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DISCRETE CHOICE MODELS AND VALUATION EXPERIMENTS. AN APPLICATION TO CULTURAL HERITAGE

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Discrete Choice Models and Valuation Experiments
An Application to Cultural Heritage

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The usual disclaimer applies. It is obvious that I am totally responsible for any opinion expressed and results achieved.

Abstract

The paper focuses on and investigates discrete-choice parametric econometric models which attempt to incorporate preference heterogeneity in a multinomial setting. Both IIA (Independence on Irrelevant Alternatives) based models, as conditional logit, and models which relax the IIA assumption, are taken into consideration. The consistency of CL specifications, and relative significances are compared. The database derives from a stated preference choice modelling experiment carried out on users of a mixed good, the Museum of Galleria Borghese in Rome, Italy, a worldwide known cultural heritage site.

Results show that the econometric analysis of choice experiment stated database warrants the implementation of different model specifications.

The main result arising is that hybrid forms of conditional logit, which incorporate heterogeneity by interaction terms, are associated to relatively high performances in terms of fit, IIA test and coefficient significances. Specifications relaxing IIA do not outperform the Conditional Logit model, when interaction terms are included: both Hev and RPL models are shown to be statistically not different from the CL specification.

Policymaking implications are also considered, presenting total gross WTP associated to different options.

The study confirms that valuation experiments offer a variety of tools, and suggests that further development be warranted. Decomposition of the cultural site into characteristic values defining a "multi-services" mixed good turns out to be relevant for valuation and ranking of people preferences over different attributes within demand-led strategies. Nonetheless, econometric analysis and economic valuation should root on a comprehensive set of estimation methods, in order to test relative consistency.

Jel: C25, C42, H4, Z1

Key words: Conditional Logit, Mixed Logit, Choice Experiments, Cultural Heritage, Discrete choice models, Non-market valuation

1.Introduction

The early phase of choice modelling applications to non-market economic valuation has focused on a basic conditional logit model (CL), rooted on the Independence on Irrelevant Alternatives (IIA) property, deriving from the iid distribution of error terms. The applied literature has mainly evolved around this model so far. This property, which characterises the class of Conditional Logit (CL) response model based on Random Utility Theory (RUM), which accounts for unobserved preference heterogeneity of consumers, is rarely satisfied and often too restrictive. The new frontier of analysis is the design and study of econometric models, which relax the often-strict hypothesis. The upcoming challenge is either to structure and implement models relaxing the hypothesis or to look for CL specifications which do not violate IIA[1].

In fact, Hanley et al. (1998, p.426) state: "*a topic that is receiving attention in choice modelling, in models employing revealed and/or stated preference data, is the treatment of heterogeneity in the population sample. Heterogeneity can be addressed using latent class approaches or using heterogeneous model estimators like the random coefficient probit and logit models"*[2]

As outlined by Train (1998), CL imposes several restrictions*: "First, the coefficients of variables that enter the model are assumed to be the same for all people. This assumption implies that different people with the same observed characteristics have the same values (i.e. tastes) for each factor entering the model. Second, Logit and nested Logit exhibit the IIA property (Logit for all alternatives, and nested Logit exhibits it within nests. [.] This substitution pattern may be unrealistic in many settings. Third, in situations with repeated choices over time, Logit and nested Logit assume that unobserved factors are independent over time for each decision maker" (p.230)*

One main objective of the paper is to test the robustness of coefficient significances and WTP estimates across different models, implying or not the IIA assumption. This is relevant for policymaking use of valuation exercises. Comparing model fits and structural changes between alternative specifications is worthy of careful investigation; reliance on the CL model is only justified if data satisfy the IIA assumption (Foster and Mourato, 2000)[3], nonetheless, the theoretical "added value" associated to models relaxing the IIA hypothesis needs assessment by empirical investigation, given the applied literature is still at an earlier stage of development (Breffle and Morey, 2000; Layton, 2000; McConnel and Tseng, 1999; Train, 1998; Eymann and Ronning, 1997).

In this study, the analysis begins by considering CL specifications: the capture of heterogeneity by classic methods and the violation of the IIA assumption are the issues of concern. Then, a model which relaxes the IIA assumption, but does not incorporate heterogeneity in a systematic way, is considered. A final step is to consider a general flexible model, which systematically incorporates individual heterogeneity (relaxing the IIA assumption).

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[1] In case of violation, the estimated parameters of the Logit will possess the properties of unbiasdness and consistency, but not the property of efficiency. Although point estimates are correct, standard errors will be inappropriate if IIA does not hold (Fry and Harris, 1998).

[2] Generally speaking, heterogeneity can be incorporated by the "classic" method of adding interaction parameters (between socio-economic variables and characteristic attributes) to the CL model, this originating a sort of *hybrid CL*. Utility thus becomes a function of those interaction terms, associated to marginal utilities. Another way to incorporate heterogeneity is to assume that one or more parameters are function of individual features in a systemic way. A third way world be to assume that the stochastic, not the deterministic part of the conditional utility function, depend on individual features in a classic or systematic way. The present study deals with the first two approaches, that is (i) adding interactions to CL and HEV models, and (ii) including socio-economic variables as explanatory elements within a RPL environment.

[3] Although some practitioners use the CL model even in presence of clear (but only partially tested) IIA violations (Bennett and Blamey, 2001)

The paper is structured as follows: section 2 introduces the choice experiment framework, defining methodological issues and theoretical underpinnings. The case study application is presented in details. The relevancy of implementing stated preference valuation tools for cultural policymaking is further underlined.

Section 3 introduces econometric models used for choice experiment estimation. A comparison between standard conditional Logit models, which rely on the IIA assumption, and other specifications which go beyond IIA, is presented, in order to test whether (some) CL specifications are robust.

Section 4 concludes the paper by drawing out the main conclusions and giving insights for further research. The paper aims at being a reference both for methodological issues concerning CE, and for econometric analysis.

2. Choice experiments, cultural heritage valuation and the *Galleria Borghese* case study

Valuation experiments and cultural heritage

The estimation of the economic value of cultural heritage has increasingly been recognised as a fundamental part of cultural policy (ICCROM, 1999; Pearce and Mourato, 1998; Bishop and Romano, 1998). Empirically, there are at least two powerful arguments for using economic valuation to inform macro and micro decisions in the cultural heritage sector. On the one hand, public institutions are increasingly being required to justify their expenditure decisions or requests for funding in terms of generated 'consumer benefits' and those that are unable to do so might find their budgets cut. Furthermore, in a world where potential visitors are spoilt for choice, time constrained (rather than income constrained) and getting more sophisticated, cultural destinations have to renew and market themselves to compete and survive. A consumer-orientated approach has increasingly taken over traditional supply driven approaches to cultural heritage management and conservation, leading to on-going market research studies to understand demand, strong marketing to generate awareness and attract new visitors. For these reasons, demand led-approaches, such economic valuation techniques, might quickly become part of the new lexicon of the cultural "industry" and a useful component of the cultural analyst tool kit. Economic value as defined here does not deny the importance of other value dimensions, but has a specific, and arguably special, role to play in cultural policy toward heritage fruition, enhancement and conservation (Bariletti and Causi, 1998).

The development of sound valuation tools is necessary insofar cultural markets do not routinely transmit clear signals about demands for cultural services, both for use and non-use values (Greffe, 1990). Valuation matters for financing and management strategies.

In this conceptual framework, the cultural heritage site on which I implement the choice modelling (CM) technique is envisaged as a multi-dimensional, multi-value and multi-attribute economic resource (Mazzanti, 2002; Sable and Kling, 2001).

Within this context, the price of cultural service is not an issue which can be addressed in isolation, since there are many other considerations, which have to be taken into account for developing a comprehensive access policy (Department of Culture, Media and Sport, 1997). According to that, I follow Bailey and Falconer (1998) in claiming that "*[..] a change of emphasis from an overwhelmingly narrow focus on admissions charges to a much broader consideration of the many factors affecting access […] it will be argued that decisions on whether to charge (and if, so at what levels) can only be determined at the level of the individual museum".*

Stated prefernces by Valuation Experiments: Choice Modelling

The Conjoint Analysis/Choice Modelling framework provides a conceptual ground for implementing the multi-dimensional and multi-attribute framework (Foster and Mourato, 2001; 2000).

Conjoint analysis is an umbrella designation for a number of related approaches where choices, ranks or matches between alternatives, as defined over and by attributes and levels, are involved[4]. The many dimensions, attributes and values characterising the supply and demand of cultural good and services lends itself to be analysed by mechanisms which have the capability of dealing with situations where goods and changes are multi-dimensional and trade off between them are analysed[5], possibly identifying part-worth utilities for different components of value, associated to services and functions. Furthermore, its avoidance of an explicit elicitation of willingness to pay (WTP), by relying instead on expressed choices[6] (or rankings and ratings) between alternative "profiles" and "scenarios", might be an advantage compared to contingent valuation (CV)[7]. Some variants of conjoint analysis can be identified in the literature according to the way preferences are measured. I wish to suggest and focus on "*Choice Experiment*" (CE) (Hanley and Mourato, 1999) or "*Choice Modelling*" (CM) (Bennett, 1999), wherein evaluation is achieved by presenting users with a series of alternative "scenarios" or "profiles" (i.e. alternative cultural "supply" of services), asking them to choose the most preferred out of the choice set, the baseline being the status quo[8]. As stated by Rolfe et al. (2000): "*an alternative technique, choice modelling appears to hold some promise because it can be used to model complex situations and to frame choices consistent with "real life" choices".*

The random utility model represents the fundamental approach for the econometric analysis of consumer choices within a discrete environment. A random model with utility function models the consumer choice behaviour as

$$U_{ij}=V_{ij}+e_{ij} \quad (1)$$

Where U is the canonical indirect utility function continuous in its arguments[9], V deterministic component, (defined over relevant attributes and any identifiable interaction terms) and e, the non-observable component of individual choice, which allows, by assuming a specific error parametric distribution (normal, Gumbel, Weibull), a probabilistic analysis of consumer behaviour.

Then

$$A+we=pg+c \quad (2)$$

Is the dollar budget, where a is non-wage income, c the cost of the discrete alternative, w the wage, e the effort, g stays for goods and p is the vector of goods price.

[4] For a comprehensive introductory analysis see Blamey and Bennett (2001), Hanley and Mourato (1999) and Pearce and Mourato (1998). For more technical analysis see Bennett (1999) and Hensher, Louviere and Swait (2000).

[5] For instance, the intrinsic trade off between accessibility - consumption and conservation aspects.

[6] Willingness to pay is inferred indirectly if a "cost" is included as attribute, by computing the marginal rate of substitution between cost and other attributes. For the "cognitive" difficulties associated to conjoint analysis and choice modelling see Garrod and Willis (1999).

[7] Choice experiment is a wider spectrum of analysis comprising contingent valuation.

[8] Choice sets are exogenously given (constructed on the basis of a pilot study) composed of not "labelled" options.

[9] Which is usually defined as additive with respect to arguments and linear with respect to parameters. See more below.

The marginal WTP is calculated by computing the marginal rate of substitution between the attribute of interest and the cost factor (in other words, taking the total derivative of the utility index). This "value ratio", or part worth, is also identifiable between non monetary elements of utility (attribute trade offs)[10].

The probability of selecting the option *j* to the alternatives *h* is expressed, as the probability that the utility associated to *j* is higher than that associated to *h,* under the budget constraint (McFadden and Train, 2000). The assumption of *iid* Weibull distributed error term leads to a Logit model (McFadden, 1973) known as *Multinomial Logit*, in case only individual characteristics are present, or *Conditional Logit,* in case only attribute choices are present:

(3)

$$P(Y_i = j) = \frac{e^{\beta' z_{ij}}}{\sum_{j=1}^{J} e^{\beta' z_{ij}}}$$

Wherein $j = 1, 2, \ldots, J$ indicates the j alternatives, β a vector of parameters and z the characteristics (levels) of the attributes. The inclusion of socio-economic factors lead to a "hybrid" Conditional Logit models with interaction terms (Greene, 2000; Long, 1997), which are included within the deterministic component of indirect utility index.

The following discussion will be phrased in terms of utility maximising consumers. Nonetheless, we can intend rational choice theory in the sense indicated by Cowen (1989), who defines "loose neoclassicism" a theory framed over self interested individual actions constrained by costs, meaning no more that users pursue their own interest, taking into account prices, incomes, and also norms and conventions (Blaug, 2001; Frey, 1997).

The case study

The multinomial cross section database derives from the Choice Experiment carried out on Galleria Borghese museum's visitors, in Rome. Intermediate and final surveys were administered during summer and autumn 2000[11]: the final survey generated 185 valid questionnaires, which were collected by direct on site interviews to visitors[12]. All survey formats are available from the author upon request.

The aim of the study is to analyse user preferences by means of a choice modelling approach. While Choice Modelling aim was to assess the value of alternative changes to the status quo, two Contingent Valuation (CV) experiments, using as elicitation approacch a payment ladder format[13], were also carried out in order to make people at ease with monetary valuation and to get information on (monetary) values attached to the status quo (for visit and site conservation).

The case study selected is the museum of Galleria Borghese, which is located within the Villa Borghese Park in Rome, and is one of the most important (state owned) cultural sites in Italy and worldwide. Further, the site was closed from 1984 to June 1997, for restoration, refurbishment, renewal and consolidation works. When opened in 1997, the museum was a

[10] See Foster and Mourato (2000) for a more detailed description.

[11] The final survey followed a visitor's focus group, interviews to museum staff and museum director and a pilot study based on 190 CVM/CM valuation experiments, aimed at testing a previous CM format and at identifying upper and lower bounds on the implicit prices to be included in the final survey.

[12] Visitor's characteristics are reported in table 0, in the appendix.

[13] After testing Dicotomous Choice and open-ended formats, which gave inferior performances and were less accepted by people.

"new" Galleria Borghese[14]. Nonetheless, since then, no visitor survey has been carried out, leading to a complete unawareness of people preferences, degree of satisfaction, general perspectives on site services. The museum has attracted 426000 visitors (144000 free entries) in 1999.

The trend, after the boom of visitors in 1998, is characterised by a stabilisation /decrease in flows. It is thus relevant to assess preferences over possible future expansion of the "supply" of services, for a demand led approach to culture (Darnell, 1998). The aim of the work is not to find an "optimal" access fee (Bailey and Falconer, 1998; Steiner, 1997), supposing it exists, but to measure marginal values of service improvements, and to assess whether or not relevant marginal WTPs are present.

I focused attention on current users of the museum. Further analysis could be targeted both at current and potential users (Santagata and Signorello, 2000).

The sample for the CM experiment is composed of 185 "CM valid" questionnaires, 92% of total returned questionnaires. The percentage of people refusing to join the survey is less than 5%, for both CVM and CM. The final sample is then of 1935 observations, associated to 645 choices ("1") made by 185 respondents.

The questionnaire comprised three sections: the first introduced the subject of the study, the second contained a CVM exercise, the third presented the CM exercise and the latter requested information on socio-economic features.

The database is first estimated by using a Conditional Logit (CL) specification (Greene, 2000; Long, 1997; Maddala, 1983). The model is a special case of Luce model[15], derived from the IIA assumption[16], where indirect utility is a linear function of attributes.

The key assumption of Multinomial Logit model analysis (MNL) is the IIA assumption. Thus, in a pairwise comparison the choice between the two profiles on offer is assumed not to be influenced by the possibility that other profiles could be chosen. The IIA assumption is tested by a Hausman McFadden test[17], under the null hypothesis of no violation (equal coefficient between restricted and non-restricted models)[18].

Furthermore, a linear utility model is usually the standard specification of parameters, leading easily to estimating monetary and non-monetary trade offs between independent variables.

The scenario is quite peculiar for the CM literature, since the current status quo (instead of the usual *no choice option*) is included as a constant base. Welfare measures and preferences can be assessed with respect to a real baseline.

The survey above is designed with the assumption that the observable utility function would follow a strictly additive form, as in the following:

[14] A rough estimate of total costs (financed by the state through public expenditure) is 30-40 billion $, of which 4 billions spent from 1991 to 1997 (personal estimate on available data collected from informal sources, since no official data are available).

[15] Long (1997, p.178) notes: "*The conditional Logit model (CLM), sometimes referred as to Luce model of choice or (confusingly) the multinomial Logit model, is a closely related model in which the coefficients for a variable are the same for each outcome, but the values of the variables differ for each outcome. For example, if I am trying to explain a commuter's choice of transportation among the options of train, bus and private automobile, I might consider the amount of time or the cost per trip for each option. The effect of time would be the same for each mode of Travel, but the amount of time would differ by the mode of transportation"*

[16] Assuming there are no ties, the IIA means that if an individual is offered an expanded choice set, that does not change this odd ratio.

[17] The test is a variant of the Hausman specification Test; it is also possible to test the null hypothesis of no IIA violation by means of variants of likelihood ratio tests (Fry and Harris, 1998, 1996). In the present study I find consistent to implement the most standard and widely known Hausman test. The main reason is that option scenarios are not labelled, thus the procedure of dropping alternatives to compare max log likelihood is, theoretically, of minor relevance. Then, in this study Hausman statistics arise as positive (the main problem of the test is that is not bounded to be positive in finite samples).

[18] See Maddala (1983, p.77-78) for a good description of IIA Hausman McFadden test. The test statistic is asymptotically distributed as a chi-squared, with degrees of freedom the number of identified estimated parameters.

$V_{ij} = \beta_0$ (ASC) + β_1(Conservation) + β_2 (Fee) + β_3 (*Service1*) + β_4 (*service2*) + β_5 (access)[19] + Bj (a series of interactions terms between attributes and socio-economic variables)

Where β refers to some constant and other coefficients to the X vector of attributes describing the cultural site. I then estimate a Conditional Logit model describing the probability of a given choice as a function of museum services.

Attributes

The Galleria Borghese museum is described as a site offering multiple services to users. The following attributes and levels were specified:

- Entry fee (Monetary factor)[20]
  - 18000
  - 20000
  - 24000
- Conservation level/activity
  - status quo
  - enhanced non ordinary activity of conservation/restoration
- Access policy (visit hours)
  - 2 hours (status quo)
  - 3 hours
- Additional services (multi-media services and additional temporary exhibitions)
  - status quo (basic services)
  - multimedia audio-visual interactive services
  - as above plus "Temporary Exhibition", additional to the existing exhibition, located outside the main Gallery[21]

Choice sets consisted of pairs alternative to the status quo (which were defined over the status quo attribute level besides the price). About half of respondents faced 3 choice sets, while the other half 4. Visitors were interviewed both before and after the visit (ex ante and ex post), in order to test differences in coefficient and model significance (the effect of "experience"). The analysis of preferences and willingness to pay both before and after the cultural experience is worthy, being culture both an experience and a trust good (Bariletti and Causi, 1998)[22].

Thus, the data set allows so estimation of (and comparison between) attribute coefficient for a general model and for two sub-sample models (ex ante and ex post). Within models, the influence of the number of choices faced (3 or 4) is also assessable.

In each case, users were asked to choose option A, option B or the status quo (SQ). A and B were alternative profiles for Museum supply services, each bearing a price. The CM design incorporated three attributes only[23], set at two or three levels, plus the price, set at 4 levels.

The experiment considered, attempting to limit their influence, of "weaknesses" associated to Choice modelling, such as "cognitive burden", Framing issues", incentive compatibility", "Technical Complexities", "cost" (Bennett and Blamey, 2001).

[19] Income drops out, as it is constant across choices.
[20] Status quo fee is 14000 liras.
[21] This option was considered before are-opening the museum in 1997, and then never implemented.
[22] 90% were first visit visitors.
[23] I follow Foster and Mourato (2001) in using a simple framework, reducing as far as possible, compatibly with research objectives, the number of attributes and levels.

Regression acronyms are FEE (continuous), *CONS* (coded); *Accessd* (coded), Service 1 (multimedia services) and *Service2* (temporary exhibition + multimedia services). Besides Fee, which is continuous, others are "coded" dummy variables.

In order to reduce the complexity of the design, only a limited range of factor or attribute levels were used in the profiles. Thus, only two access levels (2 and 3 hours), 2 conservation levels (basic and improved), and 3 services levels were used.

The payment vehicle is presented as a user fee charge, on top of the current one, covering the costs of maintenance and conservation, and ranging over 4 levels.

The permutation of 4 attributes and the associated levels give a 2*2*3*3= 36 full factorial, in other words the total set of attribute-level possible combinations (*profile sets*). Such profiles have to be paired and compared to the status quo (choice sets rooted on 3 alternatives). It is worth stressing that in our case the status quo is defined by real level attributes and it is not, as in most studies, a "no choice" alternative. Although 36 are not an excessive number of combinations, a fractional factorial is constructed using SPSS devices. From a full factorial of 2*2*3*3, a fractional orthogonal factorial[24] of 9 profiles is selected. Since status quo attribute levels were present for all attributes but price, 2 option cards, which resulted with a higher price and status quo level, were dropped[25]. Thus, the remaining 7 cards lead to 21 pairs[26]. The feasible pairs were allocated into 4 groups formed by 3,3,4,4 choice sets. That is, four different questionnaires, concerning the CM experiment, were set up, leading to 4 sub-samples. Following Bennett (1999), the minimum number of people in a sub-sample should be around fifty.

The final set of presented option profiles is shown below. Examples of choice sets are available upon request.

Cards/profiles	Access	Conservation[27]	Cultural services	Price (italian lira)[28]
1	3 hours	0	Multimedia+ Temporary Exhibition	18000
2	2 hours	1	Multimedia+ Temporary exhibition	22000
3	2 hours	1	Multimedia services	18000
4	3 hours	1	0	24000
5	2 hours	0	Multimedia+ Temporary exhibition	24000
6	2 hours	0	Multimedia services	24000
7	3 hours	0	Multimedia services	22000

[24] In order to reduce the magnitude of the task facing respondents, a common approach is to select the smallest orthogonal main effects-plan, sampled from the complete factorial design, to select profiles to be used. The smallest orthogonal plan was created by SPSS, giving 7 available profiles to be paired and compared with the status quo. After dropping dominated pairs, a final set of 14 choice pairs was obtained. Building on that result, four blocks of choice sets (two of three and two of four) were set up. Each respondent faced one of the four choice sets: the goal was to structure the experiment as less burdensome as possible, without losing structural properties of the model.

[25] The intermediate study revealed that choice sets, which differ from the status quo with respect to every chosen attribute, were not completely accepted by users. Thus, scenarios depicting sharp changes from "policy off" (status quo) to "policy on" alternatives seemed not realistic. This is maybe due to heterogeneity of preferences: some user preferring the status quo level for some attributes. I am indebted with Prof. Nick Hanley for this point.

[26] The Pairs to be compared with the status quo resulted, after a process of sequential elimination of non-relevant pairs (where a dominant option is present), to be 14 (feasible choice pairs).

[27] 0= status quo; 1= additional expenses on non ordinary activities of restoration and site conservation.

[28] 1€= 1936,27 £

Qualitative variables were coded using code effects dummies, and the models defined and calculated by omitting the level from each attribute set as a base, in this case the status quo level. In order to check and eventual "status quo (SQ) bias", the alternative specific constant (ASC) is specified as a dummy variable (ASC10) taking the value 1 for options other than the SQ.

Since individuals were used to choose only one alternative from each set of profiles, a Random utility model (RUM) is used to analyse how choice are related to attribute levels and socio-economic features. I recall that such models are based on the hypothesis that individuals make choices based on the attributes of the alternatives (an objective component) along with some degree of randomness (a random component). This random factor is consistent with random individual preferences. It is also consistent with the realistic notion that the researcher only has a partial knowledge of the real structure of preferences, while the unknown component is assumed to behave stochastically.

Based on repeated observations of choices, one can examine how the levels of various attributes influence individual utility, and compare them with a priori expectations.

3. Beyond Conditional Logit: Heteroskedastic Extreme value model and Random Parameter Logit

The sections below are intended to present and compare three different specifications for the analysis of multinomial data derived from survey based analysis of preferences over multi-dimensionally defined mixed good: conditional basic logit, Heteroskedastic models (HEV) and random parameter Logit (RPL). Building different CL specifications, further more advanced and comparative analysis is performed by using HEV and RPL models[29].

3.1 Conditional Logit specifications

I present below two Conditional Logit specifications: a first basic model with attributes only (standard CL) and a hybrid model including socio-economic factors (interacted with the monetary factor since they are choice invariant). The Hausman statistics for testing the IIA hypothesis are also reported.

I. Basic CL

I first specify a standard CL model without including socio-economic elements, depending only on site attributes. For each attribute the status quo level is set as the constant base. The model parameters estimated then reflect differences in choice probabilities between those base levels and specific attribute levels.

Both linear and quadratic specifications were tested, with the linear one performing best in terms of overall significance of coefficients[30].

The choice between the two models, as observed by Adamowicz et al. (1998), should also take into account theoretical implications for welfare measures assessment. In fact, McConnell (1995), using the idea of consumer surplus for probabilistic choice models to calculate welfare measures, but without assuming that the agent's budget is balanced in each period, concludes that "*The behavioural model which stems from a logit or extreme value distribution can be used to compute a willingness to pay measure which is consistent with the measure*

[29] LIMDEP 7.0 and Nlogit 2.0 are used as softwares.

[30] As stated by Hanley et al. (1998a,b; and Bennett, 1999) testing both forms is necessary as no a priori consensus exist over the appropriate functional form to fit Choice modelling studies.

derived from utility maximisation. This means that one may use the RUM welfare measures with confidence. despite the awkward interpretation of the budget constraint. One need not worry about the time dimension of the budget constraint. This does not imply that the calculation of welfare measures should be changed. That is the point. An equivalent welfare measure stems from the model, whether one uses the behavioural interpretation or the utility theoretic interpretation".

And, further:

"When the budget constraint is non linear, the equivalent interpretations fail. This is consistent with the standard result that Hicksian and Marshallian schedule differ when there is an income effect. It should make one wary of indirect utility functions which are non-linear in income"(p.269-70).

The econometric investigation based on the linear additive utility function shows that the fee (monetary) coefficient is negative, which confirms the *a priori* expectations that increasing fees make negative contributions to user's utility, but not very significant in the standard model *Cons* and *service2* are significant and show expected positive sign; ASC 10 is negative, showing a "status quo bias choice", which will be confirmed, but never statistically significant, in other models.

The chi-square statistic allows us to reject the null hypothesis that none of the variables are significant elements of choice at the 100% level.

More interesting, as far as IIA assumption is concerned, a Hausman- McFadden test shows that the restrictive assumption is not violated in a basic CL framework: chi-squared test statistics do not allow a rejection of the null hypothesis (table A). This is a quite rare outcome in the literature (Foster and Mourato, 2000).

Table I. Standard Conditional logit
(Values for regressions with included WTP*fee are shown in brackets)

Variables	**Coefficient**	**T value**	**Marginal WTP[31] (part worths)**
ASC10	-.7933 (-8789)	-1.187 (-1.316)	
CONS	.3802 (.4320)	3.710 (4.000)	7.8 (7.92)
Accessd	.004009 (.0364)	.037 (.339)	
Service1	.0708 (.2813)	.509 (.2.072)	
Service2	.2409 (.2813)	1.798 (2.089)	4.94 (5.15)
Fee	-.0487 (-.2869)	-1.296 (-5.694)	
WTP1fee	(.0148)	7.413	
N	1935(645)		
Log L(0)	-708		
LogL(max)	-677.55 (-644.37)		
Chi-sq	37.14[5]		
R2	.04382 (.113)		
R2(adj)	.03935 (.105)		

[31] In thousand lira.

I now turn to a "hybrid CL" specification, which incorporates socio-economic features in order to increase model significance by adding more heterogeneity[32].

II- "Hybrid" CL Model[33]

There are several possibilities for improving model fit (and removing IIA/iid violations). As suggested by Rolfe et al. (2000) and McConnel and Tseng (2000), the inclusion of socio-economic attributes is a simple but important step for estimating more accurate models of choice.

I thus specify a hybrid conditional logit model including age, sex, income, occupation, education, and a dummy dividing visitors in Italian and foreign. A possible limitation of the approach is that a priori selection of characteristics is required, depending on available data. Age and income are the only continuous variables, others are 1-0 dummies. Such variables were interacted both with the ASC_{10} dummy and with the fee monetary attribute[34], comparing achievements. As a result, a model with (*fee) interactions was chosen since it performs relatively better (Foster and Mourato, 2000).

In summary, the main results are:

- As far as attributes are concerned, *Conservation* still turns out to be the most significant element. In the "*fee model", *fee* is highly significant, and *Service 2* increases t value; *Accessd* and *Service1* confirm their non-significant t values.
- As far as socio-economic factors are concerned, Income turns out to be highly significant, with positive sign. Age is significant (+), while education, nationality, occupation and sex are not[35].
- Building on this result, additional interacted terms are introduced (individual factors*attributes) using the four relevant factors . A model with higher fit and attributes Service1 and Service2 both significant arises[36]. Taking into account only statistically significant interactions, "from*cons" results significant, showing a preference by foreign users toward conservation goals; Stud*serv1 also is significant but with negative sign, showing a preference of relatively low educated people for multimedia services (table II). A log-likelihood ratio test leads to rejection of the null hypothesis of structural similarity between the two hybrid CL models: adding new interactions change the model and explain more heterogenity.
- As far as the pseudo R^2 measure of fit is concerned, an improvement occurs for all hybrid models. This means that extended specifications explain more comprehensively the choices made by respondents; it has a higher level of parametric fit compared to the basic model, with improvements in log-likelihood values. The improvements are tested for significance with a

[32] It is worth noting that the structure of RUM allows researchers to examine two forms of heterogeneity: (i) heterogeneity in tastes; (ii) heterogeneity in scale. Adamowicz and Boxall (2001, p.10) stress: "*the first involves relaxing the assumption of the same indirect utility function for each individual. The second involves identifying individual characteristics that explain the noise or error variance surrounding the estimation of the indirect utility function"*

[33] Long (1997, p.180) affirms: "*I suspect that at some point the most useful models for the analysis of nominal outcomes will combine characteristics of the Multinomial Logit and Conditional Logit"*. Choice modelling represents an example of such a combination.

[34] I tried to test both interactions since there is no suggestion in the literature on which attribute to choose for modelling interactions. I am indebted to Susana Mourato for this point. Further analysis is obviously needed.

[35] In order to achieve more generality and robustness, a log-likelihood ratio test was implemented to compare different segments of the population. The total sample is divided in two mutually exclusive sub-samples, by socio-economic variables, to check structural changes originated by differences in those factors. Results are presented and show that while age and income confirm their relevancy; also education and nationality appear as elements influencing coefficient estimates. Thus, both approaches are worth being implemented.

[36] Although a t test does not allow rejection of coefficient equality: respondents may, in part, have perceived the attribute as holistic (expressing WTP for more additional services).

version of a Swait-Louviere log-likelihood ratio test[37] (differences are tested in table B by Swait-Louviere log-L ratio test);

- The Hausman test performed on Hybrid models still shows that the null hypothesis cannot be rejected given critical chi-square values, for both models. This result confirms the previous outcome. Thus, hybrid models appear to statistically outperform basic CL (Table C).

Although micro econometric investigation is usually more focussed on coefficient significance rather than overall fit measures (for which interpretation is somehow unclear), I attempted to add new information concerning people heterogeneity, in order to increase pseudo R^2 and also parameter significance. Exploiting the information on WTP for the visit in the status quo collected by the preliminary and complementary CV experiment, a new interaction variable is created (WTP*fee[38]). This independent variable may capture more specific preference heterogeneity than the income interaction, since it shows higher variation than income does. It is also more specific, compared to socio-economic elements, to people preference for the site, since it represents individual WTP for visiting the site as it is now.

Results are worth being noted: the inclusion of WTP*fee, both alone and added to the hybrid model with age and income, rises R^2 in those modified models. The interpretation is that more preference heterogeneity enters the model when including information on CV based WTP[39]. Part worths are more conservative than before in both standard and hybrid models, while significance levels show robustness. Thus, information collected on WTP by CVM arises as complementary, and can be used as an explanatory factor in choice modelling analysis.

Nonetheless, As far as IIA assumption is concerned, a Hausman- McFadden test shows that the restrictive assumption is violated when the WTP1*fee interaction is introduced.

Thus, although a general robustness of CL models[40] has arisen, further investigation, by using models relaxing the IIA assumption, is needed.

The section has shown the CL model to be robust when heterogenity is captured by adding interactions. The cost factor is significantly negative, conservation is perceived to be associated to relevant economic value, and also services (although they may be perceived somehow aggregated) are significantly associated to user prefernces. The access policy is instead not significant: the SQ is fine for most users[41]. Then, although a bias toward the status quo appears, (negative sign on ASC10), the coefficient is never statistically significant.

The robustness arisen so far needs further analysis, by comparison with models, which drop off the IIA restriction. If CL specifications show to be consistent with results of non-IIA models, the consistency of the CL model itself is reinforced by a test of "external validity".

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[37] The test statistics is asymptotically distributed as chi-squared, with degrees of freedom equal to the difference in estimated parameters, and is expressed $-2(LL_1 - LL_2)$, where LL are the log-likelihood statistics for the two models (Foster and Mourato, 2001; 2000).

[38] Both models with WTP1*ASC10 and WTP1*fee were checked. The former interaction variable adds more significance, and the two elements interacted show no correlation, thus it was selected for introducing more heterogenity into the model. Although coefficients appear slightly different between the two specifications, and marginal WTPs lower when ASC10 is introduced, an Hausman test generates a statistic of 11.222 at 7 d.o.f. Thus, the null hypothesis of equal coefficients cannot be rejected. On this basis, we opt for the WTP1*fee specifications, associated to a higher overall fit.

[39] The second part of the questionnaire elicited willingness to pay for the visit in the status quo and for financing a conservation fund earmarked to special interventions and conservation activities. For the former, excluding protest values, mean and median values are 7.46 and 6 (6.33 and 4 including protest bids); for the latter 16.99 and 16 (excluding who expressed 14 or less as a protest) (*1000, Italian thousand liras. 1€=1936,27£). This shows that the status quo fee is perceived high given the *current* array of services offered to the public.

[40] A Likelihood ratio test overwhelmingly rejects the null hypothesis that models with and without WTP1*fee are structurally the same, with chi-squared values of 45.2 and 75.86 at one degree of freedom.

[41] Quite interestingly, segmentation by nationality shows that a significant coefficient on access is found for Italian people, while foreign users (mainly tourists) are well with the status quo.

Table A. IIA/IID Hausman test

Alternative dropped	Chi-sq	Degrees of Freedom	Comment
A	4.27	5	No rejection/ No violation[42]
B	3.35	5	No violation
C	6.78	5	No violation

Alternative dropped (including ASC10)	Chi-sq	Degrees of Freedom	Comment
B	3.008	6	No violation
C	6.39	6	No violation

Table II. CONDITIONAL hybrid LOGIT WITH SOCIO-ECONOMIC INTERACTIONS (interactions *xfee*) (Values for regressions with included WTP*fee are shown in brackets)

	Model I (age and income)				Model II (age, income, from, study)		
Variables	**Coefficient**	**T value**	**Marginal WTP**		**Coefficient**	**T value**	**Marginal WTP**
ASC10	-.802 (-.8688)	-1.229 (-1.320)			-.8925	-1.355	
CONS	.377 (.4079)	3.73 (3.964)	6.6 (8.5)		.2655	2.363	7.47
Service1	.102 (.129)	.746 (.930)			.3013	1.983	2.54
Service2	.244 (.2781)	1.84 (2.072)	4.3 (5.81)		.2655	1.946	1.8
Fee	-.181 (-.3768)	-3.78 (3.67)			.1798	3.711	
Accessd	.0093 (.03878)	.089 (.362)			.02019	.190	
Income*fee	.01 (.0065)	4.69 (2.66)			.0105	4.52	
Age*fee	.0016 (.00201)	2.01 (2.368)			.0016	2.05	
From*cons					-.2740	-2.524	
Stud*service1					.2161	2.284	
WTP1*fee	(0.128)	6.336					
N	1935 (645)				1935		
LogL (max)	-656.58 (-633.72)				650.57		
R2	.0734 (.1056)				.08190		
R2(adj)	.0676 (.9939)				.07473		

[42] Null hypothesis (no IIA violation) cannot be rejected.

Table B. Swait-Louviere log-Likelihood test (basic vs extended models)[43]

Calculated statistics compare log-likelihood for the standard model and the two extended hybrid models (*fee)

Model (age and income)	chi sq	43.14 [2]
Model (age, income, from, study)	chi sq	57.18 [5]

Table C. IIA/IID Hausman test (*fee model)

Alternative dropped	Chi-sq	Degrees of Freedom	comment
A	8.01	7	No IIA violation/ No rejection
B	10.06	7	No violation
C	8.05	7	No violation
Including ASC10			
B	9.44	8	No violation
C	7.71	8	No violation

IIA/IID Hausman test (basic and hybrid models including WTP1*fee)

Model	Chi-sq range	Degrees of Freedom	Comment on null Hp
Including WTPfee BASIC			
	15.71-20.95	7	Cannot be rejected: IIA Violated
Without ASC	7.23-21.57	6	Violated (not all alternatives)
Hybrid			
	16.79-47.18	9	Violated
Without ASC	11.6-49.62	8	Violated (not all alternatives)

3.2 Heteroskedastic Extreme Value (HEV) models

The robustness of the conditional logit model can be first test by a comparison with a Hev model, which relax the restriction of the IIA assumption, but only allows heterogeneity to be included in classic way. This permits a direct test of CL consistency

Bhat (1995) and Allenby and Ginter (1995) have developed an extension of the conditional Logit model that works around the IIA constraint. The model arises from the assumption that the error term has a Heteroskedastic extreme value (HEV) distribution. It simply relaxes the assumption of equal variances[44]. It relaxes one variance restriction. N-1 free variance parameters are present. The important fact is that HEV does not impose IIA. The CDF is *type 1 extreme value distribution* with precision parameter θ_j – the scale parameter is $\sigma j = 1/\theta_j$

For identification purposes, one of the θ_j is set equal to one[45].

[43] The degrees of freedom are given by the difference in the numbers of parameters estimated in the two models.

[44] Since the variable is latent, its mean and variance cannot be known. For identification purposes, at least one variance must be imposed. This is a general statement concerning discrete models based on latent variables.

[45] In Limdep, this is the last one.

$F(\varepsilon)= \exp(-\exp(-\theta_j \varepsilon_j))$

The ε are independent but not identically distributed, they have mean zero but variance $\pi^2 \theta^2/6$.

The main virtue of HEV is that it allows differential cross elasticities among all pairs of alternatives, which are all equal for each attribute within MNL/CL specifications. Unlike the nested models, it does not require partitioning of the choice set into branches to achieve that outcome. It also allows more freedom in variance terms.

Although it relaxes the IIA assumption, HEV compute variances (and consequently cross elasticities) associated to ASC Choice alternatives, not attribute coefficients. When, in non-market valuation experiments, policy alternatives are not "labelled" (are not directly linked to specific policies), such variances do not explicitly refer to specific attribute designs. This is to be borne in mind when comparing and interpreting results for different "non IIA" models.

I present below results for the basic and hybrid HEV models.

The basic HEV model, if compared to the basic CL model, does not lead to improvements in overall fit. Significant coefficients are those associated to conservation activities and a temporary exhibition. As far as the HEV model with socio-economic "interaction" factors is concerned, the R^2 fit slightly increases with respect to the hybrid CL model[46]. Coefficients confirm their (relative) significance, with age and income arising as the two socio-economic factors possessing explanatory power. The hybrid model confirms to be the most satisfactory HEV specification; nonetheless, its added value is not high, if compared to the CL specification[47].

The HEV model, when WTP*fee is included as independent variable, also shows a great improvement in pseudo R^2, while coefficient sign, value and significance are robust. Further, it is relevant to notice that scale and variance parameters become highly statistically significant. This confirms that preference heterogeneity is introduced and captured more consistently. An ancillary conclusion is that often model specification is not a sufficient instrument: using data gathered from different sources is a necessary process in order to increase model fit. In terms of fit, this seems to increase more when additional information is introduced than when non-IIA specifications are shaped.

To conclude, the HEV model does appear as non significantly different from the CL specifications, in any form presented. This confirms the robustness of the CL specification. Were the alternatives labelled, the HEV added value would be (probably) higher, using interactions for capturing heterogeneity.

I turn now to the more advanced and flexible specifications allowed by the Mixed Logit, or RPL, framework, which permits to model individual heterogeneity and to make some further and deeper investigation.

3.3. Random Parameter Logit analysis

Thus far a certain robustness of the CL model, and a structural similarity between CL and HEV, has emerged. A further proof of robustness for the CL models here specified (basic and with interactions) would stem from a comparison with the random Parameter Logit,

[46] A likelihood test chi-squared statistic of 45.44 (2 d.o.f) shows that, as before for the CL model, the HEV basic and hybrid specifications are statistically different.

[47] Based on a Hausman test for overall equality of coefficients, the basic HEV model is not significantly different from the CL one: the null hypothesis of coefficient equality cannot be rejected (the test statistics is .6851828, well below the 95% critical value for 5 d.o.f). The same is confirmed by a likelihood ratio test, which for both basic and hybrid models give a chi-sq. statistic (0,875 and 4,36 respectively) well below the critical value at 95% for 4 degrees of freedom.

Table III. Basic HEV model
(Values for regressions with included WTP*fee are shown in brackets)

Variables	Coefficient	T value	Marginal WTP[48] (part worths)
ASC10	-.935 (-.8779)	.4511 (-1.309)	
CONS	.43 (.3791)	3.05 (3.709)	8.53 (6.65)
Accessd	.20 (.0292)	.16 (.288)	
Service1	.098 (.0759)	.515 (.522)	
Service2	.285 (.2601)	1.559 (1.961)	5.7 (4.5)
Fee	-.0503 (-.2610)	-.993 (-4.214)	
WTP1fee	(.013)	(4.79)	
N	1935		
Log L(0)	-708.6		
LogL(max)	-677.12 (-643.87)		
Chi-sq	62.95 [8] (129.46 [9])		
R2	0.044 (.098)		
R2(adj)	0.038 (.091)		

Scale Parameters of Extreme Value Distribution (basic HEV)

```
  Coefficient          sd          t value    p value
s_A    .8682268485       .40407234    2.149      .0317
s_B     1.209845137      .28787990    4.203      .0000
s_C     1.000000000     ........(Fixed Parameter)........

          Std.Dev=sigma*pi/sqr(6) for H.E.V. distribution.

s_A       1.113544171       .51824289        2.149    .0317
s_B       1.551686639       .36922031        4.203    .0000
s_C       1.282549800     ........(Fixed Parameter)........
```

[48] In thousand lira.

Table IV. HEV Hybrid model with socio-economic factors
(Values for regressions with included WTP*ASC10 are shown in brackets)

Variables	Coefficient	T value	Marginal WTP[49] (part worths)
ASC10	-1.07 (-.7670)	-.31 (-1.107)	
CONS	.483 (.3899)	3.249 (3.733)	7.8 (5.8)
Accessd	.576 (.3737)	.406 (.362)	
Service1	.133 (.7575)	.612 (.502)	
Service2	.365 (.2814)	1.949 (2.088)	5.9 (4.2)
Fee	-.292 (-.3596)	-3.46 (-4.293)	
Income*fee	.016 (.006)	3.567 (2.36)	
Age*fee	.00319 (.0017)	2.165 (2.14)	
WTPfee	(.012)	(4.44)	
N	1935		
Log L(0)	-708.6		
LogL(max)	-654.4 (633.39)		
Chi-sq	108.33 [10] (150.41[11])		
R2	0.076 (.106)		
R2(adj)	0.069 (.098)		

Scale Parameters of Extreme Value Distribution (Hybrid HEV)

Coefficient	sd	t value	p value
s_A	.4455240490	.12991658	3.429 .0006
s_B	1.072208962	.28067341	3.820 .0001
s_C	1.000000000	.....(Fixed Parameter).....	

Std.Dev=sigma*pi/sqr(6) for H.E.V. distribution.

s_A	.5714067799	.16662449	3.429 .0006
s_B	1.375161389	.35997762	3.820 .0001
s_C	1.282549800	.....(Fixed Parameter).....	

[49] In thousand lira.

Which is a model, which allows a completely free matrix of variances and covariance's and two sources of heterogeneity[50], based on a mixed "logit-normal" specification, has arisen in the literature. This is the Random parameter logit, or Mixed logit (Greene, 2000; Train, 1998), which under mild regularity conditions is a RUM.

Train (1998) states:

"RPL generalises Logit by allowing the coefficients of observed variables to vary randomly over people rather than being fixed. With this generalization, the model does not exhibit the IIA property and its restrictive substitution patterns. In fact, any pattern of substitution can be represented arbitrarily by an RPL. The variation in coefficients over people implies that the unobserved utility associated with any alternative is necessarily correlated over time for each decision-maker. This correlation is incorporated into the estimation when there are observations on more than one choice situation for each person." (p.230)

Within a "choice experiment" environment, each respondent repeats n choices-at the same time- thus the unobserved portion of utility is (possibly) correlated across choices made and attribute scenarios (sites).

The model allows two sources of heterogeneity: one associated to the parameter variation (overall heterogeneity) and the other linked to differences across individuals (individual heterogeneity).

RPL allows (i) individual heterogeneity entering the model in a systematic way[51]; (ii) correlation over choices (time), whenever observations on more than one choice are available, and over attributes of choice.

The choice specific constants and the vector of B coefficients are allowed to be distributed randomly across individuals such that for each coefficient,

α or/and $B = \gamma + \delta Z + \sigma u$,

Where the mean is $\gamma + \delta Z$, (Z a vector of socio-economic characteristics which produce an individual specific mean, and γ the constant term), σ is the standard deviation of the distribution and u is normally or log-normally distributed- mean 0 and standard deviation 1- with correlation matrix R (Greene, 2000).

Thus, the two sources of heterogeneity and unobserved portions of utility (which includes an individual specific index) are $\beta X + \varepsilon$, which is correlated over sites (alternatives) and choices due to the influence of B. This drops out of the model the IIA assumption. If the standard deviations of coefficients are significant, the parameters do vary in the population, and the overall fit should end up with being higher. If they are not, a possible interpretation is that allowing coefficient to vary across individuals in a systematic way, as a function of individual characteristics does not produce added value with respect to the CL. In this case the RPL might collapse to a CL specifications[52] (in fact, both CL and HEV specifications are special cases of the mixed Logit)

[50] The two sources considered by mixed Logit models are (i) features of alternatives that are not recorded by the analyst and (ii) unmeasured consumer features that determines preferences (McFadden and Train, 2000).

[51] This relaxes the assumption of having the same coefficients associated to different people with same socio-economic characteristics.

[52] The test for the hypothesis that the RPL is the same as the conditional logit may roots both on the t-statistics for the vector of standard deviations and on likelihood ratio tests (McConnel and Tseng, 2000)

I present below results for the following RPL specifications, which include, as parameters of individual heterogenity, different set of socio-economic factors (W vector) [53].

A first model here considered includes all socio-economic characteristics in the W vector[54]. The fit is relatively high (comparable to the hybrid CL model[55]) and coefficients are all significant except "access"; the chi-squared value shows that the specification is highly significant as well.

The increased significance in *Service1 (and service 2)* and the reduced significance of the conservation element are worth noting[56]. This shows that a deeper modelling of heterogeneity can change attribute significance. It is worth noting that randomness in the cost factor has to be specified in order to make the RPL significant: as for the CL model, the latent heterogenity associated to the monetary factor is to be incorporated for achieving statistical significance. With respect to the basic CL model, a chi-squared Louviere test statistic at 69.42 [34 dof] shows that the two models are significantly different.

As noted above, another less arbitrary approach for selecting relevant socio-economic parameters is to segment the total population sample by available socio-economic elements, setting up a series of mutually exclusive segments (Foster and Mourato, 2000). On this basis likelihood ratio test is implementable in order to test if coefficient variations across segments occur (Ben-Akiva and Lerman, 1985). Performing tests on available variables revealed that only for income, age, education (study) and nations of origin (from) the null hypothesis of coefficient equality is rejected at 95% critical value. Results are shown in table VI. Thus, a second RPL model is estimated inserting those variables in the W vector.

A third model is estimated including age and income as explaining factors for preferences on site attributes, in order to allow comparison with the CL hybrid model (table V).

Results for both aforementioned models RPLII and RPLIII, which are not statistically different with each other (the chi squared value resulting from a likelihood ratio test is 15.84 with 10 d.o.f.)[57], are presented in table V.

Two outcomes are worth being underlined:

- The relative shift of significance from the conservation element to *service 1* and *service2* is confirmed, although RPLIII shows a conservation element which become significant at 10%. Fee is always highly significant[58]
- Among the set of interaction terms, the significant element arising within RPL model are shown in table VI. What is worth noting is that this set mimics the significances which are found when adding interaction terms to a basic CL models. Similarity is then reinforced.

  In our opinion, this is a further proof of CL robustness for the present database. Heterogenity is well captured by classic methods. An obvious suggestion is that,

[53] I do not allow ASC to vary randomly as in other studies (McConnell and Tseng, 2000) since in my case alternatives are not representing "policy labels". An ancillary result supporting this choice is that preliminary tests on regressions allowing ASC to vary randomly show lower overall significance.

[54] The dummy ASC is not included. The statistical similarity of models using the dummy ASC10 and ASCs (A,B,C) is confirmed by the value of the chi-squared statistic (0.14 with 1 d.o.f) for the likelihood ratio test.

[55] The relationship between CL and RPL is the following: when the standard deviation of random parameters in RPL is zero, the random parameter degenerates to the standard parameter estimates.

[56] The same result emerges in some CL hybrid specifications when attribute*individual factors interactions are introduced. All outcomes are not shown here but are available upon request.

[57] The RPL3 is not different from the CL including age and income interactions: 5,79 with 13 dof. The same applies when comparing RPL2 and a CL model interactions considering age, income, education, nationality: the chi-squared value is 9.04 with 20 dof

[58] The relevancy of socio-economic elements in explaining the cost impact was underlined by comparing the basic and hybrid CL and HEV models. The same holds here: the omission of the cost factor from the random coefficient vector in RPL leads to a less significant and statistically different model (26.06 chi-sq statistic with 8 d.o.f).

Table V. RPL (I&II)

Variable	Coefficient RPLI[59]	T value	Marginal WTP[60] (part worths)	Coefficient RPLII[61]	T value	Marginal WTP (part worths)
ASC10[62]	-.984	-1.322		-.895	-1.214	
CONS	.315	1.376		.2827	1.395	
Accessd	.253	.957		.2039	.888	
Service1	.465	2.28	1.53	.4158	2.173	1.65-3.7
Service2	.585	2.95	1.93	.5376	2.902	2.13-5.23
Fee	-.303	-3.87		-.2519	-3.603	
N	1935			1935		
Log L(0)	-708.6			-708.6		
LogL (max)	-642.84			-646.05		
Chi-sq	131.5 [34]			121.1 [26]		
R2	0.092			.08827		
R2(adj)	0.068			.06952		

RPLIII

Variable	Coefficient RPLIII[63]	T value	Marginal WTP[64] (part worths)
ASC10	-.7863	-1.11	
CONS	.3501	1.814	1.51-6.5
Accessd	.0918	.441	
Service1	.2897	1.666	1.25-5.44
Service2	.4305	2.487	1.86-8.1
Fee	.2317	3.491	
Significant interactions			
Fee:age	.00304	2.236	
Fee: income	.00957	2.575	
N	1935		
Log L(0)	-708.6		
LogL (max)	-653.68		
Chi-sq	109.84 [18]		
R2	.07751		
R2(adj)	.06445		

Table VI. RPL significant interaction Parameters (Heterogeneity in mean)

Significant Coefficient	t value	Significant Coefficient	t value

[59] W= all socio-economic parameters
[60] In thousand lira.
[61] W= age, income, from, study.
[62] Non random.
[63] W= age, income
[64] In thousand lira.

(W= all socio-economic factors)		(W= age, income, from, age)	
Fee :age	2.451	Fee :age	2.193
Fee:income		Fee:income	2.141
Fee:occ	1.982		
Serv:stud	-1.862	Serv:stud	-2.255

Table VI. Ben Akiva and Lerman Likelihood ratio test on structural change of coefficients[65]

Variable of sample segmentation	Test value statistic[66] [dof]	comment
Income	33.98 [6] 25.52 [7][67]	Reject null hp[68]
Age	22.04 [6]	Reject null hp
Gender	8.54 [6]	Do not reject
Education	13.18 [6]	Reject null hp
Ex ante - ex post visit	6.42 [6]	Do not reject
Nationality: Foreign/italian	21.5 [6]	Reject null hp
occupation	10.6 [6]	Do not reject
¾ choices presented	1.8 [6]	Do not reject

alongside with WTPs, great attention should be devoted to the quantity *and* quality of core socio-economic variables[69].

As a conclusion, incorporating heterogeneity by rendering attributes systematically dependent on socio-economic variables does not lead to specifications which have more explanatory power than the hybrid CL models. RPL models are not structurally different from CL ones when heterogeneity is incorporated. This is a further proof for CL consistency (a counter intuitive result) in the present case study.

Marginal Willingness to pay for new cultural services

This section presents a qualitative analysis on point estimates of marginal WTPs calculated across examined specifications[70].

[65] The test is based on a comparison between log-likelihood function for the model estimated on the pooled sample- where coefficients are implicitly restricted to be equal, and the sum of the log-likelihood's estimated across mutually exclusive segments. The test statistics is distributed as a chi squared variable with degree of freedom equal to the difference in the number of parameter estimated across the restricted and unrestricted models (that, is the number of parameters if an equal number of coefficients are present).

[66] Critical chi-sq value at 95% level is 12.59 at six dof.

[67] Including the income interaction term.

[68] Coefficient equality.

[69] A final check is attempted by relaxing the assumption of uncorrelated parameter; this leads to the following results.
A model which adds correlations between parameters (represented by the Choleski matrix) to the specification with W=(age, income, from, study) shows that correlations are not significant. The coefficient for attributes mimics those of uncorrelated specification; the specification is not statistically different from models without correlations.

[70] Train states (1998, p238): "*in all three scenarios* (a Clogit and two RPL) *the compensating variation from the logit model is between those from the two RPLs. Bhat (1996a) found that the estimated WTP for travel attributes were somewhat but not greatly*

I focus on CL (and HEV) hybrid specifications, and RPLII and RPLIII (incorporating age, income, nationality and education), which are respectively structurally similar models.

The analysis has shown that a positive and significant willingness to pay exists for non-ordinary conservation and restoration activities, and for ancillary services (multi-media and temporary exhibition). Instead, mean willingness to pay is not significant for increasing access time.[71]

Thus, the compensating variation for conservation is bounded between 6.6 and 7.47 thousand lira considering CL hybrid specifications, and between 6.5 and 7.8 considering also hybrid HEV[72].

The WTP for a temporary exhibition, additional to the visit at the main gallery, and multimedia services, arises, on the basis of CL and HEV specifications, bounded between 4.3 and 5.9. Considering also RPLII and RPLIII, the range is between 4.3 and 8.1. The WTP for only multimedia services (using RPL estimates) is instead bounded between 3.7 and 5.44.[73]

The value of new options and services

Building on the estimated WTPs and on Galleria Borghese figures for the year 2000, some estimation on potential additional surplus deriving from conservation activities and expansion of services are presented. Non free entries were 270855, 66% of total entries (411000), with a decrease of about 4% with respect to 1999. The study shows that the current access policy (2 hours visit) is perceived as fair by users, who do not express (on average) a positive WTP for staying in more. On the other hand, a positive WTP is associated to the possibility of using multi-media services, and to visit a temporary thematic exhibition. The study also shows that a consistent amount of WTP for specific (earmarked) non-ordinary conservation purposes is not currently captured.

Table VII presents figures for different options, using conservative point estimates for WTPs. The gross economic surplus, which is *potentially* capturable by introducing new services and earmarked conservation funds, is ranging between 30% and 118% of current direct revenue raised by fee charges[74], and between 22% and 86% with respect to the total yearly economic surplus figure (4.601.826[75]) calculated using mean WTP for access in the status quo, elicited by the CVM experiemnt (16.99 (8.7€)). Nonetheless, those figures are to be treated as a benchmark for economic surplus derived from new services and functions. In practice, it is obvious that (i) the amount of WTP for conservation is dependent on the extent of free riding behaviour, if the capture mechanism is a voluntary donation fund (Santagata and Signorello, 2000); (ii) given cultural institutions have only a limited power of implementing price discrimination, the estimated economic surplus figures are correct only under free service provision (funded by taxes, that is by the general public). In all other cases, the economic

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different in an RPL than a logit. These results might suggest that the logit model is fairly robust with respect to estimating compensating variations. However, these results are undoubtedly situation specific. Bhat (1996b), in a different situation, found large differences between a logit and an RPL in estimated WTP for travel mode attributes. Revelt and Train (1996) found that estimated WTP for appliance attributes differed between a logit and an RPL for some attributes and were similar for others. There is probably no general answer to whether logit obtains reliable estimates of compensating variations; to answer the question for any specific situation, estimation of an RPL is needed for comparison"[70]

[71] This does not mean that different segments of the user population may be associated to positive WTPs. Analysing segments is a good approach for founding the rationale of differentiated service and price policies.

[72] 7.46 and 6 are mean and median values (dropping protest bids) obtained by CVM in the final survey, for conservation earmarked activities.

[73] We should nonetheless recall that the mean WTPs for service1 and service2 may be, for the aggregate sample, not statistically different, therefore intended as values for the provision additional services (whose supply is currently poor). Again, more detailed analysis on segments would allow higher possibility of disentangling levels of the same attribute. A higher N will be needed anyway.

[74] The only source of direct financing at the moment.

[75] 2,37 millions of €.

surplus would be lower. Mix of charges and voluntary donations could be envisaged in order to find a balance between the competing ends of (i) reduction of demand distortions and (ii) minimisation of free riding.

If changes from the status quo should increase visitor's flows per year (by attracting new first visitors and incentiving further visits), total economic surplus would also increase.

All in all, the WTP estimated should be used to reckon the possible sources of *direct* financing, for implementing and funding conservation-targeted and access targeted investments plans[76]. The decision whether or not to charge is only in part driven by economic rationales (Davies, 1994, Montias, 1995).

Table VII[77]. Total gross WTP and strategy options

Options	attribute	mean WTP	added revenue reckoned on 2000 payment entries	2000 revenue	increase%	economic surplus	%
option 1	Multimedia services	3,7	1.002.163,5	3.348.000	30%	4.601.826,45	22%
option 2	1+temporary exhibition	4,3	1.164.676,5	3.348.000	35%	4.601.826,45	25%
option 3	Conservation fund	6,6	1.787.643	3.348.000	53%	4.601.826,45	39%
option 4	1+2+3	14,6	3.954.483	3.348.000	118%	4.601.826,45	86%

Conclusions

The study has methodological (econometric) and practical management implications.
As far as econometrics is concerned, the study has focussed on the following comparisons

- Between the conditional logit model and "non IIA" models;
- Between *standard* and CL *Hybrid* models.

Theoretical discussion does not suggest a preference for one model over the other. Any final statement should be based on considerations on the coefficient significance and overall measures of fit, specific to each model. Thus, the choice among IIA based and non-IIA based models needs empirical investigation case by case.

The implementation of likelihood ratio tests and Hausman tests has shown that:

- Hybrid models are generally structurally different from basic (CL and HEV) specifications. Interactions variables incorporating heterogenity lead to highly significant models
- CL basic models are not statistically different from HEV basic models; CL hybrid models are not statistically different from hybrid HEV and RPL specifications. This, in addition to the consistency with respect to IIA violation, supports the CL specification as far as the present setting is concerned.

The present study shows that heterogeneity in tastes is (partially) captured by the inclusion of socio-economic interactions in standard CL models[78]. The income and age interaction term prove to be significant across models, with the expected positive sign (the sign depends on the

[76] Given the discrete nature of attributes, it is barely impossible to recover demand schedule for each attribute.
[77] In Italian liras.
[78] And by analysis on different segments.

way the interaction term is set up), which confirms the assumption of economic theory that WTPs increase with income level (and age[79]).

Overall, the null hypothesis of the Hausman test cannot be rejected, in this study, for most specifications. CL models arise as consistent; this result confirms what found by Foster and Mourato (2000), but is not in line with Train (1998). Further research is needed for achieve more generality of results.

One reason for the emerging robustness of hybrid CL models may be the following: the implicit IIA assumption, while reasonable when all alternatives are recreational sites of the same type or alternatives concerning the same site, is not reasonable when the compared sites differ by type (Haab and Hicks, 1999). Thus, on this basis we should expect when implementing choice experiments on a single site, that the IIA assumption is consistent and not violated.

The other reason may be peculiar to the structure of demand for cultural heritage services. Most studies (Santagata and Signorello, 2000) find that cultural users (people with positive WTPs) belong to specific and elitist classes of the population, wherein variability and heterogeneity is lower. Thus, positive WTPs are expressed by a limited sub-sample of people. The present study is not different: the levels of income and education are well above the population means. Thus, further research is encouraged along this line of reasoning.

Heteroskedastic extreme value models do not lead, other things being equal, to marginally valuable results compared to the CL hybrid models. This may be due to the fact that, when policy options are not "labelled", the focus on ASC covariance-variance matrix is not relevant. Nonetheless, the inclusion of socio-economic interacted variables increases the significance of variance terms, confirming that adding explanatory factors to models captures heterogeneity.

Although RPL models are quite significant and robust, it emerges that they do not differ from hybrid CL models, which consistently capture heterogeneity in tastes, whenever good and reliable socio-economic data are collected[80]. This result, which nevertheless needs to be reassessed case by case, is partially in contrast to what emerges from the recent literature on RPL and discrete choice models.

The non-violation of IIA assumptions in CL models associated to a low "marginal value" of non-IIA specifications is a proof of consistency, showing that HEV and RPL superior performance cannot be taken for granted in applied studies. Nonetheless, it should be further investigated whether this result is dependent on the peculiar nature of *cultural users,* who belong to a specific and elitist, in terms of education and income, class of the population, wherein variability in preferences and socio-economic covariates may be somewhat lower.

Summing up, some results are found to be present across specifications:

(i) The cost factor is negative and significant in hybrid specifications: incorporating heterogenity is necessary for giving significance overall (R_2) and to single coefficients. Thus, the collection of good and reliable socio-economic data is a complementary and necessary task.

(ii) A status quo bias appears, although not significant on aggregate, in most specifications;

(iii) The introduction of WTP for the status quo, derived from a CV experiment[81], among interactive independent variables (WTP*fee), adds significance both to overall fit and to coefficients, for the cases of CL (where IIA violation nonetheless occur) and HEV

[79] The result is confirmed by the comparison of two low age and high age segments; the former show higher responsiveness to fees. The opposite, concerning age and cultural heritage WTP, is found by Santagata and Signorello (2000)

[80] More interactions arise as significant. A work in progress is devoted to CL hybrid specifcations

[81] Using a payment ladder format.

specifications. Using CV data thus allows more individual heterogeneity into the model, when the CV and CE experiments belong to the same population under study[82];

(iv) A major evidence shown by the present study is that non-IIA (RPL) specifications turn out not "dominant" in comparison to CL models. When CL hybrid models are specified by including interactions terms, heterogeneity is consistently captured.

As far as policy making is concerned, the following points may be drawn out:

- The study shows that, although the fee is perceived quite high in the status quo (this also emerges from complementary and preliminary CVM exercises), there exists space for capturing marginal WTPs by expanding the set of services and by implementing voluntary donations schemes (earmarked to conservation);
- The gross added revenue would be marginally substantial, in terms of museum budget, although free riding may reduce conservation-targeted estimated figures. On the other hand, the expansion of services may well increase the number of visitors (new visits and are-visits), leading to even higher increase in total gross revenue[83].
- The economic surplus figures are a benefit value benchmark, to be compared with costs of financing the improvements in services, exploiting visitor's WTP as one source within a multi- options financing strategy. Multi-financing is necessary in order to (i)
  This study has shown that cultural institutions may investigate by stated preference (survey) analysis which incremental services are valued by users and what the possible sources of economic (and financial) surplus are.[84] Although the budget of cultural institutions needs complementary public subsidies, finding sources of direct revenues is necessary to increase the "degrees of freedom" and be less dependent on political (changing) will.

All in all, choice experiments turns out to be a compelling economic tool for demand oriented management and demand –led policy making of cultural heritage sites, insofar it is deemed necessary (i) to value consumer preferences for "innovations" in cultural services (market and non market); (ii) to assess what socio-economic variables (and what attributes to different segments) are relevant for management and access policy.

Although complementary to CVM and qualitative socio-economic investigations, it arises as possessing greater potentialities, since information gathered by CE allows a larger array of analysis and considerations. The higher complexity in design and estimation can be easily overcome following implementation guidelines. Cultural institutions may well pursue ex ante study for assessing relative preferences, in terms of WTP, toward different services and option of supply expansion.

Nonetheless, an investigation based on alternative econometric specifications show and confirms that the analysis of choice experiment database warrants the implementation of different specifications, and need a comprehensive statistical investigation, to assess the extent to which alternative specifications, and consequently compensating variation figures, are really structurally different, and which one is the most consistent.

[82] I am indebted to Anna Montini for this point.
[83] Economic benefits would also be greater if free entries were included in total welfare accounts.
[84] For a discussion of "value and capture" mechanisms for cultural heritage policies see Pearce and Mourato (1998).

Appendix

Table 0. Sample descriptive statistics

Socio-economic CHARACTERISTICS (Means)	FINAL SURVEY (CM sample, N=185)
Age	38,7
Income (in lira millions)	6,25
Member (1=member of conservation associations)	.19
Sex (1=F)	.483
Education (1=laurea degree or more)	.626
From (1=foreign)	.533
Occupation (1=employed 0=students, unemployed, retired)	.675

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