward the presence of animals and infrastructures in the forest. According to the adjusted McFadden ρ^2, models from the CH sample are better adjusted than models from the RC sample, and the ML outperforms the CL models.

In most cases, the magnitude of the estimated parameters shows no large differences between the CH and the RC results when using similar models. The Likelihood Ratio test results (Table 2) indicate that we cannot reject the hypothesis that the parameter vectors of the CH and RC models are statistically indistinguishable (hypothesis H_A) for both the CL and the ML models.

Table 3 shows the mean WTP resulting from these models and obtained by using either the ENT or the EXP payment-vehicle. The complete combinatorial test results (Table 3) indicate that we cannot reject the hypothesis of statistically indistinguishable WTP measures between the CH and the RC (hypothesis H_B) in most of the cases. Only for ASC-REC, TREE and *Stone pine visit* in the CL model when using the ENT payment-vehicle and for TREE in the CL model when using the EXP payment-vehicle we reject the null hypothesis for H_B.

[Table 3]

Overall, our results demonstrate convergent validity between the CH and the RC. In our subsequent analyses, we continue with a data enriched model that pools the CH and RC datasets as there are no significant differences between these formats.

4.2 Entrance-fee versus increase in trip-expenditures

Table 4 presents the CL and ML models for the pooled dataset. Both models show similar results than the CH and RC models in terms of significance and sign of the parameters. The enriched model obtains a significant mean parameter for TREE, which was not found previously for the RC model. For the payment-vehicles, the negative parameter is larger for ENT. This indicates that an increase in the entrance-fee derives in a lower probability of visiting the forest than the same increase in trip-expenditures. A *t-test* for differences between ENT and EXP parameters show significant differences in both the CL (*t-stat* = -119.28; *p-value* < 0.0001) and the ML model (*t-stat* = -102.94; *p-value* < 0.0001). Thus, we reject the hypothesis of similar marginal utility of money (model parameters) associated to both payment-vehicles (hypothesis H_C).

[Table 4]

The comparison of WTP values obtained with each payment-vehicle (Table 5) shows significant differences in all cases, except for the attribute TREE. In all other cases, respondents are willing to pay around 2.6-2.7 additional euros as trip-expenditures for each additional euro they are willing to pay as an entrance-fee to the forest. Thus, we reject the hypothesis of similar WTP obtained from these two payment-vehicles (hypothesis H_D).

[Table 5]

Although this result rejects convergent validity, it corroborates the findings from Campos et al. (2007). Here, we have made a similar comparison but valuing the two payment-vehicles jointly in the same choice sets and using a survey to forest visitors at their homes instead of *in situ*. Apparently, neither of these differences helps minimizing the gap obtained between payment-vehicles. As Campos et al. (2007) argue there are cultural and institutional factors associated to free-access in Spanish forests that may be the reason of these differences. These two additional payments would have the same effect on the disposable income for forest recreationists but they do not seem to have the same effect on their utility.

4.3 Aggregated values of forest public recreation

For the estimation of aggregated values, we follow two approaches: (i) the compensating variation; and (ii) the simulated exchange value (SEV) method. Both approaches require the relevant population that consumes the public recreation services (annual visits to the forest), the area that produces these services and the parameter estimates from the CE.

The annual visits to Stone pine forests are estimated from a question included in the survey. This question asked to those respondents that had made a recreation visit to a Spanish forest at least once in the past 12 months (see section 3.1) how many of these visits were made to Stone pine forests. Considering the population from each of the provinces of our stratified sample, we obtain a total of 13,359,885 visits between May 2007 and April 2008 (we assume that these visits correspond to 2008). As the Stone pine forest area in Spain relevant for our valuation exercise is

451,826 hectares (MAGRAMA, 2014c)[4], these forests received on average 27.12 visits per hectare in 2008. We work with this average estimate because we cannot distribute visits among specific forest areas and we assume the same number of visits for each hectare of forest.

For Cork oak forests, we use the annual visits to the Monfragüe National Park and to the Alcornocales Natural Park, the two major Cork oak forest areas that receive recreation visits in southwestern Spain. For the Monfragüe National Park, MAGRAMA (2014d) estimates 331,788 visits in 2008. For the Alcornocales Natural Park, Oviedo et al. (2015) calculate 1,737,695 visits in 2010. We have no further information about the evolution of these visits over time and in the case of the Alcornocales Natural Park we assume that the visits to these Cork oak forests were similar in 2008. As these two forests cover jointly an area of 186,163 hectares[5], we obtain that they received on average 11.11 visits per hectare in 2008.

To derive the relevant WTP measures for aggregated values, we work with the model that pools the CH and CR datasets as they offer similar results and allow us to obtain estimations from enriched data. Moreover, in this model we do not use as payment-vehicles ENT and EXP separately. Instead, we use the variable BID, which adds up the amount offered with both payment-vehicles and therefore weights their potential effects on the WTP estimates. Results from this model are presented in Table 6 and show that all parameters are significant and have the same signs than in previous models. Parameter values are larger for the ML, which is better adjusted than the CL according to the McFadden ρ^2. The significance of the standard deviation parameters for TREE, INS, ANI and MUSH gives evidence of preference heterogeneity for these attributes. Based on this model, we obtain the WTP per person that will be used for calculating the aggregated values of public recreation (all estimated values are in € for year 2008).

[Table 6]

The Compensating Variation (CV) offers the welfare value associated to the current provision of these public recreation services. This measure includes the maximum WTP of each individual of the relevant population; that is, it considers the whole area under the demand curve if we assume that the income effect is irrelevant. This value could be of interest for cost-benefit

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[4] This only considers hectares where the Stone pine is identified as the main species.

[5] The Monfragüe National Park and the Alcornocales Natural Park cover 18,396 and 167,767 hectares, respectively (Europarc España, 2012).

analysis and for public managers adopting a welfare maximization approach in policy-making. According to Small and Rosen (1981), the individual CV for forest alternative *j* from the CL is:

$$CV_j = \frac{1}{\beta_{BID}}\left[\ln \sum_{k=1}^{K-2} \exp^{V^*_{0k}} - \ln \sum_{k=1}^{K-2} \exp^{V^*_{jk}}\right], \quad [8]$$

being V^*_{0k} and V^*_{jk} the part of the utility corresponding to the *K-2* non-monetary attributes in alternatives *0* (the status quo) and *j* (forest visit alternative) respectively:

$$V^*_0 = \beta_{ASC-REC}X_{ASC-REC0} + \beta_{TREE}X_{TREE0} + \beta_{INS}X_{INS0} + \beta_{ANI}X_{ANI0} + \beta_{MUSH}X_{MUSH0}, \quad [9]$$

$$V^*_j = \beta_{ASC-REC}X_{ASC-RECj} + \beta_{TREE}X_{TREEj} + \beta_{INS}X_{INSj} + \beta_{ANI}X_{ANIj} + \beta_{MUSH}X_{MUSHj}. \quad [10]$$

Departing from [8], the individual CV for forest alternative *j* estimated from the ML model is:

$$E(CV_j) = \frac{1}{\beta_{BID}}E\left(\left[\ln \sum_{k=1}^{K-2} \exp^{V^*_0} - \ln \sum_{k=1}^{K-2} \exp^{V^*_j}\right]\right), \quad [11]$$

where the expectation is taken with respect to the following attribute parameters $(\beta_{TREEi}, \beta_{INSi}, \beta_{ANIi}, \beta_{MUSHi}) = (\bar{\beta}_{TREE} + \tilde{\beta}_{TREEi}, \bar{\beta}_{INS} + \tilde{\beta}_{INSi}, \bar{\beta}_{ANI} + \tilde{\beta}_{ANIi}, \bar{\beta}_{MUSH} + \tilde{\beta}_{MUSHi})$. To compute this, we use stochastic simulation as in the ML model (equation [7]). The aggregated CV is estimated as the individual CV multiplied by the relevant population (current forest visits).

The SEV method offers the economic value that, in a partial equilibrium context, could be potentially collected in a real market. The forest owner/manager would set a single price for the environmental service to maximize the benefits in a potential market, so only part of the relevant population would pay that price. The method uses a WTP function for the environmental service (demand curve), usually estimated from nonmarket valuation, and a cost function (offer curve) using the commercial cost data associated to the service. However, as all costs can be considered fixed as they are already a real market value, the maximization of benefits occurs at the same price than the maximization of earnings[6]. This implies that we do not need the cost function to find the maximization point and we can directly operate with the earning function.

[6] This assumption probably needs to be relaxed when the interest is on the potential of a market that does not exist at all, and for which costs data do not exist and need to be simulated as well.

We estimate the SEV in two scenarios: (i) one alternative of forest visit plus the status quo, and (ii) two alternatives of forest visit plus the status quo. The first case is equivalent to a CVM scenario, which has the drawback of ignoring potential substitutes for the recreational visit. The second case is more similar to the scenarios used in a CE, which has the advantage of including substitute alternatives. The presence of an additional alternative is often claimed as an advantage of CEs but previous applications of the SEV method have used only the CVM.

In both scenarios we estimate the SEV for the same forest recreation alternatives than in previous sections, where alternative j corresponds either to visiting Stone pine forests or to visiting Cork oak forests. The earning function for alternative j (E_j) in the hypothetical market is defined as the price (BID) for accessing the forest multiplied by the probability of paying that price, which is then transformed in expected visits to the forest: $E_j = P_j \cdot BID$. To find the maximum earning that the owner/manager of forest alternative j would obtain we take the following steps: (i) we transform the probability functions obtained from the CE (functions [5] or [7] depending on the model used) so that the BID is isolated on the left-hand side of the formula; (ii) we substitute the BID equivalence in E_j so that earning depends only on the P_j variable; and (iii) we calculate the first derivative of E_j respect to P_j and find the first order condition.

In the scenario of one alternative plus the status quo for the CL model, the resulting formulas for the *BID* (using function [5]) and for E_j are:

$$BID = \frac{\ln\left(P_j/1-P_j\right)-V_j^*}{\beta_{BID}}, \qquad [12]$$

$$E_j = P_j \cdot BID = P_j \frac{\ln\left(P_j/1-P_j\right)-V_j^*}{\beta_{BID}}. \qquad [13]$$

We find the maximization point when $\left(1/1-P_j\right)+\ln\left(P_j/1-P_j\right)=V_j^*$. As this equation has no analytical solution, the maximization value of P_j must be obtained by iteration. We then substitute this value in [9] to obtain the price (BID) for this maximum and with these two values we estimate from [10] the maximum earning for alternative j, which the SEV sought.

For the ML model in this scenario, the maximization point is found using stochastic simulation as in [7] when $\left(1/1-P_j\right)+\ln\left(P_j/1-P_j\right)=E\left(V_j^*\right)$, where the expectation is taken with respect to the parameters of the attributes TREE, INS, ANI and MUSH. This point is estimated

1,000 times and the mean of the P_j values for which this equation holds is used to calculate the *BID* and therefore the SEV_j.

In the scenario of two alternatives plus the status quo we assume that the same price would be set in each forest alternative. Thus, departing from the probability of choosing alternative *j* when the substitute is alternative *h* in the CL model, the resulting formulas for the *BID* (using function [5]) and for E_j are:

$$BID = \frac{-1}{\beta_{BID}} \ln\left(\left(\exp^{V_j^*}/P_j\right) - \exp^{V_j^*} + \left(P_j \exp^{V_h^*}/1-P_j\right) - \left(\exp^{V_h^*}/1-P_j\right)\right). \qquad [14]$$

$$E_j = P_j \cdot BID = P_j \frac{-1}{\beta_{BID}} \ln\left(\left(\exp^{V_j^*}/P_j\right) - \exp^{V_j^*} + \left(P_j \exp^{V_h^*}/1-P_j\right) - \left(\exp^{V_h^*}/1-P_j\right)\right). \qquad [15]$$

In this case, the maximization point is found when $-\beta_{BID} * BID = \dfrac{\exp^{V_j^*}}{\exp^{V_j^*}\left(1-P_j\right) - \exp^{V_h^*} P_j}$.

Similarly than in the previous scenario, this equation has no analytical solution for P_j and the maximization point must be obtained by iteration. The difference respect to the previous scenario is that the result depends now on the utility received by both possible forest visit alternatives as a consequence of introducing a substitute in the choice decision.

For the ML model in this scenario, the maximization point is found using stochastic simulation as in [7] when: $-\beta_{BID} * BID = E\left(\dfrac{\exp^{V_j^*}}{\exp^{V_j^*}\left(1-P_j\right) - \exp^{V_h^*} P_j}\right)$. The expectation is taken here also with respect to the parameters of the attributes TREE, INS, ANI and MUSH. This point is estimated 1,000 times and the mean of the P_j values for which this equation holds is used to calculate the *BID* and therefore the SEV_j.

Table 7 shows the CV and SEV estimations from the CL and the ML models for Stone pine and Cork oak forest. The first relevant result is that CL models show in all cases higher prices and aggregated values than ML models. Focusing on ML results, we find a higher WTP per visit for Stone pine forests for the CV and SEV-2 calculations. The percentage of visits to the forest in SEV-2 (recall that for CV estimations all visits are taken into account) is 33% in Stone pine forest and 46% in Cork oak forest. As expected the simulated scenario for Stone pine forests leads to a lower percentage of current visits to the forest, as a consequence of higher price at which benefits are maximized. As the number of visits is 6 times higher in Stone pine forests, aggregated values are higher in all cases for these forests.

For the SEV-3 scenario, the maximization price is forced to be the same for both forest, but this price translates in different percentage of visits to the forest. In this case, the percentage of visits to Stone pine forest is kept at 33%, while for the cork oak forest it drops to 27%. Thus, when both forest compete the Stone pine keeps a higher rate of visits but similar to the one in the SEV-2 scenario, while the cork oak forests see how their rate of current visits is lower than in the SEV-2 scenario. In all cases, again, aggregated values are higher for Stone pine forests.

[Table 7]

5. Conclusions

In this paper we present the results of two convergent validity tests in a choice experiment for valuing public recreation in Stone pine and Cork oak forests in Spain. We find mixed results on convergent validity. On one hand, we obtain similar results from a choice and than from a recoded ranking as a choice. Our experiment included three alternatives plus the status quo, which represent a step forward in choice complexity respect to previous comparison of these formats (Caparrós et al., 2008; Akaichi et al., 2013). This reinforces the idea of people making rational choices in these experiments, which allows for the use of ranking formats that provide more information at a relatively low cost (only by including an additional alternative in the choice set) without the risk of losing the first rank information, which is equivalent to a choice.

On the other hand, we obtain significant different results associated to two payment-vehicles included simultaneously in the choice sets. Respondents are willing to pay €2.6-2.7 additional as an increase in trip-expenditures for each additional euro paid as an entrance-fee to the forest. Thus, the consideration of both payment-vehicles in the same valuation exercise by the same respondent does not change the divergence observed in previous research that presented these payment-vehicles to different samples (Campos et al., 2007).

The empirical results of the experiment show a slight, but significant, difference in the WTP for visiting Stone pine and Cork oak forests in Spain, which is higher by around €2 in the former. The valuation of the other attributes show a significant WTP for the presence of infrastructures for recreation and for the possibility of sightseeing animals and picking-up mushrooms. Of these three attributes, the highest value is placed on the infrastructures while the other two are valued very similarly. An implication for the manager of these forests is that, given the preferences of the recreationist of these forests in Spain, a higher economic value will be placed to forest recreation areas that give priority to the presence of installations.

Concerning the aggregate economic value of public recreation in these forests, we have estimated the compensating variation associated to public recreation in these forest, but also exchanges values for these environmental services. We have compared the results from three scenarios that can be used depending on the practitioner's goal. While the compensating variation is a measure more appropriate for a welfare analysis, it does not provide values that can be realized in real markets. The simulated exchange value approach provides values that can be potentially internalized in markets and that fit better in ecosystem accounting frameworks (Bartelmus, 2013), but yet they are also sensitive to the assumptions made about the presence of substitutes alternatives. Aggregated values obtained using the simulated exchange value are between 35% and 51% of the compensating variation values, depending on the scenarios considered for forest alternatives. These results highlight that the decision of which of these estimated values to use in an economic analysis that attempts to integrate non-market public recreation should not be taken lightly due to the important differences observed.

References

Abildrup, J., García, S., Olsen, S.B. and Stenger, A., 2013. Spatial preference heterogeneity in forest recreation. *Ecological Economics* 92: 67-77.

Adamowicz, W.L., Louviere, J. and Williams, M., 1994. Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental Economics and Management* 26: 271-292.

Adamowicz, W.L., Swait, J., Boxall, P., Louviere, J. and Williams, M., 1997. Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation. *Journal of Environmental Economics and Management* 32: 65-84.

Akaichi F., Nayga, R.M. Jr. and Gil, J.M., 2013. Are Results from Non-hypothetical Choice-based Conjoint Analyses and Non-hypothetical Recoded-ranking Conjoint Analyses Similar? *American Journal of Agricultural Economics* 95(4): 949-963.

Alevy, J.E., List, J.A., Adamowicz, W.L., 2011. How Can Behavioral Economics Inform Nonmarket Valuation? An Example from the Preference Reversal Literature. Land Economics 87 (3), 365–381.

Bartczak, A., Lindhjem, H., Navrud, S., Zandersen, M. and Zylicz, T., 2008. Valuing forest recreation on the national level in a transition economy: The case of Poland. *Forest Policy and Economics* 10: 467-472.

Bartelmus, P., 2013. Environmental–economic accounting: progress and digression in the SEEA revisions. Rev. Income Wealth 60, 887–904.

Biénabe, E. and Hearne, R.R., 2006. Public preferences for biodiversity conservation and scenic beauty within a framework of environmental services payments. *Forest Policy and Economics* 9: 335-348.

Boyle, K.J., Holmes, T.P., Teisl, M.F. and Roe, B., 2001. A Comparison of Conjoint Analysis Response Formats. *American Journal of Agricultural Economics* 83(2): 441-454.

Campos, P. and Caparrós, A., 2006. Social and private total Hicksian incomes of multiple use forest in Spain. *Ecological Economics* 57: 545-557.

Campos, P., Caparrós, A. and Oviedo, J.L., 2007. Comparing Payment-Vehicle Effects in Contingent Valuation Studies for Recreational Use in two Spanish Protected Forests. *Journal of Leisure Research* 39(1): 60-85.

Caparrós, A., Campos, P. and Montero, G., 2003. An Operative Framework for Total Hicksian Income Measurement: Application to a Multiple Use Forest. *Environmental and Resource Economics* 26: 173-198.

Caparrós, A., Oviedo, J.L. and Campos, P., 2008. Would you choose your preferred option? Comparing choice and recoded ranking experiments. *American Journal of Agricultural Economics* 90(3): 843-855.

Caparrós, A., Cerdá, E., Ovando, P. and Campos, P., 2010. Carbon Sequestration with reforestations and biodiversity-scenic values. *Environmental and Resource Economics* 45: 49-72.

Christie, M., Hanley, N. and Hynes, S., 2007. Valuing enhancements to forest recreation using choice experiment and contingent behaviour methods. *Journal of Forest Economics* 13: 75-102.

Efron, B. and Tibshirani, R.J., 1993. *An Introduction to the Bootstrap*. New York: Chapman & Hall.

Europarc España, 2012. *Anuario 2011 del estado de las áreas protegidas en España*. Madrid: Fundación Fernando González Bernáldez.

Haener, M.K., Boxall, P.C. and Adamowicz, W.L., 2001. Modeling recreation site choice: Do hypothetical choices reflect actual behavior? *American Journal of Agricultural Economics* 83(3): 629-642.

Hausman, J., 1993. *Contingent Valuation: A Critical Assessment*. Amsterdam: Elsevier Science.

Hausman, J., 2012. Contingent Valuation: From Dubious to Hopeless. *Journal of Economic Perspectives* 26(4):43-56.

Hensher, D., 2006. How Do Respondents Process Stated Choice Experiments? Attribute Consideration Under Varying Information Load. *Journal of Applied Econometrics* 21 (6), 861-878.

Hoehn JP, Lupi F, Kaplowitz M., 2010. Stated Choice Experiments with Complex Ecosystem Changes: The Effect of Information Formats on Estimated Variances and Choice Parameters. *Journal of Agricultural and Resource Economics* 35(3): 568-590.

Huhtala, A. and Pouta, E., 2008. User fees, equity and the benefits of public outdoor recreation services. *Journal of Forest Economics* 14: 117-132.

Kaczan, D., Swallow, B.M. and Adamowicz, W.L., 2013. Designing a payments for ecosystem services (PES) program to reduce deforestation in Tanzania: An assessment of payment approaches. *Ecological Economics* 95: 20-30.

Krinsky, I. and Robb, A.L., 1986. On Approximating the Statistical Properties of Elasticities. *Review of Economics and Statistics* 68: 715-719.

MAGRAMA, 2014a. *Mapa forestal de España (MFE50)* [online]. Ministerio de Agricultura, Alimentación y Medio Ambiente, España. Available at: http://www.magrama.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/informacion-disponible/mfe50.aspx [accessed June 2014]

MAGRAMA, 2014b. *Provincias.shp* [online]. Ministerio de Agricultura, Alimentación y Medio Ambiente, España. Available at: http://servicios2.magrama.es/sia/visualizacion/descargas/capas.jsp [accessed June 2014]

MAGRAMA, 2014c. *Tercer Inventario Forestal Nacional IFN3* [online]. Ministerio de Agricultura, Alimentación y Medio Ambiente, España. Available at: http://www.magrama.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/informacion-disponible/ifn3.aspx [accessed June 2014]

MAGRAMA, 2014d. *Datos de visitantes a los Parques Nacionales 2006-2013*. Ministerio de Agricultura, Alimentación y Medio Ambiente, España. Available in: http://www.magrama.gob.es/es/red-parques-nacionales/la-red/gestion/visitantes.aspx [accessed June 2014]

Mitchell, R.C. and Carson, R.T., 1989. *Using Surveys to Value Public Goods. The Contingent Valuation Method*. Washington D.C.: Resources for the Future.

Mogas, J. and Riera, P., 2001. Comparación de la ordenación contingente y del experiment de elección en la valoración de las funciones no privadas de los bosques. Economía Agraria y Recursos Naturales 1(2): 125-147.

Morrison, M.D., Blamey, R.K. and Bennett, J.W., 2000. Minimising Payment Vehicle Bias in Contingent Valuation Studies. *Environmental and Resource Economics* 16: 407-422.

Nunes, P.A.L.D. and Travisi, C.M., 2008. Comparing Tax and Tax Reallocation Payments in Financing Rail Noise Abatement Programmes: Results from a Stated Choice Valuation Study in Italy. *Environmental and Resource Economics* 43: 503-517.

Ovando, P., Oviedo, J.L., Campos, P. and Montero, G., 2010. Private net benefits from afforesting marginal crop and shrubland with cork oaks in Spain. *Forest Science* 56(6): 567-577.

Oviedo, J.L., Álvarez-Farizo, B., Caparrós, A. and Campos, P. 2015. Valoración ambiental de servicios recreativos públicos de los sistemas forestales de Andalucía. In P. Campos and A. Caparrós, *Valoración de los servicios públicos y la renta total social de los sistemas forestales de Andalucía* (Campos P., Caparrós A., eds). Scientific report for the RECAMAN project, Vol. 5 (5.1): *forthcoming*.

Poe, G.L., Giraud, K.L. and Loomis, J.B., 2005. Computational methods for measuring the difference of empirical distributions. *American Journal of Agricultural Economics* 87: 353-365.

Rai, R.K. and Scarborough, H., 2012. Economic value of mitigation of plant invaders in a subsistence economy: incorporating labour as a mode of payment. *Environment and Development Economics* 18: 225-244.

Roe, B., Boyle, K.J. and Teisl, M.F., 1996. Using Conjoint Analysis to Derive Estimates of Compensating Variation. *Journal of Environmental Economics and Management* 31(2):145–159.

Rosenberger, R.S., Needham, M.D., Morzillo, A.T. and Moehrke, C., 2012. Attitudes, willingness to pay, and stated values for recreation use fees at an urban proximate forest. *Journal of Forest Economics* 18: 271-281.

Saelen, H. and Ericson, T., 2013. The recreational value of different winter conditions in Oslo forests: A choice experiment. *Journal of Environmental Management* 131: 426-434.

Scarpa, R., Hutchinson, W.G., Chilton, S.M. and Buongiorno, J., 2000. Importance of forest attributes in the willingness to pay for recreation: a contingent valuation study of Irish forests. *Forest Policy and Economics* 1: 315-329.

Small, K.A. and Rosen, H.S., 1981. Applied welfare economics with discrete choice models. Econometrica 49(1): 105-130.

Swait, J. and Louviere, J., 1993. The role of the scale parameter in the estimation and comparison of multinomial logit models. *Journal of Marketing Research* 30: 305-314.

Swallow, S.K. and McGonagle, M.P., 2006. Public Funding of Environmental Amenities: Contingent Choices Using New Taxes or Existing Revenues for Coastal Land Conservation. *Land Economics* 82(1): 56-67.

Train K., 2009. *Discrete Choice Methods with Simulation*. New York: Cambridge University Press, 2nd edition.

Whitehead, J.C., Blomquist, G.C., Hoban, T.J. and Clifford, W.B., 1995. Assessing the Validity and Reliability of Contingent Values: A Comparison of On-Site Users, Off-Site Users, and Non-users. *Journal of Environmental Economics and Management* 29: 238-251.

Whitehead, J.C., Blomquist, G.C., Ready, R.C. and Huang-J.C., 1998. Construct Validity of Dichotomous and Polychotomous Choice Contingent Valuation Question. *Environmental and Resource Economics* 11: 107-116.

Whitehead, J.C., Pattanayek, G., Van Houtven, G. and Gelso, B., 2008. Combining revealed and stated preference data to estimate the nonmarket value of ecological services: An assessment of the state of the science. *Journal of Economic Surveys* 22: 872-908.

FIGURES

Source: own elaboration based on MAGRAMA (2014a and 2014b).
ArcGIS version 10.2.1 has been used for their elaboration.

Figure 1a. Distribution of Stone pine (*Pinus pinea*) forest area in Spain

Source: own elaboration based on MAGRAMA (2014a and 2014b).
ArcGIS version 10.2.1 has been used for their elaboration.

Figure 1b. Distribution of Cork oak (*Quercus suber*) forest area in Spain

TABLES

Table 1. Attributes of the Experiment and Levels

Attributes	Levels
Type of forest (TREE)	Stone pine; Cork Oak
Infrastructures (INS)	No; Yes
Domestic animals (ANI)	No; Yes
Mushroom collecting (MUSH)	No; Yes
Entrance-fee (ENT)	€2; €7; €12; €17
Increase in trip-expenditures (EXP)	€2; €7; €12; €17

Table 2. Choice and ranking recoded as a choice models. Likelihood ratio tests for comparing parameter vectors

Attribute	Choice			Ranking recoded as a choice		
	Conditional logit	Mixed logit		Conditional logit	Mixed logit	
	Mean parameter	Mean parameter	St. dev. parameter	Mean parameter	Mean parameter	St. dev. parameter
ASC-REC	1.7839***	2.2942***		1.3580***	1.9211***	
	(0.3091)	(0.4716)		(0.2897)	(0.4911)	
TREE	-0.1652**	-0.2000*	0.7318**	-0.0285	-0.0799	1.0466***
	(0.0675)	(0.1213)	(0.3083)	(0.0721)	(0.1529)	(0.3480)
INS	0.8737***	1.4375***	1.3474**	0.8108***	1.4771***	1.9569***
	(0.1379)	(0.3446)	(0.5325)	(0.1469)	(0.3973)	(0.5983)
ANI	0.5079***	0.7939***	2.0877***	0.3674**	0.5603**	1.5334***
	(0.1368)	(0.3044)	(0.5850)	(0.1454)	(0.2794)	(0.5307)
MUSH	0.2712**	0.5492*	1.6511***	0.5380***	0.9777***	1.5225***
	(0.1320)	(0.2883)	(0.5731)	(0.1429)	(0.3132)	(0.5304)
ENT	-0.1402***	-0.2400***		-0.1560***	-0.2858***	
	(0.0222)	(0.0537)		(0.0263)	(0.0644)	
EXP	-0.0517**	-0.0859***		-0.0695***	-0.1307***	
	(0.0204)	(0.0332)		(0.0232)	(0.0436)	
N	324	324		286	286	
Log-likelihood	-351.67	-339.75		-325.31	-312.89	
Adj. McFadden ρ^2	0.1259	0.1520		0.1076	0.1376	

Likelihood ratio test	H_{A1}: $\beta_{CH}=\beta_{RC}$	Reject H_{A1}?	H_{A2}: $\mu_{CH}=\mu_{RC}$	Reject H_{A2}?	Reject H_A? $\mu\beta_{CH}=\mu\beta_{RC}$
Conditional logit					
χ^2 (CH vs. RC)	7.520	No	1.042	No	No
Mixed logit					
χ^2 (CH vs. RC)	9.492	No	2.755	No	No

Standard errors are shown in brackets; N: number of observations; Asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Table 3. **Mean willingness to pay (WTP) values and complete combinatorial test results from choice and ranking recoded as a choice Models**

Attribute	Choice (CH)		Ranking recoded as a choice (RC)		Complete combinatorial test (H_B: $WTP_{CH,k,pv} = WTP_{RC,k,pv}$)	
	Conditional logit (WTP)	Mixed logit (WTP)	Conditional logit (WTP)	Mixed logit (WTP)	Conditional logit (*p-value*)	Mixed logit (*p-value*)
Entrance-fee payment-vehicle						
ASC-REC	13.07	9.68	8.96	6.86	0.069*	0.146
	[9.17 , 17.98]	[6.68 , 13.40]	[5.84 , 12.69]	[4.30 , 9.92]		
TREE	-1.23	-0.82	-0.20	-0.29	0.075*	0.250
	[-2.20 , -0.40]	[-1.76 , -0.05]	[-1.03 , 0.57]	[-1.28 , 0.66]		
INS	6.37	6.09	5.33	5.31	0.277	0.340
	[4.52 , 8.75]	[4.05 , 8.51]	[3.56 , 7.60]	[3.35 , 7.70]		
ANI	3.67	3.47	2.37	2.07	0.182	0.149
	[2.10 , 5.49]	[1.53 , 5.66]	[0.85 , 4.10]	[0.45 , 3.85]		
MUSH	2.00	2.40	3.57	3.51	0.143	0.254
	[0.42 , 3.68]	[0.34 , 4.63]	[1.92 , 5.48]	[1.85 , 5.49]		
Stone Pine visit	14.30	10.50	9.16	7.15	0.069*	0.116
	[10.17 , 19.35]	[7.36 , 14.34]	[6.02 , 13.00]	[4.44 , 10.35]		
Cork Oak visits	11.84	8.86	8.76	6.58	0.171	0.205
	[8.13 , 16.49]	[5.70 , 12.65]	[5.68 , 12.55]	[3.85 , 9.72]		
Increase in trip-expenditures payment vehicle						
ASC-REC	39.70	28.72	22.72	16.37	0.142	0.117
	[19.99 , 86.45]	[16.24 , 53.73]	[11.87 , 40.46]	[9.20 , 27.48]		
TREE	-3.76	-2.47	-0.53	-0.68	0.086*	0.217
	[-10.10 , -0.86]	[-6.49 , 0.14]	[-2.66 , 1.32]	[-3.05 , 1.63]		
INS	20.38	18.63	13.80	13.19	0.272	0.270
	[8.72 , 45.33]	[8.23 , 37.52]	[6.51 , 26.86]	[6.08 , 24.58]		
ANI	11.65	10.36	5.95	4.95	0.176	0.149
	[4.73 , 24.03]	[3.67 , 21.41]	[1.88 , 11.68]	[1.10 , 10.46]		
MUSH	6.81	7.02	9.22	8.73	0.292	0.403
	[0.78 , 15.90]	[0.85 , 16.88]	[3.87 , 17.91]	[3.56 , 16.79]		
Stone Pine visit	43.46	31.19	23.26	17.05	0.118	0.102
	[22.03 , 95.86]	[17.35 , 58.91]	[12.09 , 41.00]	[9.35 , 29.46]		
Cork Oak visits	35.94	26.26	22.19	15.69	0.178	0.148
	[18.22 , 77.99]	[13.72 , 49.79]	[11.54 , 40.28]	[8.32 , 26.83]		

Lower and upper bounds of the confidence interval (95%) are shown in brackets. Asterisk (*) denote significance at the 10% level. Subscript $_k$ stands for attribute $_k$, and subscript $_{pv}$ stands for payment-vehicle.

Table 4. Pooled models using the choice and ranking recoded as choice data

Attributes	Conditional logit	Mixed logit	
	Mean parameter	Mean parameter	St. dev. parameter
ASC-REC	1.5505***	2.0012***	
	(0.2099)	(0.3248)	
TREE	-0.1027**	-0.1574*	0.8351***
	(0.0491)	(0.0937)	(0.2248)
INS	0.8387***	1.4051***	1.6360***
	(0.1000)	(0.2515)	(0.3806)
ANI	0.4357***	0.6450***	1.8748***
	(0.9897)	(0.1978)	(0.3805)
MUSH	0.3964***	0.7461***	1.3031***
	(0.9642)	(0.2025)	(0.3962)
ENT	-0.1436***	-0.2525***	
	(0.1680)	(0.0394)	
EXP	-0.0580***	-0.0967***	
	(0.1519)	(0.0254)	
N	610	610	
Log-likelihood	-681.26	-660.14	
Adj. McFadden ρ^2	0.1180	0.1435	

Standard errors are shown in brackets; N: number of observations; Asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively.

Table 5. Mean willingness to pay (WTP) values and complete combinatorial test results obtained with the entrance-fee and increase in trip-expenditures payment vehicles from the pooled model

Attributes	Conditional logit		Mixed logit		Complete Combinatorial test (H$_D$: $WTP_{ENT,k} = WTP_{EXP,k}$)	
	Entrance-fee (WTP)	Increase in trip-expenditures (WTP)	Entrance-fee (WTP)	Increase in trip-expenditures (WTP)	Conditional logit (*p-value*)	Mixed logit (*p-value*)
ASC-REC	10.90	28.46	8.15	21.73	0.001***	0.000***
	[8.35, 13.72]	[18.58, 44.52]	[6.18, 10.33]	[14.62, 33.04]		
TREE	-0.73	-1.97	-0.54	-1.46	0.133	0.224
	[-1.31, -0.17]	[-4.14, -0.41]	[-1.24, 0.11]	[-3.45, 0.32]		
INS	5.92	15.68	5.58	15.04	0.002***	0.001***
	[4.56, 7.49]	[9.26, 25.44]	[4.15, 7.10]	[9.33, 24.42]		
ANI	3.07	7.99	2.58	6.87	0.013**	0.038**
	[1.86, 4.34]	[4.38, 13.10]	[1.25, 3.90]	[3.03, 11.74]		
MUSH	2.75	7.22	2.89	7.67	0.021**	0.023**
	[1.64, 4.02]	[3.74, 12.36]	[1.58, 4.34]	[3.89, 12.44]		
Stone Pine visit	11.63	30.43	8.69	23.19	0.000***	0.000***
	[9.04, 14.72]	[19.87, 47.21]	[6.60, 11.06]	[15.45, 34.97]		
Cork Oak visit	10.16	26.49	7.60	20.27	0.001***	0.001***
	[7.58, 13.07]	[16.88, 41.24]	[5.56, 9.85]	[13.52, 31.23]		

Lower and upper bounds of the confidence interval (95%) are shown in brackets. Asterisks (e.g.,***,**) denote significance at the 1% and 5% level, respectively. Subscript $_k$ stands for attribute $_k$.

Table 6. Pooled models using the choice and ranking recoded as choice data and including the variable BID as payment attribute

Attribute	Conditional logit	Mixed logit	
	Mean parameter	Mean parameter	St. dev. parameter
ASC-REC	1.5446***	1.9192***	
	(0.2087)	(0.2999)	
TREE	-0.0993**	-0.1461*	0.7528***
	(0.0488)	(0.0869)	(0.1993)
INS	0.7918***	1.2452***	1.5240***
	(0.0985)	(0.2153)	(0.3505)
ANI	0.4326***	0.6189***	1.6524***
	(0.0981)	(0.1839)	(0.3462)
MUSH	0.3982***	0.6896***	1.2751***
	(0.0958)	(0.1865)	(0.3594)
BID	-0.0978***	-0.1586***	
	(0.0112)	(0.0228)	
N	610	610	
Log-likelihood	-688.69	-668.41	
Adj. McFadden ρ^2	0.1089	0.13321	

Standard errors are shown in brackets; N: number of observations; Asterisks (e.g.,***,**,*) denote significance at the 1%, 5% and 10% level, respectively. The attribute BID adds up the two amounts offered in the entrance-fee and increase in trip-expenditures payment attributes.

Table 7. Aggregated values of Compensating Variation (CV) and Simulated Exchange Value (SEV) for public recreation Stone pine and Cork oak forests in Spain (year 2008)

Measure	Stone pine				Cork oak			
	€ per visit	Visits	Aggregated		€ per visit	Visits	Aggregated	
			€	€/ha			€	€/ha
Conditional logit								
CV	16.81	13,359,885	224,564,914	455.79	14.78	2,069,483	30,583,277	164.28
SEV-2[a]	18.50	6,128,800	113,382,807	230.13	18.00	873,059	15,715,055	84.42
SEV-3[b]	21.50	3,927,026	84,431,062	171.37	21.50	498,738	10,722,857	57.60
Mixed logit								
CV	13.02	13,359,885	173,939,696	353.04	11.18	2,069,483	23,141,404	124.31
SEV-2[a]	16.00	4,408,762	70,540,193	143.17	12.00	951,962	11,423,546	61.36
SEV-3[b]	16.00	4,408,762	70,540,193	143.17	16.00	558,760	8,940,167	48.02

Total hectares of Stone pine and Cork oak forests are 492,689 and 186,163, respectively. SEV-2 stands for simulated exchange value in the scenario of a one-day forest visit alternative and the status quo (staying at home). SEV-3 stands for simulated exchange value in the scenario of two one-day visit alternatives (either to a Stone pine or to a Cork oak forest) and the status quo.

Appendix 1: Choice sets for the valuation of Stone pine and Cork oak forest public recreation

Think now in the recreational visits that you make to Spanish forests and consider your gas expenditures and the possibility of an entrance-fee establishment for the forest access by the landowner (either if this is a public institution or a private party, since both have the right to exclude access).

We ask you to imagine that in your next recreation visit to a forest you only have the chance to decide among the alternatives shown in the following cards (OPTIONS A, B, C), in addition to having the option to stay home. Bear in mind that if you choose to pay, you could not spend that money on other things.

Choice format

Please, mark in each card the alternative that you WOULD CHOOSE (ONLY ONE).

Characteristics	CHOICE 1R (Code 1)			
	Option A	Option B	Option C	Option D
Type of forest	Stone Pine	Cork Oak	Stone Pine	I prefer to stay at home
Infrastructures	No	Yes	No	
Domestic animals	Yes	Yes	No	
Mushroom collecting	Yes	Yes	No	
Increase in trip-expenditures	€7	€17	€12	
Entrance-fee	€12	€2	€17	
Mark only one option (A,B,C, or D)	Option A □	Option B □	Option C □	Option D □

Ranking format

Please, RANK the alternatives presented in each card from MOST PREFERRED (1) to LEAST PREFERRED (4).

Characteristics	RANKING 1R (Code 1)			
	Option A	Option B	Option C	Option D
Type of forest	Stone Pine	Cork Oak	Stone Pine	I prefer to stay at home
Infrastructures	No	Yes	No	
Domestic animals	Yes	Yes	No	
Mushroom collecting	Yes	Yes	No	
Increase in trip-expenditures	€7	€17	€12	
Entrance-fee	€12	€2	€17	
Rank the four option (A,B,C, or D)	Option A 1ª□ 2ª□ 3ª□ 4ª□	Option B 1ª□ 2ª□ 3ª□ 4ª□	Option C 1ª□ 2ª□ 3ª□ 4ª□	Option D 1ª□ 2ª□ 3ª□ 4ª□