

Preservation of a rural and cultural landscape. Insights from the multinomial and error components logit model

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Introduction

The public good nature of the landscape and the production of external benefits that the market doesn't account for, are arguments for public intervention. The main objective of the assessment of the economic value is to support and justify policy decisions and the management of the landscape. The use of non-market valuation techniques, as the stated preferences, creates a hypothetical market to imitate the transactions and choices in the real world. One of these techniques is the discrete choice experiments (DCE), which assumes that the value that accrues from a good is derived from its characteristics or attributes.

Valuation of landscape through DCE has received increasing recent interest (e.g., Colombo *et al.*, 2005;

Abstract

The present paper uses the discrete choice experiments to elicit visitors' preferences for a hypothetical preservation program of the main attributes of the Alto Douro Wine Region, an evolving rural and cultural landscape, classified by UNESCO as world heritage site. The paper compares the performance of the multinomial logit model, relying on the independence assumption between the choices made by the same respondent, with the error components logit model that explicitly considers the panel data structure.

There is evidence that the utility of participating in a preservation program is positively determined by the income level and by the status of ADW' world heritage list. Moreover, the utility is negatively influenced by household size and by the distance between the residence and the ADW.

Keywords. Discrete choice experiments, Error components logit model, Cultural heritage valuation, Visitors' preferences, World cultural landscape.

Résumé

En appliquant la technique des choix discrets, cet article identifie les principaux déterminants des visiteurs qui participent à un programme hypothétique qui veut préserver les particularités les plus importantes de la région viticole du Haut-Douro, un paysage culturel, reconnu par l'UNESCO comme patrimoine mondial. En comparaison avec le modèle logit polytomique standard, les résultats du modèle logit à composantes d'erreur s'avèrent être meilleurs ; en plus, ils détectent l'hétérogénéité non-observée et spécifique des alternatives, et rendent compte des patrons de substitution et de la spécification en panel.

Il a été prouvé que l'utilité de participer à un programme de préservation est influencée positivement par le niveau de revenu et le statut de patrimoine culturel du site à analyser. D'autre part, l'utilité est négativement influencée par la taille de la famille et la distance entre le lieu de résidence et la région viticole du Haut-Douro.

Mots-clés. Méthode des choix discrets; Modèle logit à composantes d'erreur, Évaluation du paysage culturel, Préférences des visiteurs, Patrimoine mondial.

Campbell, 2007; Campbell *et al.*, 2008; Sayadiet *al.* 2009; Blazyet *al.*, 2011; Dominguez-Torreiro and Soliño, 2011).

Landscapes can be interpreted as a cultural good, although they may also be interpreted differently (Ayala *et al.*, 2012). The recognition of the landscape as a cultural heritage item attests the history of a place and its cultural traditions in addition to its ecological value. Differently from protected landscapes in which the emphasis on human relationships with the environment focuses on the natural environment, biodiversity and ecosystem integrity, on cultural landscapes the emphasis is on the human history, continuity of cultural traditions and social values (Mitchell and Buggey, 2000).

The economic valuation of the agricultural land-

scape as an item of cultural heritage distances itself from a vast body of literature on non-market valuation of the environment in which the potential benefits of cultural heritage are considered alongside a magnitude of other attributes related to agricultural activity¹. Ayala *et al.* (2012) present a recent review of DCE applications on landscape and identify the following attributes: vegetation, rural aspects, wildlife, water, cultural heritage, boundaries, access and recreation, others. Distinctly from the majority of studies of non-market valuation of landscape, this article focuses on its cultural heritage status.

DCE applications to cultural good have focused on: monuments², cultural institutions³ and sites⁴. Whereas the DCE studies applied to cultural institutions aim to capture the ben-

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¹ For example, Campbell (2007); Campbell *et al.* (2008) consider four rural landscape improvements provided by an agri-environmental scheme in the Republic of Ireland, namely, the "protection of 'mountain land' from overstocking; enhancement of the visual aspect of 'stonewalls'; maintenance of 'farmyard tidiness'; and safeguarding of 'cultural heritage'".

² Morey *et al.* (2002).

³ Maddison and Foster (2003); Mazzanti (2003); Apostolakis and Jaffry (2005); Snowball and Willis (2006); Willis and Snowball (2009); Choi *et al.* (2010); Jaffry and Apostolakis (2011).

⁴ Alberini *et al.* (2003) and Tuan and Navrud (2007).

efits related to use, the DCE applied to monuments and sites embraces non use values too, such as benefits derived from its preservation and existence.

In DCE, data analysis is performed through discrete choice models. The observed non-compliance with the most popular multinomial logit model (MNL) assumptions (Train, 2003; Hensher *et al.*, 2005) has called for less restrictive models closer to the observed behavior, such as the error components logit model (ECL). The ECL (e.g. Brownstone and Train, 1999) may be viewed as a possible interpretation of the mixed logit model (McFadden and Train, 2000; Hensher and Greene, 2003; Hensher *et al.*, 2005) along its random parameters interpretation⁵ (Train, 2003). In this paper we estimate the error components specification of the mixed logit model accounting for unobserved heterogeneity specific to alternatives, relaxing the independence assumption of the error terms across choice situations and allowing for correlation across the alternatives. The proposed specification is useful to accommodate the repeated choices' problem presenting stated preferences methodologies, which is reflected in the under estimation of standard deviations for the estimated coefficients from models relying on the independence assumption, as the MNL (Ortúzar *et al.*, 2000; Cho and Kim, 2002).

Using the data from a DCE to evaluate visitors' preferences for the Alto Douro Wine Region (ADW), a cultural landscape classified by UNESCO as a world heritage site, (UNESCO, 2001), this paper aims: (1) to identify the sources of systematic and unobserved alternative-specific heterogeneity within the assessment of the most significant determinants of the participation decision in a preservation program; (2) to demonstrate how the use of the ECL provides relevant improvements in model fit relatively to the MNL, in a context of multiple observations per respondent and in the presence of a common *None-option*.

The remainder of the paper is organized as follows: section 2 presents the methodology; section 3 describes the DCE application to ADW, including the stated choice task, survey instrument, sample and choice models; section 4 presents the results. Finally the principal conclusions are exposed.

1. Methodology

The DCE defines the goods to be valued (alternatives available in each choice set) by the attributes and their respective levels. Based on the random utility theory (RUT), the utility that the consumer n derives from the alternative i , U_{ni} , consists in two components: the observed or deterministic (V_{ni}) and the unobserved by the analyst (ε_{ni}) or stochastic, such that $U_{ni} = V_{ni} + \varepsilon_{ni}$. The deterministic component is comprised by the alternatives' attributes as well as

the decision maker's characteristics, whereas the stochastic component is represented by a random error term capturing unobservable influences on individual choice.

Considering the basic assumption under the RUT, the consumer n faced with a choice among a set C of J alternatives ($j = 1, \dots, J$), will choose the alternative that provides the greater perceived utility. However, given the presence of random terms, the choice is probabilistic. Assuming that random components of the utility are independent and identically distributed (*iid*) extreme value type 1, the choice probability of an alternative from the choice set C (P_{nj}) is given by the MNL (McFadden, 1974).

Given its closed form solution and analytical simplicity, the MNL was the most commonly used discrete choice model (Train, 2003; Hensher *et al.*, 2005). Nevertheless, its underlying assumptions impose a restrictive framework of behavioral choice which is not always possible to satisfy, specifically:

- i. The independence of irrelevant alternatives (IIA) property (Luce, 1959) cannot fit situations without equal attractiveness between all pairs of alternatives (Keane, 1997; Train, 2003; Hensher *et al.*, 2005).
- ii. Deriving directly from the *iid* assumption, the MNL cannot identify correlations patterns across alternatives, as it could be the case of a DCE including a *None-option* potentially different from the remaining options involving a change, and across choice situations in a repeated DCE, where the independence assumption is difficult to remain, due to the invariance of behavioral structure along the sequential choices.
- iii. The random taste variation or unobserved heterogeneity is not accounted.

In order to overcome the MNL limitations, more flexible models have been developed, relaxing, partially or totally, the *iid* assumption. One of these models is the ECL that emerges to capture unobserved individual influences related to the choice of alternatives or unobserved alternative-specific heterogeneity (Greene, 2007). Ben Akiva *et al.* (2001) nominated it as Logit Kernel Model, defining the same as a discrete choice model that includes random terms *iid* extreme value type 1, like the MNL, and disturbances normally distributed.

The unobserved heterogeneity is introduced in the model by the inclusion of M additional error components in the alternatives' utility functions ($M \leq J$), which additionally can be used to induce patterns of correlation between options.

The utility that decision maker n obtains from choosing alternative j in choice situation t is given by (Greene, 2007: N14-13):

$$U_{njt} = \beta'X_{njt} + \varepsilon_{njt} + \sum_{m=1}^M d_{jm}\sigma_m E_{nm}, \quad j = 1, \dots, J_n; \dots t = 1, \dots, T_n \quad (1)$$

Where:

X_{njt} = vector of observed variables relating to individual n , alternative j and choice situation t

⁵ The mixed logit model allows incorporating attribute' preference heterogeneity, specifying random parameters, and preference heterogeneity specific to the choice of the alternatives, introducing error components.

$\varepsilon_{njt} = (\varepsilon_{n1t}, \dots, \varepsilon_{nJt}) =$ random terms *iid*, extreme value type 1
 E_{nm} = Merror components for individual n , normally distributed $E_{nm} \sim N[0,1]$. Alternatively it is possible to specify a heteroscedastic error component model, such that $\text{var}[E_{nm}] = \exp(\gamma_m h_n)$ where h_n represents the vector of individuals' characteristics invariant to the choice that produce heterogeneity in the variances of error components

σ_m = standard deviation of effect m
 d_{jm} = dichotomous variable equal to 1 if E_{nm} appears in the utility function for alternative j and 0 otherwise; (it's possible to induce correlations patterns between alternatives, overlapping the same effect in different utility functions)

Under the ε_{nit} *iid* assumption, the probability conditioned on the error components follow the standard logistic form:

$$P(y_{nt} = j | E_{1n}, \dots, E_{2n}, \dots) = \frac{e^{(\beta'x_{njt} + \sum_{m=1}^M d_{jm}\sigma_m E_{nm})}}{\sum_{q=1}^J e^{(\beta'x_{nqt} + \sum_{m=1}^M d_{qm}\sigma_m E_{nm})}} \quad (2)$$

The unconditional probability is obtained integrating E_{nm} out of the conditional likelihood function:

$$L_n = \int_{E_{n1}} \dots \int_{E_{nM}} \prod_{t=1}^{T(n)} \frac{e^{(\beta'x_{njt} + \sum_{m=1}^M d_{jm}\sigma_m E_{nm})}}{\sum_{q=1}^J e^{(\beta'x_{nqt} + \sum_{m=1}^M d_{qm}\sigma_m E_{nm})}} \phi(E_{nM}) \dots \phi(E_{n1}) dE_{nM} \dots dE_{n1} \quad (3)$$

where, $\phi(\cdot)$ is the normal density function of the error components.

The ECL choice probability (3) has no closed mathematical form, as in the MNL, being approximated by a simulation procedure. The simulated likelihood function for the individual n (for the panel of T choices) is expressed by:

$$L_{n,S} = \frac{1}{R} \sum_{r=1}^R \prod_{t=1}^{T(n)} \frac{e^{(\beta'x_{njt} + \sum_{m=1}^M d_{jm}\sigma_m E_{nm,r})}}{\sum_{q=1}^J e^{(\beta'x_{nqt} + \sum_{m=1}^M d_{qm}\sigma_m E_{nm,r})}} \quad (4)$$

where $E_{nm,r}$ is the set of M independent normal draws (pseudo-random, Halton sequences, the most used) and R is the number of replications in the simulation. The parameters are estimated through maximizing the simulated log likelihood.

$$\text{Log}L_s = \sum_{n=1}^N \log L_{n,S}$$

2. Description

A DCE was conducted to assess the determinants of the participation in a program to safeguard the most relevant at-

tributes of a traditional European wine production region⁶, the ADW, classified as a world heritage site (UNESCO, 2001).

The ADW is located in the northeast of Portugal along the Valley of Douro River and its tributaries⁷. Its 24,600 hectares spread throughout 13 municipalities each one with public power on its own territory. The configuration of the landscape was the result of the hard work of landholders transforming an adverse nature, specially planting vineyards (during 2000 years), from which the worldwide recognized Porto Wine is obtained. A miscellaneous of vineyards, Mediterranean crops and forestry defines a mosaic, together with a characteristic type of villages.

Due to its evolving-living nature and economic pressures, the coexistence of the more traditional elements of the cultural landscape has been called into question, with the risk of their disappearance. While experts in various fields have an important role in deciding what should be preserved, the public nature of ADW means that these choices should not be independent from the interests of the general population, expressed, for example, through the preferences of the ADW' visitors. To achieve the previous goal, for the implementation of the DCE study, a set of hypothetical preservation programs were designed. Based on these scenarios, the visitors' preferences are assessed from the choices made among the preservation programs presented.

The stated choice task

To elicit subjects preferences over preservation programs four attributes were selected :terraced vineyards supported by walls of schist (VIN); landscape mosaic with agricultural diversity (MOS); traditional agglomerations/settlements (AGGLO); Price (€), defined as an annual tax increase per household (TAX). The three landscape attributes' (VIN, MOS, AGGLO) are binary: level 1 (if the attribute is protected, ensures its presence in the landscape) or level -1 (otherwise). The TAX attribute was set to the levels 20€, 40€ and 60€ for the options involving a preservation program and 0€ for the *None-option*⁹ alternative, corresponding to the absence of a program.

Using the software SAS, a D-efficient design was obtained (e.g. Huber and Zwerina, 1996; Kuhfeld *et al.*, 1994) through which the above four attributes and their levels

⁶ Hertzberg and Malorgio (2008) used the DCE to assess the preferences for wine attributes in Italy. In the present paper we focus on the cultural heritage perspective of the wine region.

⁷ A detailed description of the good under evaluation can be found in UNESCO (2001).

⁸ This selection was based on four different sources: the information present on the ADW proposal and the acceptance criteria on the UNESCO world heritage list; the results of a previous pilot survey; the information from personal interviews with ADW experts; and on the evolution trends of the landscape.

⁹ The definition of the TAX attribute levels was based on the results obtained in an open-ended question about the willingness to pay for a preservation program for the ADW in a previous pilot study carried out.

Table 1 - *Descriptive Statistics.*

Variable	Acronym	Codification	Sample average ^a	Std.Dev
Socioeconomic variables, attitude and context				
Gender	GE	1 Male; -1 Female	0.58	-
Age	AGE	18-75	39.5	12.6
Education degree	EDU	1 Primary; 2 Secondary; 3 Post-secondary	2.4	-
Monthly household income	INCOME	1 (<1000€); 2 (1000-2000); 3(2001-3000); 4(>3000€)	2.3	-
Household size	SIZE	1- 6	2.67	1.18
Profession	PROF	1 Members of legislative bodies, public companies' managers and intellectual and scientific professions; -1 Others	0.4	-
Member of a cultural association	MEMBER	1 Yes; -1 No	0.185	-
Consumption of cultural activities (Number times last year)	CULT	0-389	24.27	39.9
Visit the ADW for the 1 st time	FIRST	1 Yes; -1 No	0.14	-
Number of ADW visits (last year)	VISIT	1- 60	7.47	10.37
Distance between the residence and the ADW	KM	15-622	136.6	0.36
Visit purpose	PURPOSE	1 To know the ADW cultural heritage; -1 Others	0.249	-
Influence of the world heritage classification in decision to visit	LIST	1- Yes; -1 No	0.28	-
Identifies the more traditional attributes	IDENT	1 Yes; -1 No	0.84	-
Know the reasons of ADW inclusion in UNESCO list	KNOW	1 Yes; -1 No	0.439	-
Choice Decision Process	TRADE	1 Considered all the attributes presented; -1 Other	0.561	-
Source: <i>Own elaboration; a relative frequency of 1s (dichotomic variables).</i>				

were combined in 12 generic and unlabeled alternatives (preservation programs) and simultaneously allocated in 6 choice sets to present to each respondent. In addition to the two experimentally designed alternatives, each choice set includes the *None-option* alternative corresponding to the absence of a preservation program. Therefore all six choice sets have a constant size of 3 alternatives (A, B or none).

Data collection

The stated preference survey was conducted in two emblematic points of the ADW, (S. Leonardo da Galafura and Pinhão), between May and August 2008. Respondents were visitors over 18 years, randomly selected, and who agreed to complete the survey under the guidance of the authors

and trained interviewers. A total of 189 surveys were considered valid for the study, giving rise to a sample size of 1134 observations or useful choice responses for model estimation (each respondent-completed six choicesets). Table 1 reports the descriptive statistics of the data collected and the variables included in the choice models. The average respondent is 40 years old and 42% are women; over 50% has, at least, the post-secondary education, 61.5% earns less than 2,000€/month and the average household size is 2.67.

About 18.5% are members of cultural societies and, on average, attended cultural activities 24 times/last year. Most visitors have previously visited the ADW, only for 14% of the respondents this was their first-visit, the remaining visitors made, on average, 7 visits last year. The distance between respondents' residence and the ADW ranges from 15 to 622 kilometers (KM).

For 25%, the purpose of the visit is to enjoy the landscape and cultural heritage and for the remaining is to relax, to visit friends or family and to work. The world heritage' status influenced the visit decision of 28% of the respondents. Concerning the knowledge of the characteristic elements of the ADW, 84% of the respondents state their ability to identify the traditional elements of the landscape, while almost 44% report knowing the ADW' inscription criteria. About 56% of the respondents stated that all the attributes were pondered in their choices.

The choice models

In this section we first investigate the adequacy of the more restrictive MNL to our data and then the adequacy of the more flexible ECL.

The MNL₁ includes the ADW attributes on the three alternatives, assuming that the representative component of utility of an alternative *i* is linear and additive on the parameters (β) and attributes (*X*). One alternative specific constant (ASC) was set to 1 for the None-Option and 0 for the remaining (A and B). Moreover, MNL₁ considers a form of systematic preferences heterogeneity that accounts for differences in the preferences for the choice of an alternative across individuals (Bhat, 1998), by introducing the observed individuals' characteristics as alternative-specific variables in the representative utility function of alternatives A and B (considering the *None-Option* as the reference alternative).

In the estimation of the ECL, a common error component

is included in the utility function of the alternatives A and B, which induces a correlation pattern between these options¹⁰. In this sense, the ECL₁ has the same representative utility function as MNL₁. ECL₂ extends the ECL₁ introducing the heteroscedastic error components. To analyze possible sources of heterogeneity in the variance of the error components, all respondents' variables were inserted into the vector h_n referred in (1). The only statistically significant variable was the education level and, by this reason, the variance of the error component was defined as a function of the EDU variable (E01EDU in Table 2).

3. Results and discussion

Based on the above specifications, all models are estimated using NLogit 4.0 econometric software (Greene, 2007). The maximum likelihood estimations of the MNL and the maximum simulated likelihood estimations of the ECL (500 Halton sequences) are presented in Table 2.

The ECL, in terms of model fit, is superior to MNL, considerably improving the converge value of LL (LR test and AIC criterion). Moreover ECL₂ outperforms the ECL₁ and, in this sense, the variability analysis of the error component improved the adjustment in terms of the convergence value of LL, AIC criterion and correct predictions proportion.

Selecting ECL₂ as the model that best explains the individual choices, the coefficients of the alternatives' attributes are statistically significant at the 5% level and maintain the expected sign, keeping the evidence of the remaining estimated models (MNL and ECL₁). The preservation of the attributes VIN, MOS and AGLLO has a positive influence on the utility of an alternative whereas the negative signal of the cost attribute reflects the reverse effect¹¹.

¹⁰ This procedure is based in the potentially distinct nature of the *None-Option* in comparison with the two remaining alternatives involving a preservation program.

¹¹ Confirming the evidence from previous empirical applications, the parameter estimates of the attributes from the ECL (in absolute value) are higher than in MNL.

¹² As postulated in the literature (e.g. Ortúzar et al., 2000; Cho and Kim, 2002) the MNL underestimates the standard deviations for the estimated coefficients, which results in individually statistically significant coefficients that are not confirmed by the ECL₂ which accounts for the panel specification.

The ASC, distinctly from the MNL, is no statistically significant in ECL.

Concerning the influence of the respondents' characteristics and attitudes to explain the choice of a preservation program alternative versus the *None-Option*, four variables are statistically significant¹². In line with the results of other cultural valuation applications INCOME has the expect-

Table 2 - Estimation results from the MNL and ECL.

N=1134	MNL	ECL1	ECL2
Variable	Coefficient estimates (s.d)	Coefficient estimates (s.d)	Coefficient estimates (s.d)
VIN	0.429 ^{***} (0.04)	0.44 ^{***} (0.04)	0.44 ^{***} (0.045)
MOS	0.458 ^{***} (0.04)	0.47 ^{***} (0.04)	0.47 ^{***} (0.042)
AGLLO	0.439 ^{***} (0.04)	0.45 ^{***} (0.04)	0.45 ^{***} (0.04)
TAX	-0.006 ^{**} (0.0025)	-0.0055 (0.003)	-0.0054 [*] (0.003)
ASC	-4.85 ^{***} (0.88)	-15.87 (19.2)	-25.4 (17.2)
GE	0.033 (0.13)	-0.054 (2.58)	-1.06 (2.1)
AGE	-0.03 ^{***} (0.01)	-0.003 (0.24)	-0.19 (0.2)
INCOME	0.64 ^{***} (0.16)	5.99 (5.1)	9.45 [*] (5)
EDU	-0.17 (0.23)	2.63 (5.6)	1.87 (3.96)
SIZE	-0.36 ^{***} (0.1)	-2.15 (2.56)	-3.8 [*] (2.1)
PROF	0.05 (0.14)	-5.6 (4.45)	-3.9 (3.04)
MEMBER	0.04 (0.16)	3.12 (3.49)	3.23 (4.13)
FIRST	-0.32 ^{**} (0.16)	-0.25 (4.38)	-1.2 (2.8)
TRADE	0.79 ^{***} (0.12)	5.3 (3.7)	5.47 (3.46)
VISIT	-0.13 ^{***} (0.03)	-0.73 (0.97)	-0.43 (0.58)
VISIT2	0.002 ^{***} (0.0006)	0.011 (0.02)	0.003 (0.016)
PURPOSE	-0.025 (0.13)	0.26 (3.3)	1.7 (2.9)
LIST	0.72 ^{***} (0.16)	3.25 (3.5)	5.1 [*] (2.9)
KNOW	0.17 (0.13)	-1.8 (3)	1.6 (1.9)
IDENT	0.36 ^{***} (0.14)	2.27 (3.6)	0.64 (1.88)
CULT	0.005 (0.004)	0.06 (0.09)	0.036 (2.85)
KM	-0.008 ^{***} (0.001)	-0.06 [*] (0.03)	-0.06 ^{**} (0.025)
Error component		15.88 [*] (8.2)	1.82 (1.5)
Std deviation (SigmaE01)			
Heterogeneity around the std of the error components (E01EDU)			0.8 ^{***} (0.27)
Model fits			
LL(model)	-874.0535	-681.5183	-678.3
LL ratio test=-2[LL _C -LL(model)]	459.7	844.8	851.25
Pseudo \bar{R}_C^2	0.187	0.36	0.37
AIC	1.58	1.24	1.2369
Correct Predictions	53.9%	52.3%	55%

Source: Own elaboration.

Notes:

* Significant at the 0.10 level; ** Significant at the 0.05 level; *** Significant at the 0.01 level; () standard deviations.

$$AIC = \frac{2LL(model)+2p}{N}$$

, p=number of parameters, LL(model)=model log-likelihood value, N= number of observations;

$$Pseudo \bar{R}_C^2 = - \frac{LL_{(model)} - k}{LL_C - K_C}$$

, where LLC = log-likelihood value with only alternative specific constant, and K =number of parameters of the model and KC=number of constants; Correct Predictions (%)=Predicted choice outcomes for the sample based upon the estimated model versus the actual choice outcomes (Hensher et al., 2005).

ed positive sign¹³. Alternatively, the negative sign of household SIZE indicates that the utility of choosing an alternative with a preservation program is lower for larger households. One explanation for this result is that the contribution to a preservation program could mean a greater burden on the budgets of the larger households that have more expenses. The positive sign for LIST coefficient means that the utility of choosing an alternative with a program is higher for the respondents whose visit decision was influenced by the inclusion of the ADW in the UNESCO list. This relationship can be understood as a consequence of the status of world heritage, and by its effects on the demand and on the importance of contributing to the ADW preservation. Additionally, the distance coefficient (KM) is negative and significant, suggesting that the value of choosing an alternative involving a program is lower to the respondents who live farther from the ADW. Given the slightest familiarity and proximity to the ADW, this evidence is consistent with expectations.

With respect to the additional estimated parameters, results from ECL₂ exhibit differences in the variance of the error components between educational attainment levels (higher for superioeducation levels, E01HAB coefficient). Ceteris paribus, the standard deviation of the error component increases to the extent that the educational level increases, leading to an increase in the preferences heterogeneity of these unobserved effects. This result can be a signal that the more educated respondents have a more complex decision process, considering a high number of non-observed factors to make its choice.

Assuming the evidences of the previous analysis, it seems that the homoscedastic error components model (ECL₁) underestimates the significance of the invariant individuals' characteristics, only recognizing the effect of the KM variable to explain the decision of participation on a preservation program (versus the *None-Option*). Probably it captures some effect of the systematic heterogeneity as a source of unobserved influences specific to the alternatives, especially in the error component (the standard deviation associated with the error component suggests a statistically significant correlation between the unobserved factors common to alternatives A and B). In this context, the serious investigation of the heterogeneity of the variance of the error component appears as a fundamental task in the implementation of the ECL model.

4. Conclusion

This paper presents the results of a DCE application regarding the visitors' preferences for a program to preserve the main attributes of a Portuguese wine region classified as a world heritage site. In order to analyze the choices among a finite set of three mutually exclusive alternatives, discrete choice models were employed. Starting with the estimation

of MNL, the analysis was extended to the ECL, entering in the domain of opened form models, one of the possible interpretations of the mixed logit model.

Regarding the relative importance of the attributes, all estimated models suggested the landscape mosaic of the ADW as the most significant, followed by agglomerations, and by vineyards terraced with schist walls, respectively. The analysis demonstrates the utility of preserving all attributes included in the preservation program.

The ECL achieved significant improvements in model fit relatively to the MNL model. Additionally the ECL detected unobserved heterogeneity alternative specific, an omitted issue in MNL framework. The heteroscedastic ECL revealed the presence of heterogeneity in the variance of the error components between educational attainment levels, increasing to the extent that the educational level increases. For the ADW, the analysis of the heterogeneity of the component error' variance in the ECL was statistically preferable to homoscedastic ECL.

Finally, there is evidence that the utility of participating in a preservation program is positively determined by the income level and by the status of ADW' world heritage list. Moreover, this utility is negatively influenced by household size and by the distance between the residence and the ADW. This information should be incorporated in the formulation of public policies concerning to safeguard the rural landscape, including the determination of the appropriate payment vehicle to ensure its provision.

Despite the advantages of the ECL relative to the MNL, the model does not incorporate attribute heterogeneity, which is an important topic for future investigation.

Finally, this article assesses the determinants of individual participation in a preservation program. The program intends to preserve the relevant attributes that ensure the designation of cultural heritage status. This constitutes a new perspective relative to the majority of the DCE applications to valuing landscapes (agricultural, natural, human, etc).

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¹³ See for example, Pearce *et al.* (2002); Morey *et al.* (2002); Morey and Rossmann (2003); Pollicino and Maddinson (2002); Mazzanti (2003); Tuan and Navrud (2007).

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