Extending the Contingent Valuation Method (CVM) to Assess Externalities Created Round a Cultural Heritage Preservation Site - A Knowledge Based Approach

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Abstract: - This work deals with assessing externalities created round a cultural heritage preservation site by using the Contingent Valuation Method (CVM), properly extended to include expenditure – benefit analysis. This extension was achieved through the design/development of a methodological framework under the form of an algorithmic procedure with 29 activity stages and 5 decision nodes. An implementation is presented, referring to the ruins of an ancient temple located in the centre of Athens, Greece. The data obtained by circulating the CVM questionnaire were processed by means of a Logit model.

Key-Words: - cultural heritage, externalities, Logit regression, experimental economics, contingent valuation method, benefit maximization.

1 Introduction

The Contingent Valuation method (CVM) is an important technique of the recently established scientific field of Experimental Economics. [1] This technique is basically subjective, attempting to acquire objectivity by extracting opinion/attitude and information/knowledge from a stratified representative sample of interviewees, who are asked by means of a questionnaire to assign a value on a non-marketable (e.g., cultural or environmental, like a monument or a forest respectively) good or an externality (considered as 'transaction spillover' by *laissez-faire* economists like Milton Friedman and Friedrich Hayek), meaning a benefit or cost not related to market values. The main objective of the questionnaire mentioned above is to 'measure' the willingness of interviewees (i) to pay (alternatively, to participate) for a positive and/or (ii) to be paid in order to accept a negative externality (WTP, WTA, respectively). More precisely, WTP reflects the maximum monetary amount an individual would pay to acquire the non-marketable good/service under examination, while WTA corresponds to the minimum monetary amount an individual would demand as compensation in order to relinquish this good/service [2]. Conceptually, the CVM might be extended to (or considered to be part of) a corresponding cost-benefit method by relating expenditure (implying capital and operating cost) with benefit, including (but not limited to) externalities, e.g., by preserving a monument.

In such a case, the optimal expenditure E_{opt} can be determined 'theoretically' as the abscissa of maximum benefit $B_{max} = (B_1+B_2)_{max}$, where B_1 stands for satisfaction due to heritage culture preservation (externalities, assessed indirectly in a general way by mean of Experimental Economics techniques like the CVM) and B_2 is the net economic result including externalities assessed directly in a specific way through CVM. The former is an increasing function of E with a decreasing rate (i.e., $dB_1/dE>0$, $d^2B_1/dE^2<0$), because of the validity of the Law of diminishing (differential on marginal) returns (LDR); this Law is based on sound evidence and is widely accepted in most scientific disciplines, like Technology, Psychology, Economics, Engineering, with the exception of anti-entropic (e.g., knowledge and self-organizing) systems.

The partial benefit B_2 is a decreasing function of E with a decreasing algebraic or an increasing absolute rate (i.e., $dB/dE < 0$, $d^2B_2/dE^2 < 0$ or $d|dB_2/dE|/dE>0$) for the reason quoted above. Evidently, E_{opt} is found as an equilibrium point in the trade off between the partial benefits B_1, and B_2, where $d(B_1+B_2)/dE = 0$, or $MB_1 = MB_2$, where $MB1 = dB_1/dE$ and $MB_2 = dB_2/dE$ are the marginal values of B_1 and B_2, respectively.

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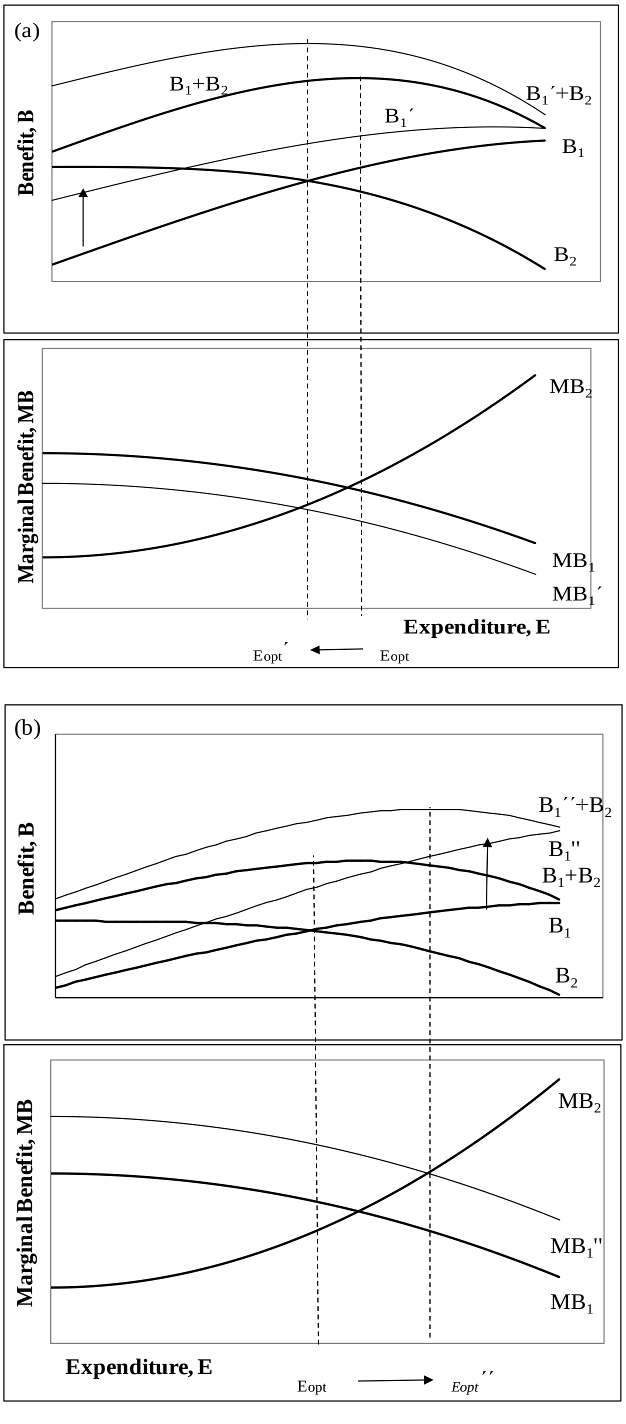

Figure 1. Dependence of the partial benefits B1 and B2 on Expenditure E, and shifting of Eopt, when(a) subsidization takes place for enhancing knowledge diffusion, and (b) restoration design/construction incorporates information points within the ancient monument.

If a subsidy is granted from EU sources or by the Central Governance or by the Local Authorities in order to enhance knowledge diffusion about the history of the monument into the public, then the B_1-curve moves upwards to its new position B_1' becoming also more flat, since the difference in B_1-values from the original curve is higher in the region of lower E-values where there is adequate margin; as a result, E_{opt} is shifting to E'_{opt}, where $E'_{opt} < E_{opt}$ (Fig.1a). If the restoration design/construction includes/ incorporates information points with texts, figures, tables, and so on, in order to make the visitors more aware of the parts of History that are relevant to the monument, then the B_1-curve is moving upwards to its new position B''_1 becoming also steeper, since the establishment of such information points requires additional expenses and is more likely to occur in the region of higher E-values; as a result, E_{opt} is shifting to E''_{opt}, where $E''_{opt} > E_{opt}$ (Fig.1b).

Since B_1 (E) depends exclusively on externalities and B_2 (E) depends only on economic (market-based) results, the (B_1+B_2) function corresponds to data obtained from interviewees living/working or having real estate interest in the vicinity of the site under consideration; on the other hand, the B_1 (E) function corresponds to data obtained from visitors living/working far from this site, also without having any real estate interest in the vicinity of the site. Consequently, the B_2-curve may be obtained computationally by subtracting B_1 from B. Since we might place another independent variable x, instead of E, we can symbolize with $B_2 = f_2(x)$ the corresponding function, which is obtained by subtracting the respective function $B_1 = f_1(x)$ from the total benefit function $B = f(x)$. Such a generalization may create problems of stochasticity and additivity (superposition), because of the different properties that each function has, as a result of its origin and the data upon which is based.

2 Methodology

For solving such problems, we have designed/developed a methodological framework under the form of an algorithmic procedure, including the following 29 activity stages and 5 decision nodes (Fig.2).

1. Description of the monument to be restored.
2. Mapping of the urban area round it.
3. Searching for alternative restoration plans.
4. Design of a unique prototype restoration plan.
5. Setting of alternatives in comparative forms.
6. Description of alternatives at the highest information granularity level not entailing excessive investment capital, preferably within a pre-determined budget.

7. Structure of a criteria vector and a preference matrix based on the alternatives described above.
8. Assignment of weights on the elements of the criteria vector and marks on the elements of the preference matrix.
9. Performance of multicriteria analysis (MCA) and ranking of alternatives in order of descending preference.
10. Robustness analysis of the alternative ranked first.
11. Searching for the causes of decreased robustness.
12. Redesign of the criteria used for MCA.
13. Description of what we want to know at the appropriate information granularity level.
14. Design of the CVM questionnaire.
15. Development of the corresponding statistical procedures.
16. Circulation of the questionnaire within a testing sample, chosen as representative of the population of interviewees that will finally participate in the project.
17. Processing of the data extracted from the responses and evaluation of results.
18. Investigation of possible causes of non-satisfactory evaluation results.
19. Stratification of interviewees' population, according to the characteristics to be examined.
20. Design of the final sample on the basis of the stratification performed so far.
21. Circulation of the final questionnaire within the stratified sample.
22. Processing of responses to derive numerical data adequate to determine directly functions of the form $B = f(x)$ and $B_1 = f_1(x)$.
23. Indirect derivation, by means of computational or simulation techniques, of functions of the form $B_2 = f_2(E)$.
24. Investigation/identification of probable/possible endogenous and exogenous events/policies that may cause a change in B or B_1 functions, leading to respective shift of E_{opt}.
25. Estimation (by experts) of these probabilities/possibilities and their impact.
26. Preparation of implementation proposed on a minimal modification basis (i.e., just enough to obtain an acceptable E_{opt}-value in practice).
27. Preparation of implementation proposal on an *as is* basis (i.e.,without modifying the ranked first alternative) including possible subsidization [3,4].
28. Development/operation/updating of an internal Knowledge Base (KB).
29. Searching in external KBs by means of an Intelligent Agent (IA), according to [5].

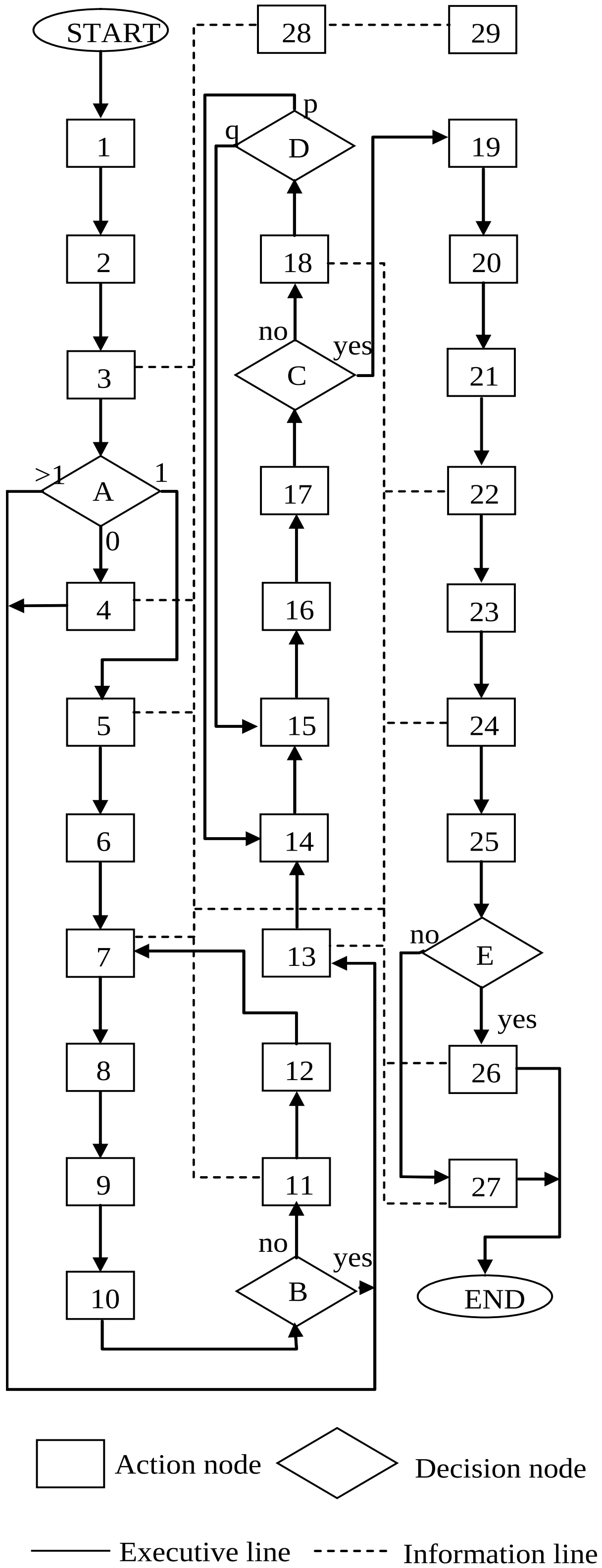

Figure 2. Flow chart of the methodological framework designed by the authors (i) to extend the CVM towards a cost benefit analysis direction, and (ii) to investigate the role of information/knowledge diffusion in the public.

A. How many alternative restoration plans have been found (0, 1,>1)?
B. Is the solution, represented by the ranked first alternative, a robust one?
C. Are the evaluation results satisfactory?
D. Are the causes of non-satisfactory results within the circulated questionnaire or within the developed statistical procedure (quoted by q and p, respectively, in the flow chart of Fig.2)?
E. Are these probabilities/ possibilities (given as parameter values of specific statistical distributions or as fuzzy sets, respectively, in order to count for uncertainty) significant, according to a pre-set confidence interval?

3 Implementation

The cultural heritage monument we used as a case example is the temple of Artemis Agrotera (the Huntress), one of the most important historical and archeological sites located in the center of Athens. It is situated on Ardittou St, (Mets area) a few meters from the Panathenian Stadium and the hill of Ardittos, facing the Acropolis, the temple of Olympian Zeus and the Lycabetus hill.

The ionic temple of the 5th century B. C., deemed to have been a work by Kallikrates, the architect of the ionic temple of Apteros Nike on the Acropolis, with which it shares great similarities, holds a principal position in the history of ancient Greek architecture due to its detailed sculptures. The nearby Ilissos River was flanked by sacred sites from ancient times. The temple of Artemis Agrotera is the only sacred site remaining on the south bank of this river (the ancient naming of the area being Agrae meaning “hunting ground” from which came the epithet “Agrotera and was considered the place of initiation for the lesser Eleusinian Mysteries known as the “Agrai mysteries”, according to Plutarch and Pausanias [6].

It suffered many changes in its long history. It was converted into a Christian basilica in the 5th century and much later in the 17th century with the addition of a dome into the church dedicated to the Virgin Mary known as "Panagia stin Petra". The detailed drawings of elevations, ground plans and members of the temple and its pediment (now in the museums of Berlin and Venice) executed by architects J. Stewart & N. Revett on their visit to Athens give testimony of the monument as it stood in 1753. The Turk commander of Athens Ali Haseki pulled down the temple in 1778 and its parts were used to build the Walls of Athens. Surviving tombs of the early Christian cemetery, the remains of the semiexagonal apse of the church, part of the ancient marble pediment now in the Archeological Museum of Athens, and a quantity of small votive vessels used in the lesser Eleusinian mysteries came to light with the first official excavation by A. Skias in 1897.

Figure 3. Views of the cultural heritage site under examination: the urban environment round the ruins of the ancient temple (top), and graffiti artwork on the wall protecting the archeological findings (bottom).

The results of the statistical processing of the data obtained through the circulated questionnaire (addressed to 55 individuals) gave the following Logit Regression expression: $WTP = 48.2+0.043X_1+0.008X_2+0.046X_3+0.010X_4+0.021X_5+0.015X_6+0.003X_7$, where the independent variables X_j (j=1…7) stand for respondents income near the mean of the habitants/professionals living/working in the urban area round the ancient temple, age of the interviewees, living/working distance from the temple, real estate ownership in the vicinity, membership in organization with cultural activities, extent to which the interviewee is

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informed about the history of the site, coming in the site as visitors/tourists individually (instead within a group), respectively. The independent variables proved to be insignificant at confidence level 95% are the knowledge about the required site maintenance/emergence activities, information sources about the history and the aesthetic value of the temple, level of education, opinion expression about alternative schemes of restoration.

The Logit model used above gives the logistic function [7,8]:

$$f(z)=\frac{e^z}{e^z+1}=\frac{1}{1+e^{-z}} \qquad (1)$$

where the variable *z* is usually defined as:

$$z=\beta_0+\beta_1 x_1+...+\beta_k x_k \qquad (2)$$

where β_0 is the intercept and $\beta_1,...,\beta_k$ are the regression coefficients of $x_1,...,x_k$, respectively.

4 Discussion and Conclusion

An alternative to the non-linear regression model we used herein is the Probit model, which forms a popular specification for an ordinal or a binary response expression that employs a link function [9]. In this model, the response variable y is binary and may represent a certain condition. A generalized form of this model is the following:

$$\Pr(y=1/x)=\Phi(x'\beta) \qquad (3)$$

where Pr denotes probability and Φ is the cumulative distribution function of the standard normal distribution. The parameters β are typically estimated by maximum likelihood. There exists an auxiliary random variable:

$$y^*=x'\beta+\varepsilon \text{, where error } \varepsilon\in N(0,1) \qquad (4)$$

Then *y* can be considered as an indicator for whether this latent variable is positive:

$$y=1_{\{y^*>0\}}=\begin{cases}1 & if \quad y^*>0, \quad i.e., -\varepsilon<x'\beta \\ 0 & otherwise\end{cases} \qquad (5)$$

Introducing the dimension of time in the analysis performed so far, we can transform the rather static model existing beneath the B1-curve movement in Fig.1, (leading to Eopt shifting) into a dynamic model related to 2nd order cybernetics, since human intervention is indispensable for evaluating knowledge. As a matter of fact, B2-curve is moving upwards to its new position B'2 becoming also steeper in the short run, because of some information accumulation leading to respective empirical (though 'learning by doing') knowledge advancement which is more expressed in the region of lower E-values, where know-how was initially rather low as a result of lower investment capital; consequently, Eopt is shifting to E'opt, where E'opt<Eopt (Fig.4a). On the other hand, B2-curve is moving upwards to its new position B''2 becoming also more flat in the long run, since the plethora of accumulated information in the time course leads to changing the knowledge pattern initially adopted towards a more effective model, especially in the region of higher E-values, where a richer background exists due to higher investment capital; as a result, Eopt is shifting to E''opt, where E''opt>Eopt (Fig.4b). It is worthwhile noting that, since the vectors (E'opt – Eopt) and (E''opt – Eopt) have opposite directions, the initial shifting of Eopt towards lower values will progressively be neutralized and subsequently the inverse effect will appear tending to a maximum, possibly by following an asymptotic path.

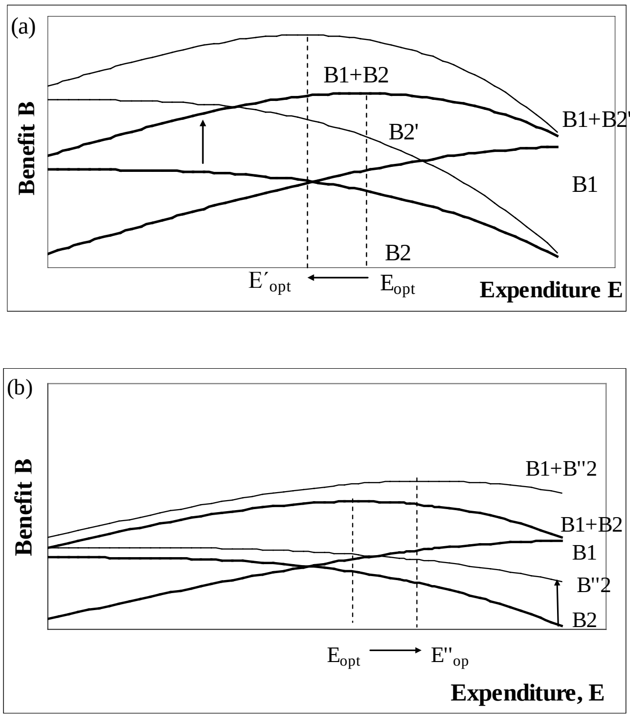

Figure 4. Investigation of the Eopt-shifting in the (a) short and (b) long run, as a result of information accumulation and knowledge transformation.

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At any case, the interviewees living/working far from the archaeological site under examination are expected to be more informed and more willing to participate (i.e., exhibiting higher WTP values) in relevant activities, since their coming from distant places is a measure of eagerness. Consequently, the computational determination of the B2-curve by subtracting B1 from B is a rough approximation because of the different characteristics of the two populations, (i) the living/working or having real estate interest in the temple – area, and (ii) the living/working in distance and having no such interest. Nevertheless, since the interviewees were found altogether attending a lecture about the history/importance of the temple, we may assume that the similarities of the groups (i) and (ii) mentioned above are more in comparison with the common situation where the reviewer asks the people he meets in or near the site under consideration.

In conclusion, the methodological framework we have designed/developed under the form of flowchart, including 29 activity stages and 5 decision nodes for assessing externalities created round a cultural heritage preservation site, seems to perform satisfactorily. This was proved by estimating WTP in the case of public participating in the preservation of the temple of Artemis Agrotera (the Huntress), one of the most important historical and archeological sites located in the center of Athens, Greece. The main explanatory independent variables, found at 0.05 significance level by means of Logit regression analysis, were (i) respondents income near the mean of the habitants/professionals living/working in the urban area round the ancient temple, (ii) age of the interviewees, (iii) living/working distance from the temple, (iv) real estate ownership in the vicinity, (v) membership in organization with cultural activities, (vi) extent to which the interviewee is informed about the history of the site, (vii) coming in the site as visitors/tourists individually (instead within a group).

It is worthwhile noting that this method can be further extended to cover environmental impact assessment issues, which were initially developed in [10].

5 Acknowledgments

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