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A NEW COEFFICIENT OF ECONOMIC VALUATION BASED ON UTILITY SCORES [1]

This paper proposes a new coefficient for measuring economic valuation based on utility scores and attribute importance values derived from standard conjoint analysis. The coefficient allows to quantify the impact of a change in an attribute of a good or service in monetary terms. We utilize the suggested coefficient for the economic valuation of a worldwide cultural event to reveal the trade-offs among its attributes in terms of total revenue variation. In addition, our findings indicate how the user degree of satisfaction affects the determinants of demand in generating an economic surplus or shortfall.

Keywords: conjoint analysis, willingness-to-pay, economic valuation, valuation of public goods.

JEL Classification: Z11, H41

1. INTRODUCTION

Conjoint analysis (henceforth, CA) is a widely used technique for investigating consumer choice behaviour in commercial studies (Green and Srinivasan 1978). More recently, CA has been developed as a stated preference method for the economic valuation of changes in multi-attribute non-market goods, such as environmental commodities or cultural goods (Roe 1996, Willis and Snowball 2009). Such an evaluation can be particularly useful for non-market goods whose purchasing process is not well defined given a lack of rivalry and exclusiveness (Sanz *et al.* 2003). In this paper, we focus on ranking-based conjoint analysis to derive a coefficient for valuing the revenue variation induced by a change in the combination of attributes of a given non-market good.

A number of stated preference techniques have been proposed with the aim of estimating the value of non-market goods (see Louviere *et al.* 2000;

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Mazzanti 2003). A common feature of these approaches is the elicitation of individuals' preferences over the attributes of a good to obtain estimates of individuals' willingness-to-pay for a hypothetical change in that good. The most common approaches for stated preference elicitation are the contingent valuation method (hereafter, CV) and the discrete choice experiment (DCE). A traditional CV survey asks respondents to express their maximum willingness-to-pay for a hypothetical change in a non-market good. Although consistency between stated willingness-to-pay and economic theory is still under debate in literature (Diamond and Hausman 1994, Hanley *et al.* 2001), when assuming that willingness-to-pay amounts which derive from the CV survey are an elicitation of the respondents' underlying preferences, the CV format represents a direct method for estimating the monetary value of a hypothetical change in a good.

The DCE approach presents each respondent with various alternative profiles (henceforth, simply 'alternatives' for the sake of brevity) which correspond to the possible combinations of the attribute levels describing a good; then, respondents are asked to choose the most preferred alternative from the set of alternatives. As noticed by Adamowics *et al.* (1998), this method is consistent with the random utility theory proposed by Lancaster (1966). DCE differs from the traditional CA used in commercial studies, since the latter usually asks respondents to rate or rank the various alternatives. Therefore, DCE does not exploit all of the information provided by respondents when they are asked not only to select the most preferred alternative, but also to rate or rank the various alternatives.

In this paper, we use the conjoint ranking response format in order to exploit the additional information upon respondent preferences in a conjoint ranking survey. A part-worth utility linear function is assumed as the preference model and the part-worth utilities for each level of the various attributes are estimated by using the OLS multiple regression. Our main objective is to develop a coefficient based on part-worth utilities which can determine the monetary variation associated with any change in the combination of the attributes of a non-market good (e.g. a cultural event) with respect to the actual revenue generated by that non-market good.

We apply the proposed coefficient to the world-renowned cultural event "Venice and Islam 828-1797": we first hypothesize some changes in the status quo of the cultural service offered to visitors, we then determine the hypothetical revenue variations by using the coefficient.

The remainder of the paper is organized as follows: Section 2 outlines the framework of the CA use for non-market economic valuation and introduces a conjoint-based coefficient of economic re-evaluation; in Section 3 we apply the coefficient to a ranking conjoint survey carried out from July to November 2007 among visitors of "Venice and Islam 828-1797", a cultural event that was held in Venice; Section 4 concludes.

2. A CONJOINT-BASED COEFFICIENT OF ECONOMIC VALUATION

We firstly introduce the stated preference model we use to obtain part-worth utilities (Subsection 2.1), we then propose a new coefficient that measures the monetary variation linked to a hypothetical change in the combination of the attribute levels of a non-market good (Subsection 2.2).

2.1. Preference Model

In general, studies investigating willingness-to-pay for environmental or cultural goods use either CV or DCE as the stated preference elicitation technique (Boxall 1996, Bille Hansen 2003, Sanz *et al.* 2003, Mazzanti 2003). A typical CV survey asks the respondent about his/her maximum (or minimum) willingness-to-pay for a hypothetical change in a non-market good. As noted by Irwin (1993), the CV process of making decisions differs from that required by the standard conjoint format of DCE in which the respondent is asked to compare alternatives which have a pre-specified price. Given its capability to evaluate differences in preferences of a multi-attribute good, the DCE approach has begun to be used as a multi-attribute based approach to elicit preference structure for non-market goods, such as cultural events (Willis and Snowball 2009) or environmental goods (Roe 1996). As price is commonly included as an attribute, DCE provides an estimate of price utility score which can be compared to those of the remaining attributes, even though this approach may imply some problems (Breidert, 2006).[2] DCE adopts a choice modeling approach consistent with random utility theory (Mackenzie 1993, Mazzanti 2003). The random utility model

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[2] Breidert (2006) fully discusses the implications of including price into conjoint design, raising both theoretical and practical issues linked to this procedure. For instance, the author argues that "treating price as an attribute in a conjoint study, part-worths are estimated for the presented price levels as for the other attributes. By definition, the price of a product does not have a utility, rather it reflects the foregone alternative consumption (with the associated utility) if the product is purchased".

often works on the probability of choosing the most preferred choice from the set of alternatives. But this model does not fully exploit all the information contained in the conjoint ranking format. When respondents are asked to express the exact rank order of the alternatives included in a set of choices, the additional information about ordinal ranking of the remaining alternatives beyond the first choice is not utilized by modeling the probability of any specific alternative being chosen as the most preferred. Beggs *et al.* (1981) developed a rank data model which is consistent with the random utility theory and exploits all the information provided by a full ordering of the various alternatives. However, this model critically relies on the assumption of independent and irrelevant alternatives (IIA), the violation of which implies that the use of the model is not legitimate (Foster and Mourato 2002). Hausman and Ruud (1987) argued that IIA violation does not illegitimatize the use of the rank data model when aiming at estimating willingness-to-pay measures. In Allison *et al.* (1994), it was noticed that the use of the rank data model is feasible if its estimates are considered as an approximation of the preference structure of respondents.

More recently, Louviere *et al*. (2010) argued that DCE differs from traditional CA since there is no error theory associated with CA. Accordingly, DCE seems more suitable than CA for eliciting choice behaviour, since the former shows a well-founded theoretical basis in random utility theory. On the other hand, there are at least two remarks in favour of the use of CA. First, when a respondent is asked to rank various alternatives, one can assume that the ranking behaviour is related to the choice behaviour (Chapman and Staelin 1982), enabling the ranking choice process to be decomposed into a process composed of a set of DCEs (Louviere *et al*. 2010, p. 64). In this case, the difference between discrete choice models and CA in understanding the underlying choice process seems less evident. Second, by using fractional factorial designs instead of full factorial design, CA reduces the set of alternatives the respondent is asked to rank, allowing one to face situations where there are several combinations of attribute levels.[3]

In this paper, we focus on ranking scale and opt for a very general preference model used in traditional CA. In fact, we exploit the information contained in the ranking conjoint format by regressing the individual responses on a piece-wise linear function of all the attribute levels which

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[3] As pointed out in Foster and Mourato (2000), ranking a set of alternatives which contains more than eight alternatives may be cognitively difficult for respondents.

describe the good in question. Since conjoint data is collected on a nonmetric scale, a nonmetric estimation procedure like MONANOVA would be more appropriate than OLS; however, as demonstrated in Carmone *et al*. (1978) and Cattin and Wittink (1982), the OLS regression provides similar parameter estimates for both ranking and rating scales, therefore it seems a reliable estimation procedure. This function is defined as follows,

$$U_k = \sum_{i=0}^{n} \beta_i x_{ik} \quad (1)$$

where x_0 is equal to 1 and n is the number of all levels of the attributes which define the combination of a given good. Each variable x_{ik} is a dichotomous variable which refers to a specific attribute level, and it equals 1 if the corresponding attribute level is present in the combination of attributes which describes the alternative k, otherwise that variable is 0. As a result, the utility associated with alternative k (U_k) is obtained by summing the terms $\beta_i x_{ik}$ over all attribute levels, where β_i is the partial change in U_k for the presence of the attribute level i, holding all other variables constant. We refer to this piece-wise linear function as a part-worth function model which gives a specific utility value for each level of the considered attributes, usually referred to as part-worth utility. As a consequence, the number of parameters estimated by assuming the part-worth specification is larger than that required by alternative preference model specifications, such as the vector model form and the ideal model.[4]

2.2. A New Coefficient of Economic Valuation

Having chosen the preference model (and the ranking scale), we then proceed to develop a coefficient of economic re-evaluation for a hypothetical change that occurs in the combination of the attribute levels. We introduce the following notation:

- Let b be the current profile (hereafter, status quo) of the good or service;
- Let i (with i=1,…,n) be the alternative profile which differs from b for the attribute level i;

[4] The vector model states that a single linear function relates preference to a given quantitative attribute and it needs to estimate the fewest number of parameters. In the ideal point model, the number of estimated parameters is lower than the part-worth model but higher than the vector model (Green and Srinivasan 1990).

- Let U_b denote the sum of the part-worth utilities associated with the status quo of the good or service;
- Let U_i denote the sum of the utility scores associated with the alternative profile *i*.

We can calculate the total utility variation obtained by replacing one attribute level of the status quo *b* with the attribute level *i*, that is when passing from the status quo *b* to the alternative profile *i*. M_i indicates the ratio which results by dividing the difference between the total utility of the alternative *i* and the status quo one by the total utility of the status quo (Mariani *et al*. 2011), formally

$$M_i = \frac{U_i - U_b}{U_b} \tag{2}$$

where U_b is assumed to be different from 0.[5] The ratio in (2) indicates whether the status quo modification generates a loss or a gain in term of total utility. It is evident that a zero value for M_i represents the indifferent situation between loss and gain in terms of total utility. However, the utility modification arising from an attribute level modification can be considered more or less important by respondents. Consequently, such an attribute level modification can have a more important economic impact than a utility modification which has a similar intensity but involves a less relevant attribute. As a solution, we propose to weigh M_i by the relative importance of the modified attribute.

The range of the utility values (from highest to lowest) for each attribute provides an indicator of how important the attribute is compared to the remaining attributes. Attributes with larger utility ranges play more important roles than those with smaller ranges. For any attribute *j*, the relative importance can be computed by dividing its utility range by the sum of all utility ranges as follows

$$I_j = \frac{\max\left(W_j\right) - \min\left(W_j\right)}{\sum_{j=1}^{J}\left[\max\left(W_j\right) - \min\left(W_j\right)\right]}, \tag{3}$$

where J is the number of attributes and W_j is the set of part-worth utilities referred to the various levels of attribute *j*. Usually, the importance values are represented as percentages and have the property of summing to one

[5] Assuming U_b=0 is equivalent to say that the utility score associated with the status quo is zero. Since this situation is unlikely, assuming $U_b \neq 0$ is a very weak constraint.

hundred. Otherwise, we can express these importance values in terms of decimal fractions whose sum is one. If this is the case, entering the importance of the modified attribute in equation (2), the coefficient formulation becomes

$$MI_{ij} = M_i * I_j . \tag{4}$$

Since U_b can be negative, the general formulation of the coefficient is

$$MI_{ij} = \begin{cases} \dfrac{U_i - U_b}{U_b} * I_j & U_b > 0 \\ \dfrac{U_b - U_i}{U_b} * I_j & U_b < 0 \end{cases} . \tag{5}$$

We can use formula (5) for estimating the variation of the total revenue generated by assuming a change in the status quo profile. Given the total revenue associated with the status quo profile, π, the coefficient of economic re-evaluation is expressed as follows

$$V_{ij} = MI_{ij} * \pi , \tag{6}$$

where V_{ij} denotes the amount of the revenue variation. Revenue variation in equation (6) is obtained by supposing that the monetary attribute referred to a non-market good (price or admission charge) varies in proportion to the change in total utility of that good. Although this assumption seems restrictive, we argue that if the monetary amount asked to a user concerning a non-market good (e.g. a cultural event) reflects on how that user values the combination of attributes of the good in terms of utility, it is credible to assess the economic value of a change in the combination of attributes as a function of the utility and importance of the modified attribute. In addition, we notice that CA serves the scope of approximating the real structure of preferences, given that only a partial knowledge of preferences can be known. We therefore suggest using the coefficient of economic re-evaluation as a monetary indicator which approximates the impact of a given utility change in monetary terms.

3. APPLICATION TO A CULTURAL EVENT

We apply the coefficient to a survey which refers to the cultural event “Venice and Islam 828-1797”, held in Venice, Doge’s Palace (28 July - 25 November 2007). After Paris and New York, this large-scale exhibition on the relationship between Venice and the world of Islam was hosted in Venice itself in the symbolic Doge's Palace.

Scholars from the Institut du Monde Arabe in Paris, the Metropolitan Museum of Art in New York and the Musei Civici Veneziani, worked together to produce the exhibition. Many of the exhibited works were rented by European and American museums and some private Venetian collections. The exhibition consisted of various sections illustrating different chronological phases and topics of the millenary relationship between the Venetian and Islamic civilizations. The path of the exhibition begins with the legendary transfer of San Marco's corpse from Alexandria to Venice (827) and continues up to the end of the 'doge' era in 1797.

3.1. Survey Design and Data Collection Method

The sample comprises 501 respondents who were interviewed after the visit. Data was collected by using face-to-face interviews in which each respondent was asked to rank alternatives included in a set of choices presented within a questionnaire. The questionnaire was divided into four sections. In the first section, the respondent was asked to give the reasons that induced him/her to visit the exhibition and to describe the visit through a series of either bundled or unbundled questions. In the second section, the respondent gave answers about the sources of information used to gather information concerning the cultural event. Furthermore, in this section, the respondent could express a judgment concerning the use of complementary services to be implemented in the visit in accordance with his/her experience. In the third section, the respondent was asked to rank a set of alternatives concerning the arrangement of the exhibition. The last section was devoted to collecting information on the socio-economic characteristics of the respondent.

The alternatives included in the set of alternatives were taken from a full factorial design produced by a permutation of all the attribute levels. Each alternative is described by four attributes: admission charge, location, modality of gathering information about the exhibition, additional information services. Admission charge is defined over three ticket levels. A dichotomous attribute locates the venue in Venice or in a different place. A further attribute distinguishes between information about the exhibition provided to visitors by organizers and information gathered by visitors autonomously. Another dichotomous attribute refers to the presence (or absence) of additional multimedia services that help in the understanding of the exhibition. Starting from a full factorial which comprises ($2\times2\times2\times3=24$)

profiles, we created a fractional factorial design for main-effects which included eight profiles (Addelman 1962).

3.2. Analysis of Results

In this section, we hypothesize changes in the status quo and we then calculate the corresponding revenue variation by using the coefficient of economic valuation. We pursue this objective in two stages. Firstly, we estimate part-worth utilities and the relative importance for each attribute. Secondly, we use these estimates to obtain a valuation of revenue variation associated with a change in the combination of the attributes describing the cultural event in question. We also investigate how the degree of visitor satisfaction affects the visitor preference structure in terms of utility.

We estimate the part-worth utilities using OLS.[6] Table 1 shows the utilities for each attribute level and the relative importance assigned to the corresponding attribute. Table 1 shows that visitors prefer the venue in Venice rather than in a different place. Visitors seem more interested in collecting information about the exhibition autonomously. In so doing, visitors show a preference towards the provision of additional multimedia services which makes the exhibition easier to understand.

Table 1

Part-worth utilities and attribute importance values

Attribute	**Level**	**Part-worth utility**	**Attribute importance**
Venue:	Venice	0.692	0.23526
Venue:	Other place	-0.692	
Inf. concerning the exhibition:	Autonomous	0.355	0.13948
Inf. concerning the exhibition:	Induced	-0.355	
Additional inf. services:	Present	0.567	0.24974
Additional inf. services:	Absent	-0.567	
Admission charge:	Ticket EUR 8-10	1.266	0.37552
Admission charge:	Ticket EUR 11-12	-0.124	
Admission charge:	Ticket >EUR 12	-1.143	
Intercept		4.183	.

Source: own calculations on data provided by the “Fondazione di Venezia”

[6]OLS regression is performed using SPSS statistical package.

Table 1 also presents the importance for each attribute. The admission fee emerges as the most important attribute in terms of relative importance. The modality of gathering information appears as the least relevant attribute whereas location and additional multimedia services show a similar level of relative importance.

The part-worth utilities and relative importance values shown in Table 1 can be used to estimate revenue variation generated by the change in the status quo in accordance with equation (6). We therefore compute the total utility associated with the status quo by summing the part-worth utilities of the corresponding attribute levels. Thus, we can hypothesize any change in the status quo combination of the attribute levels and calculate the total utility assigned to that alternative. Table 2, column 1 outlines the combination of attribute levels specifying the actual exhibition (status quo). If we hypothesize that the revenue generated by this status quo is EUR 93,200 (π), we can estimate the revenue variation induced by a single attribute level change as shown in Table 2.

Table 2

Economic re-evaluation by changing a non-monetary attribute

Status quo	**Modification of attribute *j***	MI_{ij}	$V_{ij}(€)$
Venue in Venice	Other place	-0.06236	-5,811.84
Information concerning the exhibition (induced)	Autonomous	0.01899	1,770.01
Additional multimedia services (absent)	Present	0.05430	5,061.19
Number of observations		501	

Source: own calculations on data provided by the “Fondazione di Venezia”

Table 2 shows that revenue decreases if the venue changes (EUR -5,811.84). Revenue increases by EUR 5,061.19 when multimedia services are available. Furthermore, as visitors prefer gathering information autonomously, such an option generates a revenue gain of EUR 1,770.01.

We then distinguish between visitors who declared that the admission charge was too high and visitors who were happy with it, in order to check whether the utility estimates are influenced by visitor opinions after visiting the exhibition.[7] We create two sub-groups: a group composed of 158 satisfied visitors and a group of 216 unsatisfied visitors.[8] We aim at assessing the effect of visitor satisfaction on the revenue variation induced by changing the attribute combination. Thus, we calculate the coefficient of re-evaluation for both groups. The results are reported in Table 3.

Table 3

Economic re-evaluation by visitor's satisfaction degree

		Unsatisfied	**Satisfied**
Status quo	Modification of attribute j	V_{ij} (€)	V_{ij} (€)
Venue in Venice	Other place	-4,932.063	-7,080.85
Information concerning the exhibition (induced)	Autonomous	1,238.385	2,995.64
Additional multimedia services (absent)	Present	4,577.564	6,007.95
Number of observations		216	158

Source: own calculations on data provided by the "Fondazione di Venezia"

Table 3 shows that revenue variations are smaller for unsatisfied visitors. In this case, the monetary attribute's relative importance definitely exceeds the importance values of the other non-monetary attributes. This reduces the impact of a utility change generated by modifying a non-monetary attribute on the revenue variation.

4. CONCLUSIONS

Conjoint-based studies have begun to exceed the area of market goods and to be used for non-market goods, such as cultural events. Due to CA capability of addressing the multi-dimensional nature of a given good, it can serve the scope of investigating trade-offs between the attributes which describe the good in terms of utility associated with that good. A relevant issue in economic valuation is determining the monetary variation related to

[7] Few respondents (16) answered that the paid admission charge was lower than the amount they were willing to pay. But we excluded these respondents from sub-group conjoint analysis because of the number of respondents willing to accept a higher admission charge was not large enough to form a further group beyond the two groups defined above.
[8] A number of visitors (111) attended the exhibition with a cut price ticket or a complimentary ticket, we then excluded them from the sample.

a hypothetical change which occurs in the combination of attributes which specifies the good. To solve this issue, we propose a coefficient of economic re-evaluation that works on part-worth utilities for determining which revenue variations derive from the introduction of changes in the current specification of the good. The coefficient has the appealing feature of accounting for the relative importance of the modified attribute when determining the revenue variation. This allows to link the monetary variation with the role played by the modified attribute compared to those of the other attributes in the outline of the preference structure. Moreover, we stress that the coefficient has general applicability, since it can be used for both rating and ranking data.

The results from a conjoint survey concerning visiting the cultural event "Venice and Islam 828-1797" reveal the way preferences affect the revenue generated by that cultural event. We apply the coefficient to obtain a valuation in terms of total revenue variation generated by considering hypothetical changes in the combination of the attributes of the exhibition. Our findings suggest that choosing Venice as the venue for the exhibition generates the larger gain in terms of total revenue variation. Furthermore, we show how determinants of demand for the cultural event in question vary in accordance with actual visitor's opinion on the admission charge required for attending the exhibit. More specifically, when visitors believe that the admission charge is too high, the hypothetical revenue variations are smaller than for people who are happy with the price. We argue that this technique may be used not only for assessing the effect of customer satisfaction, but also for investigating how revenue varies when respondent's socio-economic characteristics change.

In conclusion, the article suggests an alternative approach for estimating willingness-to-pay by exploiting all the information collected in a ranking or rating conjoint response format. Moreover, our proposal may provide cultural event organizers with information on determinants of revenue variation.

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