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MASTER IN ECONOMICS: EMPIRICAL APPLICATIONS AND POLICIES

A CHOICE EXPERIMENT IN GARATE-SANTA BARBARA (GUIPUZCOA)

Welfare benefits of conservation plans for a Natura 2000 Network site

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ABSTRACT

In economics, we usually work with goods and services regulated by a market, but natural resources have no mechanisms to determine price. However, this does not imply an absence of value. There exist several methods for the valuation of environmental goods and services whose objective is to measure the utility and welfare provided by these goods. In this study, we analyze different land uses in a determined area using a discrete choice experiment methodology. The introduction of sociodemographics allows us to consider heterogeneity. Finally, welfare measures for different conservation levels of natural resources are calculated.

Keywords: discrete choice experiment, environmental valuation, willingness to pay, Natura 2000

JEL Classification: Q51, Z10

1. INTRODUCTION

The environment is an infinite set of relationships between species that works on its own and assures the existence of life on Earth. A black box with complex mechanisms inside that provides a budget of goods and services that are indispensable for our lives. From an economic point of view, the problem facing non-market valuation is the absence of a market that regulates supply and demand. However, not having a price does not imply the absence of value, which is why we should be conscious of the importance of environmental goods and be ready to face environmental degradation processes. Market failure that makes essential goods lack a market, or have a price that will never represent their real value (e.g. the case of water), is well known in environmental economics.

As Hoyos et al. (2009) pointed out, the estimation of an economic value for environmental goods and services is justified, among other things, by the fact that they can be taken into account in decision-making tools such as cost–benefit analyses. In environmental economics, the standard approach to evaluate policies associated with national protected areas and the ecosystem services supplied by them is mainly based on traditional cost–benefit analysis.

Different economic valuation techniques have appeared within the theoretical framework of environmental economics to estimate, in monetary terms, the value of non-market goods. Existing approaches are broadly grouped into revealed preference (RP) methods (e.g. hedonic pricing or the travel cost method) and stated preference (SP) methods (e.g. contingent valuation and choice experiments (CEs)) (Hoyos et al. 2008). However, RP data are sometimes scarce, and since the early 1990s SP methods have received growing attention and acceptance, mainly because of their flexibility and ability to measure not just use values (as do RP methods) but also the non-use values of natural resources as well (Mitchell and Carson 1989).[1] Furthermore, SP methods are the only methodologies able to estimate hypothetical changes in nature, as will be the case in this study.

Within SP methods, the main difference between the contingent valuation method (CVM) and discrete choice experiment (DCE) methodology is that whereas in the former individuals

[1] The concept use value refers to the value people derive from the direct use of a good. However, non-use value refers to the value that people derive from economic goods independent of any use, present or future, that people might make of those goods.

face the valuation of one good with varying prices, in the latter one individuals face the valuation of several goods (or one good with multiple attributes) with different prices. The underlying idea of DCEs is that if human-induced changes in the state of an ecosystem can be coherently represented by a bunch of attributes, people's choices provide substantial information about their preferences regarding alternative states of the environment. The flexibility of the CVM has expanded to DCEs, thereby allowing the investigation of many different situations and policies.

Thus, the use of the DCE methodology in this context is justified for two reasons: first, as a SP non-market valuation technique, it allows for the estimation of hypothetical environmental quality changes; and second, it is able to separately estimate the preferences of individuals for different environmental attributes and provide them with marginal values. The greater flexibility of DCEs allows for the assessment of a wide variety of potential damages to a diverse set of environmental attributes. Recent applications of CEs to natural resource management can be found in Campbell et al. (2008), Czajkowski and Hanley (2009), Hoyos (2009) and Hoyos et al. (2009).

The DCE methodology presents several advantages: DCEs facilitate the valuation of multiple options rather than evaluating a single intervention, represent an integration of several theoretical areas and are consistent with Lancaster's (1966) characteristics of the theory of demand: consumers have preferences for and derive utility from underlying attributes. DCEs are, therefore, consistent with welfare economics and consumer theory.

The purpose of this study is to analyze the welfare effects of the implementation of different conservation plans in the Natura 2000 site of Garate-Santa Barbara (Basque Country, Spain). The existing interactions among the interests of multiple actors and stakeholders are a source of land use conflict. This is why we have to proceed to estimate individuals' utility functions to try to obtain more information and be able to generate a tool for policymakers to find the land uses maximizing the welfare of the population of the Basque Country. In this work, a mix of ecological/biogeographical variables, sociodemographic aspects and monetary valuation dimensions aiming at helping in the design and implementation of conservation plans and policies in the Natura 2000 site of Garate-Santa Barbara has been included.

This rest of the work is structured as follows. In the next section, the DCE methodology and its main features are explained. Then, the case study is described. Section 4 presents and discusses the main results obtained. Finally, the last section presents some conclusions that can be derived from the work.

2. A CE METHODOLOGY TO VALUE ENVIRONMENTAL DAMAGE

The DCE methodology is an SP method of valuation that converts subjective choice responses into estimated parameters. CEs were first used in marketing research during the 1970s to analyze consumer choices. Later, this technique was used in transport economics and health economics, and more recently it has gained popularity in the fields of environmental and ecological economics as well as cultural economics. To delve into the evolution of the methodology, the following articles can be examined: Louviere et al. (2000), Alpizar et al. (2001), Train (2003), Snowball (2008) and Hoyos (2010).

2.1 Economic theory

In microeconomics, models of consumer behavior are based on utility maximization under a budget constraint. The theoretical bases of the DCE methodology can be found in Lancaster's (1966) characteristics of the theory of demand, welfare theory and consumer theory, in which individuals derive utility from the characteristics of a good rather than forming the whole good. In addition, DCEs combine the Lancasterian theory of value with the consumer demand models developed by Hanemann (1984a). The method involves the generation and analysis of choice data through the construction of a hypothetical market using a survey. Subjective choice responses are then converted into estimated parameters. Surveys comprise several choice sets, each containing hypothetical options between which respondents choose. Each option is described by a set of attributes, and each attribute takes one of several levels. The selection of the preferred choice is decided implicitly by the trade-off a consumer makes from the different alternatives that are offered in the choice sets.

Each individual is assumed to solve the following maximization problem:

$$Max_{c,\delta,x} U[\delta_1 c_1(A_1), \delta_2 c_2(A2), ..., \delta_N c_N(A_N); Z] \quad (2.1)$$

s.t. (i) $y = \sum_{i=1}^{N} p_i \delta_i c_i(A_i) + z$

(ii) $\delta_i \delta_j = 0, \forall i \neq j$

(iii) $z \geq 0, \delta \geq 0$ for at least one i,

where, *U[...]* denotes a quasiconcave utility function; δ_i is a dichotomous variable equal to one if the alternative *i* is chosen and zero otherwise; $c_i(A_i)$ is the alternative combination *i* as a function of its attributes, the vector A_i; p_i is the cost/price attribute of each alternative; *y* is the level of income; and *z* is a composite bundle of goods with its price normalized to one.

This maximization problem has the following properties (Alpizar et al. 2001):

1. All the relevant alternatives are defined and described by all the relevant attributes. Therefore, the selection of attributes and attribute levels has a direct impact on the utility function defined.
2. The price variable in the budget constraint must be related to the full set of attributes confirming each alternative, thereby reflecting a continuous dimension.
3. Restriction (ii) implies that only one alternative can be chosen in a given choice set.
4. For a given income level, the selection of one alternative (provided in an exogenously fixed quantity) implies that the amount of ordinary goods that can be purchased is also fixed.
5. Restriction (iii) implies that the individual will choose a non-negative quantity of the composite good and that an opt-out or status quo option is given.

Two further assumptions need to be made to solve the maximization problem: first, a purely discrete choice is assumed; and second, weak complementarity is assumed (i.e. the attribute levels of the non-selected alternatives have no influence on the utility function of the chosen alternative). According to Hanemann (1984a):

$$\text{If } \delta_i = 0, \text{ then } \frac{\partial U}{\partial A_i} = 0 \;\; \forall i \neq j. \tag{2.2}$$

Following Equations (3.1) and (3.2), and given $\delta_i = 1$, the conditional utility function can be written as:

$$U_j = V_j(c_j(A_j), p_j, y, z) = V_j(A_j, y - p_j c_j). \tag{2.3}$$

Going back to the unconditional indirect utility function (IUF) given by the following expression:

$$V[A, p, y] = \max[V_1(A_1, y - p_1c_1),...,V_1(A_N, y - p_Nc_N)]. \quad (2.4)$$

It follows that, for a purely discrete choice, the individual chooses alternative j if and only if:

$$V_j(A_j, y - p_jc_j) > V_i(A_i, y - p_ic_i), \forall i \neq j. \quad (2.5)$$

2.2 Econometrics of DCEs

The analysis of the choices made in a DCE is based on random utility theory. The random utility approach developed by McFadden (1974) is used to link the deterministic model with the statistical model of human behavior. The randomness of utility function suggests that only an analysis of the probability of choosing one alternative over another is possible. Estimable choice models require, thus, a distributional assumption for the random component. As a consequence, a random disturbance with a specific probability distribution, ε, is introduced into the economic model. In this context, an individual will choose alternative j if and only if:

$$V_j(A_j, y - p_jc_j, \varepsilon_j) > V_i(A_i, y - p_ic_i, \varepsilon_i), \forall i \neq j. \quad (2.6)$$

Or in terms of probability:

$$P(\delta_i = 1) = P\{V_j(A_j, y - p_jc_j, \varepsilon) > V_i(A_i, y - p_ic_i, \varepsilon)\} \forall i \neq j. \quad (2.7)$$

The final specification of the econometric model will ultimately depend on:

(i) the specification of the utility function (i.e. how the random term enters the conditional IUF); and

(ii) the distributional assumption for the error component.

The most common formulation for the utility function is additively separable, so that the error component enters the utility function as an additive term. The specification of the utility function requires two additional decisions: the functional form V_j and the relevant attributes

A_j that will determine the utility level for each alternative. The deterministic component of utility is usually assumed to be a linear and additive function of the attributes of the good and the characteristics of the respondent (x_j):

$$V_j = \beta' x_j , \qquad (2.8)$$

where β is a vector to be estimated. Utility is a latent variable, whereas choices are the only observable indicator of utility.

The second decision regarding the final specification of the econometric model relates to the specification of the probability distribution of the error term. Assuming that the DCE has M choice sets (S_m), each formed by K_m alternatives with A_i attributes such that $S_m=\{A_{im},\ldots,A_{km}\}$, the probability of choosing alternative j from a choice set S_m can be written as:

$$P(\delta_j = 1 \mid S_m) = P\{V_j(A_{jm}, y - p_j c_j) + \varepsilon_j > V_i(A_i, y - p_i c_i) + \varepsilon_i ; \forall i \in S_m ; \forall i \neq j\}. \qquad (2.9)$$

One crucial assumption relates to the way that income enters the utility function. A constant marginal utility of income is usually assumed because it facilitates the estimation of welfare measures, although it might not be always reasonable. Regarding the influence of selected attributes and interactions it is important to note that the data collected in a DCE are based on a specific experimental design that will condition the estimation of interaction effects between the relevant attributes.

A second important point relative to the specification of the model is the assumption that error terms of the utility functions are independently and identically distributed following a type I extreme value (Gumbel) distribution, and that the choice can be estimated using a multinomial logit (MNL) specification (McFadden 1974; Louviere et al. 2000). This means that the unobserved part of utility for one alternative is unrelated to the unobserved part of utility for the other alternatives.

According to Carlsson and Martinsson (2008)[2], a linear random utility function is assumed, where the indirect utility for the household n for alternative j consisting of a deterministic component v_{ij} and a random part ε_{ij} is:

[2] The notation has been modified from the original to maintain the notation followed during the study given the other bibliography consulted.

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta' a_j + \gamma(I_i - c_{ij}) + \varepsilon_{ij}, \tag{2.10}$$

where a_j is a vector of attributes in alternative j, β is the corresponding parameter vector, I_n is income, c_{nj} is the cost associated with the alternative j, γ is the marginal utility of income and ε_{nj} is an error term.

The MNL statistical model represents the probability of choosing an alternative j given that the utility of that alternative is greater than the utility of all other alternatives. The probability of individual i choosing an alternative j is:

$$P_{ij} = \frac{e^{v_{ij}/\sigma}}{\sum_{h \in c} e^{v_{ij}/\sigma}} \quad . \tag{2.11}$$

According to Train (2003), the advantages and disadvantages of MNL can be determined as follows:

1) MNL can represent systematic taste variations (those related to observed characteristics of the respondents) but not random taste variations.
2) MNL exhibits restrictive substitution patterns because it implies proportional substitution across alternatives given the specification of the utility function.
3) MNL can handle situations where unobserved factors are correlated over time for each respondent.

Observed heterogeneity can be incorporated into the systematic part of the model by including interactions between attributes or constant terms and the socioeconomic characteristics of the respondents because this will show the case of study. However, the MNL cannot incorporate unobserved heterogeneity.

The substitution patterns of MNL models satisfy the property of the independence of irrelevant alternatives (IIA), that is “the ratio of the probabilities of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the presence or absence of any additional alternatives in the choice set” (Louviere et al. 2000):

$$\frac{P_{ij}}{P_{ik}} = \frac{e^{v_{ij}}}{e^{v_{ik}}} \quad . \tag{2.12}$$

IIA depends on the choice and the variables included in the specification of the utility function that are assumed to be IID. In case of a violation of IIA, the parameters' estimation would be biased.

The classical econometric specification for estimating CEs, the MNL model, is generally overcome by random parameter logit (RPL) specification (Train 2003). In the RPL model, a random term whose distribution over individuals and alternatives depends on underlying parameters is added to a classical utility function associated with each alternative. The RPL model accounts for unobserved heterogeneity by allowing the parameters of the utility function to be random. It considers that each respondent makes choices in more than one choice situation. This methodological framework has recently been used in environmental and ecological economics applications (e.g. Hoyos et al. 2009; Abdullah and Mariel 2010).

This specification of the RPL model differs from the traditional logit model on which β is fixed. In fact, if parameter β_t were observable, the choice probability of alternative i conditional on parameter β_t would be given by this expression:

$$P_t(i/\beta_t) = \frac{e^{X_t\beta_t}}{\sum_{j=1}^{J} e^{X_t\beta_t}}, \tag{2.13}$$

which is the standard logit model. However, since it is not possible to be observed, the non-conditional probability is the integral of $P_t(i/\beta_t)$ over all the possible values of β_t:

$$P_t(i) = \int_{\beta_t} P_t(i/\beta) f(\beta) d(\beta) \,. \tag{2.14}$$

Finally, as regards to the second aspect, the flexibility of the RPL model allows one to represent different correlation patterns among non-independent alternatives. This flexibility allows us to avoid the assumption of IIA. In fact, it does not exhibit the restrictive substitution patterns of the logit model because the ratio of probabilities P_{ti}/P_{tj} depends on all the data, including the attributes of alternatives other than i and j.

2.3 Aspects to consider in a DCE

The main points to take into account after implementing or applying a DCE are presented in Table 1.

Table 1: Checklist of factors to consider in undertaking and assessing the quality of a DCE

1.	Conceptualizing the choice process	Was a choice rather than ranking, rating task used? What type of choice was used: binary response, pairs, multiple options? Was a generic or labeled choice used? Was an opt-out, status quo option or neither included? If a forced choice was used, was a justification provided? Was the task incentive compatible?
2.	Attribute selection	How were they derived and validated? Was the number of attributes appropriate? Was the coverage appropriate? What form was used: generic or an alternative? Was price included? If so, was an appropriate payment vehicle used? Was risk included? If so, was it appropriately communicated?
3.	Level selection	How were they derived and validated? Was the number of levels per attribute appropriate? Was an appropriate range used? Were the levels evenly spaced?
4.	Experimental design	What type of design was used? Full factorial? Fractional factorial? If fractional, which effects were identified: main effects + higher order interactions? How were the profiles generated and allocated to choice sets? What are the properties of the design? What is the efficiency of the design? Was identification checked (e.g. is the variance–covariance matrix block diagonal)? Was the design blocked into versions? If so, how were choice sets allocated to versions? Were the resulting properties of the version checked? Were respondents randomly allocated to versions? How many choice sets were considered per respondent? If some profiles were implausible how was implausibility defined and how was it addressed?
5.	Questionnaire design	Was an appropriate level of background and contextual information provided? Were the task instructions appropriate? Was the medium used to communicate attribute/level information (e.g. words, pictures, multimedia) appropriate?
6.	Piloting	Was coverage of attributes and levels checked? Was understanding and complexity checked? Was the length and timing checked?
7.	Population/study perspective	Was this appropriate for the research question?
8.	Sample and sample size	Were inclusion/exclusion criteria explicit? Was sample size appropriate for model estimation?
9.	Data collection	What recruitment method was used? How were the data collected (e.g. mail, personal interview, web survey)? What was the response rate? Were incentives used to enhance response rates?
10.	Coding of data	Was coding explicitly discussed? Was the coding appropriate for effects to be estimated?
11.	Econometric analysis	Were the estimation methods appropriate given the experimental design and type of choice response? Was the functional form of the IUFs appropriate given the experimental design? Were the alternative specific constants included? Were sociodemographics and other covariates included? Was goodness of fit considered?
12.	Validity	Was internal or external validity investigated? Were answers for any respondents deleted and if so on what basis?
13.	Interpretation	Was the interpretation appropriate given coding of data? Were results in line with *a priori* expectations? Were relative attribute effects compared using a common and comparable metric?
14.	Welfare and policy analysis	Was willingness to pay (WTP) estimated using welfare theoretic compensating variation? Was probably analysis undertaken? Were marginal rates of substitution calculated?

Source: Lancsar and Louviere (2008)

1.1. Conceptualizing the choice process

DCE choice questions must be incentive compatible to encourage respondents to reveal their true preferences. The methodology involves asking respondents to make discrete choices. It should be considered to allow respondents to opt out, choose neither option or choose status quo options, especially if the purpose of the study is to derive welfare measures. A status quo might be a reference point for gains and losses consistent with prospect theory (Kahneman and Tversky 1979). This position is a "do nothing" scenario (Hanley et al. 2001), also known as the "business-as-usual" position, because it does not vary across the choice sets (Mogas et al. 2006).

1.2. Attribute selection and level selection

Environmental attributes and the level of provision become critical aspects of any CE given that the only information about preferences provided by respondents takes the form of choices between these options (Hensher 2007). According to Lancaster (1991), an environmental attribute can be considered relevant if ignoring it would change our conclusions about consumer's preferences. The construction of the choice sets included in an experiment requires a correct definition of the change to be valued and the attributes levels that would be used. Attributes can be quantitative or qualitative and are generally identified from the literature, qualitative research such as semi-structured interviews and/or focus groups with samples of relevant respondents and experts. Price is typically one of the attributes in the choices. A sufficiently wide range of levels should be used to avoid respondents ignoring attributes because of small differences between the levels.

1.3. Experimental design

An experimental design is a sample from all possible combinations of attribute levels used to construct choice alternatives and assign them to choice sets. There is a growing concern about the importance of experimental design as an important factor in discrete choice analysis. The experimental design influences the types of IUFs that can be estimated from choices, so IUFs' functional forms should be considered *a priori*. If IUFs are not strictly additive the main effects are likely to be biased (Lancsar and Louviere 2008).

1.4. Questionnaire design

A proper survey design is required. The analyst should pursue an incentive compatible choice question to avoid respondents not giving their true preferences, and the choice format should mimic the actual choice context as much as possible.

1.5. Piloting

It is important to guarantee the coverage of attributes and levels. To assure understanding and guide development as well as the testing of DCE surveys, iterative face-to-face pilot testing is needed.

1.6. Population/study perspective

At this stage, it is important to check if the groups selected could be significant for the study.

1.7. Sample and sample size

Sampling requires the consideration of the population to whom the results will be generalized, opportunity costs regarding how programs are funded and the relevant perspective. Sample size should be chosen to allow the estimation of reliable models, subject to research budget and other constraints. The calculation of optimal sample sizes for estimating non-linear discrete choice models from DCE data is complicated as because it depends on the true values of the unknown parameters estimated in choice models.

1.8. Data collection

The recruitment method will be very important and the mode of data collection depends on study objectives, being convenient to prepare incentives to increase response rates.

1.9. Coding of data

The effects of coding or dummy variable coding are typically used, particularly for qualitative attributes. It should be checked if coding is appropriate for the effects that will be estimated.

1.10. Econometric analysis

Lancsar and Louviere (2008) recommended estimating the most disaggregated possible model by including parameters estimated for every attribute level but one and mapping obtained parameters against the attribute level to visualize their functional forms. Although the inclusion of the status quo option might reduce efficiency, it is justified on the grounds of better congruency with consumer theory and real choices.

1.11. Validity

In some cases, it is recommended to delete the answers of some respondents that could affect the results negatively, for example, in the presence of protest respondents. It is convenient to check both external and internal validity. The first concept refers to the results obtained from similar studies and the second to the aspects of the model.

1.12. Interpretation

Results should always be interpreted by taking reality and available information into account.

1.13. Welfare and policy analysis

DCEs provide rich data sources for economic valuation and decision making and make it able to estimate not only the WTP for a discrete change in environmental quality but also estimate the WTP for the different attributes that form the goods.

DCEs are increasingly used to elicit WTP for individual characteristics of goods/services and monetary measures of benefits (Lancsar and Louviere 2008). Owing to the linearity of income in the utility function, the marginal WTP for an attribute is the ratio between the attribute's coefficient and the cost or payment coefficient. DCEs allow the estimation of trade-offs that respondents make between attributes or their MRS[3]. Following standard consumer theory, MRS is calculated by partially differentiating the IUF with respect to the first and second attributes, and calculating their ratio:

$$MRS_{x_1,x_2} = \frac{\partial V / \partial X_1}{\partial V / \partial X_2}, \tag{2.15}$$

[3] MRS: the marginal rate of substitution measures the rate at which an individual must give up one asset to obtain a single additional unit of a second asset, while keeping overall utility constant.

where V is the IUF and X_1 and X_2 are attributes of the good and service, respectively. The numerator (denominator) is interpreted as the marginal utility of attribute 1(2). If the IUF is linearly additive, the expression above equals the ratio of the estimated attribute parameters.

Compensating surplus (CS) welfare estimates for DCEs can be obtained from Hanemann (1984b) and Train (1998):

$$CS = -\frac{1}{\alpha}\left[\ln\left(\sum \exp\left(\beta X_{ij}^{0}\right)\right) - \ln\left(\sum \exp\left(\beta X_{ij}^{1}\right)\right)\right], \tag{2.16}$$

where α is the marginal utility of income (usually represented by the coefficient of the payment attribute) and $X_{i,j}^{0}$ and $X_{i,j}^{1}$ represent the vector of environmental attributes as change by the initial level (status quo) and after the change levels, respectively. Therefore, Hicksian compensating variation measures a change in expected utility because of a change in the level of provision in the attribute or attributes by weighting this change by the marginal utility income. Simplifying, we obtain the marginal value of a change in one attribute, which with respect to another is measured through the ratios of the two coefficients:

$$WTP = -\frac{\beta_{attribute}}{\beta_{payment}} \quad . \tag{2.17}$$

Therefore, the WTP for a marginal change in the level of the provision of each environmental attribute is obtained by dividing the coefficient of the attribute by the coefficient of the payment attribute. In this case, it will be the cost. Once the IUF is estimated, it can be used in policy analysis in various ways, such as comparing the relative importance of product/program attributes.

3. CASE STUDY: GARATE-SANTA BARBARA (GUIPUZCOA)

In May 1992, European Union governments adopted legislation designed to protect the most seriously threatened habitats and species across Europe. This legislation is called the Habitats Directive and complements the Birds Directive adopted in 1979. At the heart of both these directives is the creation of a network of sites called Natura 2000. Special protection areas are classified under the Birds Directive to help protect and manage areas that are important for rare and vulnerable birds because they use them for breeding, feeding, wintering or migration. Special areas of conservation are classified under the Habitats Directive and provide rare and vulnerable animals, plants and habitats with increased protection and management.

Across the EU a diverse range of habitats are protected from flower-rich meadows to vast expanses of estuaries and even cave systems, and a huge variety of animals throughout the EU benefit from this. Member states are responsible for ensuring that all Natura 2000 sites are appropriately managed by the conservation authorities in each country. These organizations often work in partnership with other authorities, voluntary bodies, local or national charities and private landowners. Member states are expected to pay for the management of the sites in their country, but to help countries pay for urgent or innovative conservation work the EU has set aside money under a fund called LIFE-Nature, which is managed by the Environment Directorate of the European Commission. There are also a number of other community funds that can be used for Natura 2000 sites, such as structural funds and agri-environment measures.

Sometimes certain activities have to be restricted or stopped when they are a significant threat to the species or habitat types for which the site was designated as a Natura 2000 site. These are always addressed on a case-by-case basis. Keeping species and habitats in a good condition is not necessarily incompatible with human activities; in fact, many areas are dependent on certain human activities for their management and survival, such as agriculture. This is an important point to take into account and an incentive to make an effort in the studies to assure decision/policymakers have enough information to design and implement policies.

In the Basque Country, there are 52 sites of community interest and six special protection zones for birds. The case study region, Garate-Santa Barbara, is located in the province of Guipuzcoa, between the villages of Zarautz and Getaria. It has 142 hectares of which 81 belong to Getaria and 61 to Zarautz. All of them are under a private property regime. This area is part of the Basque Country's list of highly valuable environmental areas, especially given the existence of endemic biodiversity in the area, which also includes the existence of a particularly scarce forest of cork oak trees, which are abundant in the Mediterranean bio-geographical region.

The region was included in the European list of sites of community interest in 2004 because of the existence of five different types of environmentally valuable habitats: cork oak forest, holm oak forest, European dry heaths, endemic or Mediterranean heaths with gorse and lowland hay meadows (Garmendia et al. 2009).

4. RESULTS AND DISCUSSION

The study started with existing data from a previous study conducted in 2008. The survey was administered through in-person computer-aided individual home interviews. The relevant population considered was that of the Basque Autonomous Community, accounting for 1.8 million people aged 18 and over. In each location, the questionnaire was distributed using a random survey.

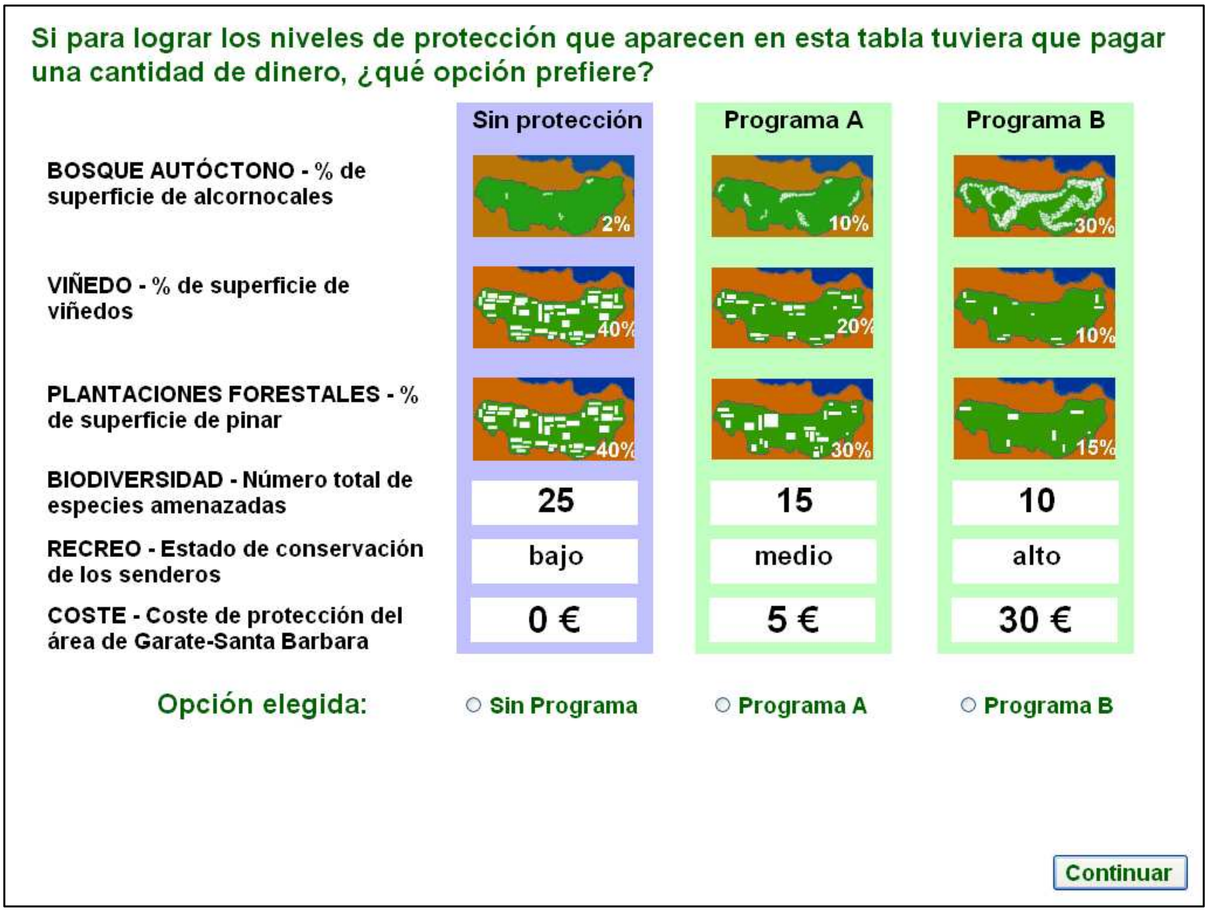
Alternatives were constructed in an interactive manner between the group of researchers and the numerous social actors in the evaluation process. These alternatives were identified based on plausible future scenarios considering the actual legal framework and the environmental potential assessed by means of the bio-geographic assessment. The land use scenarios were used to generate alternative management options considering the presence or absence of payment schemes to compensate landowners for changes in their land use for promoting conservation measures that would enhance the biodiversity of the area.

The database consisted of the results obtained from 402 completed questionnaires. Each individual responded with six choice cards, so there were initially 2412 observations. Following standard practice in SP surveys, those answers in which the individuals protested against answering or showed that they did not really understand the objectives were deleted. Furthermore, irrational answers were also rejected from the database. The final database accounted for 1326 observations.

The main objective of the study was to assess the different values associated with the potential land uses that could occur in the area because of different management plans. Six attributes were identified as being associated with different land uses: percentage of land area covered by cork oak tree forest (variable AUT, ranging from 2 to 30%), percentage of land area covered by forest plantations, based on productive pines (variable FOR, ranging from 15 to 40%), percentage of land area covered by vineyards (variable VIN, ranging from 10 to 40%), biodiversity, based on the number of endangered species of flora and fauna in the area (variable BIO, ranging from 5 to 25), the level of conservation of recreational and cultural facilities (variable REC, ranging from low to very high) and the cost of conservation programs (variable COST, ranging from 0 to 100 Euros).

These attributes were selected based on (i) a previous institutional analysis, (ii) bio-geographic analysis (iii) focus groups and (iv) expert advice. The final version of the questionnaire had six choice sets; each formed by the status quo plus two alternative protection programs (program A and program B). Figure 1 presents an example of a choice set used in the valuation exercise.

Figure 1: Example of a choice set used in the valuation exercise.



In the first step, a MNL specification was implemented to test the significance of attributes and the different socioeconomic variables included. Then, a random parameter model, with random parameters assumed to follow a normal distribution, was applied to obtain a better fit of the model and capture the heterogeneity to explain the absence of significance for the recreational and cultural facilities (REC) and forest plantations (FOR) attributes.

As mentioned, the target population of this study was the Basque population of the Basque Autonomous Community. Table 2 presents descriptive statistics of the most important sociodemographic variables included in the survey. These statistics were close to the aforementioned population statistics, showing that the analyzed sample was representative.

Table 2: Descriptive statistics

Variable	Mean	Std. Dev.	Minimum	Maximum	Cases	Missing
GENDER	0.47	0.499	0.00	1.00	1326	0
PERSONAL INCOME	965.00	1018.45	0.00	8000.00	1326	0
HIGH INCOME (HI)	0.04	0.19	0.00	1.00	1326	0
AGE	45.04	18.73	18.00	89.00	1326	0
BORN IN CAPV	0.72	0.45	0.00	1.00	1326	0
YEARS IN CAPV	27.81	20.83	0.00	60.00	162	1164
ADULTS	2.56	0.92	1.00	5.00	1326	0
CHILDREN	0.31	0.66	0.00	4.00	1326	0
STUDIES	2.73	1.16	1.00	5.00	1326	0
NGO	0.03	0.16	0.00	1.00	1326	0
FAMILY INCOME2	2051.55	1193.93	0.00	8000.00	582	744
LABOR	3.76	2.17	1.00	8.00	1326	0

Data from the experiment were examined and an MNL model specification was implemented assuming the utility function was linear in the parameters and additively separable. After the estimation of many models with different combinations of sociodemographic variables (Table 2) and attributes, the deterministic part of the model defined in (2.8) with the best fit obtained, in which the explicative variables included were the attributes identified, the variable gender multiplied by cost and the variable high income multiplied by cost was the following:

$$V_{ij} = \beta_0 + \beta_1 COST_{ij} + \beta_2 AUT_{ij} + \beta_3 VIN_{ij} + \beta_4 FOR_{ij} + \beta_5 BIO_{ij} + \beta_6 REC_{ij} + \beta_7 GENDER_{ij} * COST_{ij} + \beta_8 HI_{ij} * COST_{ij}$$

The variable high income (HI) is a dummy variable taking a value of one when the individual income per month is higher than 2500 Euros and zero otherwise. The other sociodemographic, the variable gender (GENDER), is a dummy variable that takes a value of one if the individual is a man or zero if the individual is a woman. The interaction of socioeconomic variables with attributes accounts for group heterogeneity among individuals.

In the model, β_0 represents the constant term, β_1 represents the effect of a unit increment in the cost of the program on the individuals' utility and β_2, β_3 and β_4 represent the effect of a unit increment on percentage of land area covered by cork oaks, vineyards and pines, respectively. The parameter β_5 shows how the utility changes if the number of species in danger increases by one unit and β_6 represents the effect of a change in the level of conservational and cultural facilities. Looking at the sociodemographic variables we can interpret the coefficients in the following way: β_7 explains the effect of gender if the cost increases by one unit and β_8 will measure the effect of an increase on the level of income in the WTP among those who have a high income.

Table 3 presents the variance inflation factor (VIF), which is commonly used in regression analysis for detecting problems of multicollinearity, where values greater than 10 indicate highly collinear data. In this case, all values are very low, so no problem of multicollinearity is expected in the model estimated.

Table 3: VIF

	VIF
COST	0.00157643
AUT	0.0110085
VIN	0.0175529
FOR	0.0202558
BIO	0.0556501
REC	0.452132
COST*GEN	0.00222187
COST*HI	0.0151595

The model applied first was the MNL and the RPL was then applied during the second stage. In both cases, the econometric software used was NLOGIT The estimation results will be shown in the following tables.

The results of the MNL estimation are presented in Table 4. As can be observed, the attributes "COST," "AUT" and "BIO" are significant at the 1% level and the attribute "VIN" is almost significant at 10%. All of them have the expected signs, suggesting that utility increases if the level of protection of the environmental attributes does, and decreases as the cost of the program increases. The interactions between cost and gender and cost and high income are significant at the 10% level and 5% level, respectively.

Table 4: MNL model estimation results

Variable	Coefficient	Standard error	*T*	*p-value*
FOR	–.00567080	.00602984	–.940	.3470
REC	.01772663	.02340569	.757	.4488
CONSTANT	.21770493	.25397508	.857	.3913
COST	–.01579129***	.00160858	–9.817	.0000
AUT	.04659408***	.00486529	9.577	.0000
VIN	.00732226	.00479326	1.528	.1266
BIO	–.04314493***	.00955371	–4.516	.0000
COST*GEN	–.00413233*	.00229098	–1.804	.0713
COST*HI	.01136558**	.00530387	2.143	.0321
No. of observations: 1326				
Log likelihood function: –1206.29				
Significance: *(10%); **(5%); ***(1%)				

All coefficients included in the MNL model in Table 4 were tested for their possible randomness using *t*-statistics related to the standard deviations of the random parameter. Two were found to be random, namely FOR and REC. That is why an RPL was estimated. An RPL, unlike the previous model, allows for the specification of unobserved heterogeneity among individuals (Table 5).

Table 5: RPL

Variable	Coefficient	Standard error	t	p-value
Random parameters in utility functions				
FOR	.00125871	.00893284	.141	.8879
REC	.00374885	.03040894	.123	.9019
Non-random parameters in utility functions				
CONSTANT	–.27071255	.38674867	–.700	.4839
COST	–.01853991***	.00232746	–7966	.0000
AUT	.05570121***	.00736829	7560	.0000
VIN	.00873021	.00572699	1524	.1274
BIO	–.05042937***	.01193874	–4224	.0000
COST*GEN	–.00505015*	.00273224	–1848	.0646
COST*HI	.01365459**	.00625889	2182	.0291
Derived standard deviations of parameter distribution				
FOR	.07109111**	.02809403	2530	.0114
REC	.25283739***	.09586173	2638	.0084
Number of observations: 1326				
Log likelihood function : –1202.78				
Log likelihood function (constants only) : –1387.19				
Significance: *(10%); **(5%); ***(1%)				

The improvement in the log likelihood function suggests that the RPL clearly outperforms the MNL. The LR test of the null hypothesis that the two standard deviations of random parameters are zero is 0.132 and corresponds to a *p*-value of 5%. We found that the attributes cost, autochthonous forest, vineyard and biodiversity were non-random. However, Table 5 shows that for the attributes percentage of land area covered by forest and the level of conservational and cultural facilities we can reject the null hypothesis of zero standard deviations of parameter distribution at 5%.

As expected, the negative sign of the attribute cost indicates that the utility of individuals decreases as the cost of the program increases. The utility of individuals also increases if the percentage of land area covered by cork oaks or vineyards increases, whereas the utility decreases if there are more species in danger. By contrast, regarding the random parameters, the sign of the effects for the attributes forest and recreational and cultural facilities can change for different individuals. This is the evidence of the existing heterogeneity that could not be modeled by sociodemographic variables.

The two interactions of the socioeconomic variables with the cost attribute, namely gender and high income, are significant at 10% and 5%, respectively. We can conclude that men are less willing to pay than women. This could be explained by the sensitivity of women to conserve the environment and resources more than men because of their children. The positive sign of HIGHINCOME*COST indicates that the higher the income, the higher the WTP. This is an expected result because those with more earnings should have a higher WTP.

4.1. WTP

The main research objective is to analyze the cost of maintaining different land uses. Because some SED[4] variables were included in the RPL, the simulated WTP values depend on these SED values. We have to define a base scenario that will be used as a benchmark for the WTP comparisons computed for different values of the SED variables. In the base scenario, the dummy variables, related to gender and high income, were set to zero. In this way, by setting the dummy variables to one, the effect of gender and high income on WTP can be analyzed. Table 6 reports the WTP estimates for the defined environment attributes in different scenarios depending on the values of the SED variables.

[4] SED: sociodemographic variables

Table 6: WTP

GROUPS/ATTRIBUTES	AUT	VIN	BIO	FOR	REC
WEIGHTED WTP	2.868	0.449	2.597	0.086	0.412
WOMEN WITH LOW–MEDIUM INCOME	3.004	0.471	2.720	0.090 (3.835)	0.431 (13.616)
WOMEN WITH HIGH INCOME	11.401	1.787	10.322	0.343 (14.555)	1.638 (51.674)
MEN WITH LOW–MEDIUM INCOME	2.361	0.370	2.138	0.071 (3.014)	0.339 (10.701)
MEN WITH HIGH INCOME	5.606	0.879	5.076	0.169 (7.156)	0.806 (25.408)

The attributes "AUT," "VIN" and "BIO" are non-random; however, "FOR" and "REC" are random parameters, and their means and standard deviations (in brackets) were calculated after simulation using 10,000 random numbers. The first row shows the amount of money that an average individual would pay for an increase of 1% of the land area covered by oak trees (2.87 Euros per year), an increase of 1% of the land area covered by vineyards (0.45 Euros per year), a decrease of one unit of the number of species in danger (2.60 Euros per year), an increase of 1% of the land area covered by forests (0.08 Euros per year) and an improvement in the conservation of recreation and cultural facilities (0.41 Euros per year).

It is interesting for our analysis to compare the differences in the WTP considering different values of socioeconomic variables. In general terms, we could conclude that women with high incomes would be most likely to pay and men with low or medium incomes would be least likely to pay. For the cork oak forest, we can observe that women with high incomes would pay 8.40 Euros more than women with low–medium incomes and 9 Euros more than men with low–medium incomes. The same occurs for the biodiversity attribute following the same profile but with slightly lower numbers. Looking at the results for vineyards, at first sight there seem to be lower differences among groups but the proportion is exactly the same as in the previous cases.

Summarizing for the fix attributes (“AUT,” “VIN” and “BIO”), we could conclude that men with high incomes would pay 3.80 times more than the other men, whereas women with high incomes would pay 2.37 times more than the other women. This can be interpreted as the fact that level of income is less important for women than for men when the objective is to protect an attribute that has value for them. Making comparisons between gender, and considering the same level of income, it can be concluded that women with low–medium incomes would pay 1.27 times more than men. For the group of high income the coefficient is 2.03 in favor of women too. From the strict point of view of income, there is a smaller difference between genders when they each have less income. When both have high earnings, women are willing to pay double.

Finally, it is interesting to compute the same coefficient between the most likely to pay group, women with high incomes, and the least likely to pay group, men with low–medium incomes. We obtain a coefficient of 4.83, that is, women with high incomes will pay 4.81 times more than men with low–medium incomes (Table 7).

Table 7: Approximated summarized comparison between the different WTP values among groups (for the attributes: "AUT," "VIN" and "BIO")

Women high income/women low–medium inc.	Men high income/men low–medium inc.	Women high income/men high inc.	Women low–medium income/men low–medium inc.	Women high income/men low–medium inc.
3.80	2.37	2.03	1.27	4.83

5. CONCLUSION

The results satisfy in part the main objective of the study, which was to obtain information about individuals' preferences relative to different land uses. The idea was to evaluate future possible management plans and provide useful information to policymakers about an individual's WTP, which is a reflection of the utility of individuals given the different land uses and natural resources.

Following a DCE methodology, the attributes previously identified were tested and a set of sociodemographic variables were included in the model. It is important to identify the heterogeneity among individuals including sociodemographic variables because this shows that different preferences influence choice. Thus, the valuation of environmental goods and services will also be affected by these heterogeneous preferences. Such factors, when they interact with cost, reveal that, for example, in our case, gender and income of households impact WTP.

After implementing an MNL model, an RPL model was applied, including the unobserved heterogeneity, which was not possible to model on SED variables by locating the preferences associated with socioeconomic factors. We concluded that four attributes were fixed and two were random, but all were significant at the standard significance level. In addition, the inclusion of the SED variables allowed us to present interesting conclusions.

Our analysis confirms that women and individuals with high incomes have a higher WTP to conserve the environmental attributes selected. For the cost attribute, the estimated coefficient is negative, as expected, because the utility of increasing the conservation of the different environmental options decreases with higher payments. The biodiversity attribute is negative too, and this indicates that people's utility decreases if the number of endangered species in the area increases. The positive coefficients of autochthonous forest and vineyard indicate that people's utility increases when the percentage of land area covered by these species increases. However, the coefficients for forest plantation and recreational and cultural facilities are not significant at any level of confidence and are established as random parameters.

DCEs could contribute to policy and resource allocation, and we can confirm that the negative coefficient of cost attribute indicates that the probability of accepting an annual contribution for conserving this area decreases as the price increases. Although it is interesting to note the differences in WTP between genders, it is difficult to implement different policies between them because it could be discriminatory.

However, this information could be useful because if policymakers want to improve one of the attributes they could target the different population groups identified with specific advertising campaigns depending on their WTP. A good use of the provided information to policymakers would probably help improve the welfare of society.

The policy implications emerging from this study are that researchers should acknowledge test limitations when selecting and specifying one econometric model over another. Indeed, the selection of appropriate policy programs depends on computing the right WTP values using the estimation of the model chosen. WTP values generated from models that do not consider heterogeneity or an erroneous type of heterogeneity because of the inappropriate selection of random parameters affect the evaluation of cost and benefits for specific projects. As a consequence such projects or policy programs can be erroneously established. To summarize, acknowledging this heterogeneity among the population results in efficient WTP values that can assist policymakers target appropriate programs to specific groups.

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