Improvement of Urban Environment and Preservation of Cultural Heritage through Experimental Economics by a Modified Contingent Valuation Method (CVM)

Odysseas Kopsidas and Fragiskos Batzias
Laboratory of Simulation of Industrial Processes,
Department of Industrial Management and Technology,
University of Piraeus
Karaoli & Dimitriou 80, 18534 Piraeus Greece
Tel.: +302104142368; Fax: +302104142392; email: fbatzi@unipi.gr

Abstract

The preservation of cultural heritage is entailing excessive cost (paid by people through taxation) while is a source of additional income for both, the State and the people, due to tourism. Since the evaluation of this good cannot be in market terms, we apply a modified version of the Contingent Valuation Method (CVM), which is frequently used in Experimental Economics, in order to investigate the significance that people put on this good and how much they might be willing to pay for supporting activities concerning the preservation of such antiquities, that also improve the urban environment. For this purpose, we have developed a methodological framework under the form of an algorithmic procedure with 21 activity stages and 4 decision nodes, and proved its functionality by implementing it in the case of the Cononian Walls surrounding the peninsula of Piraeus, the main port of Athens, Greece. The results indicate that people are in favor of overturning the devaluation of the monument, by participating in relevant activities, including financial support. Nevertheless, a part of the interviewees disagrees with any financial contribution, judging that this expenditure should be covered exclusively by the State. All statistical processing of answers, obtained through a properly designed/circulated questionnaire, was carried out by Logit and Probit model regression analysis. Both models gave significant (at 0.05 level) dependence of willingness to pay (WTP) on preferred course of action (i.e., leaving the ruins situation as is, performing only the necessary remediation, proceeding with radical restoration).

Key Words: ancient monument restoration, antiquities conservation, Logit model, parametric approach, Probit model, willingness to pay (WTP).

1. Introduction

Cultural heritage usually refers to the monumental remains that have been inherited from past generations to present society, which will hopefully take care of them for sake of the future generations. Moreover, the concept of cultural heritage has gradually enriched by including intangibles as well as ethnographic or industrial knowledge/know-how of the past. On the other hand, the works of both categories, art and everyday living in the community of the past, include (or/and refer to) political, socioeconomic, intellectual, philosophical or religious considerations. Since the preservation of cultural heritage, and especially of the monumental ruins, is entailing excessive cost (paid by people through taxation) while is a source of additional income for both, the State and the people, there is an increased interest for evaluating this non-marketable good.

The Contingent Valuation Method (CVM) is a survey-based technique, frequently used in Experimental Economics, especially useful for the valuation of non-market resources/goods/services, and cultural heritage objects (of aesthetic, historic, scientific or social value), such as conservation of monumental remains and preservation of the physical and anthropogenic environment [1,2]. The basic dependent variables used in CVM are (i) willingness to pay (WTP), which is the maximum monetary amount that an individual would pay to obtain/preserve a good, and (ii) willingness to accept (WTA) compensation, which is the minimum monetary amount required to relinquish the good. Therefore, WTP provides a purchase price, relevant for valuing the proposed gain of the good while WTA provides a selling price, relevant for valuing the proposed loss of the good. According to classic economic theory, a significant difference between WTP and WTA should not occur, on condition that there is (i) no transaction cost, (ii) perfect

information about goods/services and corresponding prices, (iii) no income effect, (iv) a market that engenders truthful revelation of preferences. Although these conditions were generally met in several economic experiments that used inexpensive market goods with readily available substitutes, the ratios WTA/WTP obtained were significantly greater that unity. This result was attributed to the fact that participants in these experiments lacked market experience [3].

In case that the CVM is applied for monumental remains, certain specific problems arise, because (i) the 'good' under examination has a subjective value, dependent on the cultural level of each reviewee, (ii) the intangibles associated with this 'good' are related to the present political behavior of each individual as regards his/her attitude to the local authorities or the central government, (iii) as a result, the answers may be biased, a matter that becomes evident only after final statistical processing, thus calling for supplementary information, possibly by means of an additional post-questionnaire, and (iv) the adopted/developed (for elicitation of people's WTP) technique itself should be revised (possibly by means of a meta-questionnaire) by the same group of experts who processed the answers in order to improve the questionnaire and store it into a dedicated Knowledge Base (KB) for future usage, since each monument is unique and the results coming from examining quasi-similar cases are of limited value.

2. Methodology

For solving the problem mentioned above, we have developed a methodological framework under the form of an algorithmic procedure, with the following 21 activity stages and 4 decision nodes (interconnected as shown in Fig. 1):

1. Description of the monument to be restored/preserved and its significance as cultural heritage for both, society and archaeology/history.
2. Description of the near-by (relatively narrow) urban environment and its relation to the monument.
3. Definition of the wider urban environment, where people (that might be interested on such restoration/ preservation) are living/working.
4. Interviewing experts on restoration/preservation.
5. Listing of the works of restoration/preservation to be done without entailing excessive cost.
6. Detailed job description within a limited timetable and corresponding analysis of the necessary expenditure.
7. Suggestion on priorities to be taken into account, according to project management methodology/ techniques in order to achieve the restoration/ preservation task under the constraints set by available resources.

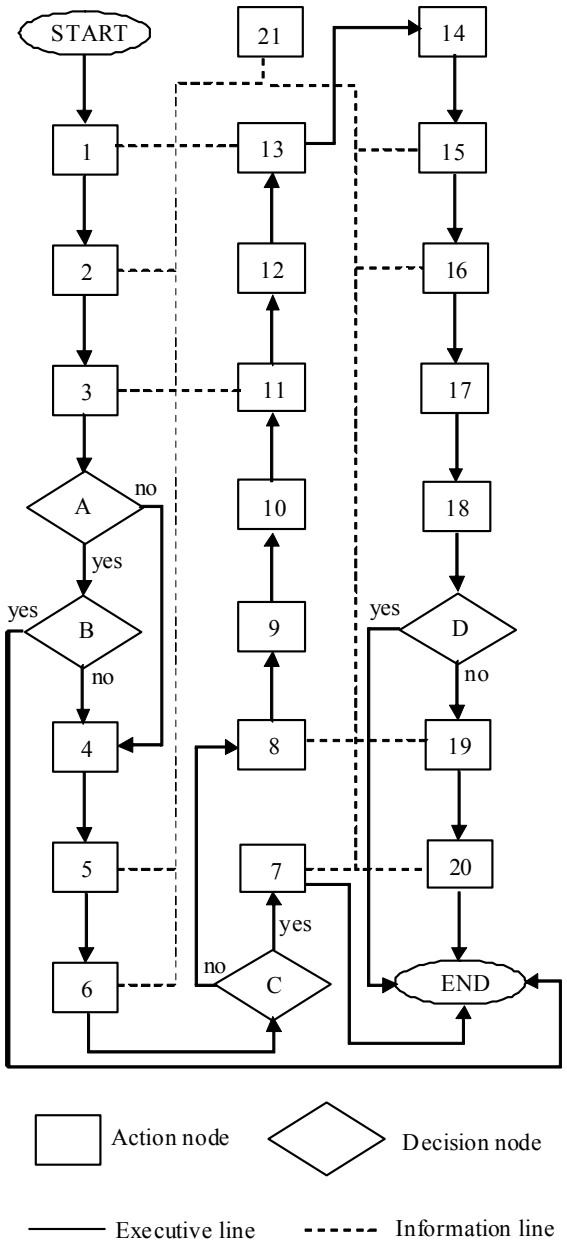

Figure 1. The methodological framework designed/ developed by the authors for improvement of urban environment and preservation of cultural heritage through Experimental Economics by a modified Contingent Valuation Method (CVM).

8. Estimation of sample of people that should be asked to express their WTP, thus indicating the amount of money that would be fair for the State or the Local Authorities to spend (since this amount is finally extracted from the citizens via taxes).
9. Synthesis and circulation of a preliminary questionnaire, according to the usual CVM.
10. Collection and processing of answers (pilot study).

11. Synthesis (on the basis of the knowledge obtained so far) and circulation of the final questionnaire, asking for answers in crisp or fuzzy form (to count for uncertainty [4]), according to a modified CVM.
12. Collection and processing of answers (main study).
13. Comparison with similar cases extracted from (i) literature on Experimental Economics and (ii) relevant experience properly selected and stored in the internal KB of stage 21.
14. Conclusions under the form of statistical results/ output, accompanied by significance indices.
15. Suggestions on (i) schemes for promoting the interest of public about cultural heritage and (ii) fiscal policymaking for restoring monuments and especially for the monument under examination.
16. Synthesis and circulation of a post-questionnaire for supplementary dealing with issues arisen from processing the answers to the final questionnaire.
17. Collection and processing of answers given tot he post-questionnaire (follow-up study).
18. Discussion with the experts, analyzing/processing the answers about the adopted/developed methodology on the basis of a meta-questionnaire synthesized by the same group.
19. Determination/identification/confirmation of the causal paths giving the unsatisfactory results.
20. Remedial proposals and corrective activities.
21. Development/operation/enrichment/updating of an internal KB and searching in external KBs for data mining and relevant knowledge discovery by means of an Intelligent Agent, according to [5].

A. Is the monument in good condition?
B. Is the monument exhibited properly (i.e., in connection with its cultural value) to the people living/working in the wider urban area, as defined in stage 3?
C. Is the amount of money required to cover this expenditure already available by local or central administration?
D. Are the final results satisfactory?

For the processing of answers in stages 10, 12, 17 (pilot, main, follow-up study, respectively) we use the following measures/indices [6-8]:

$$R^2 = 1 - \frac{\sum_{i=1}^{N} \left(y_i - \hat{y}_i\right)^2}{\sum_{i=1}^{N} \left(y_i - \bar{y}\right)^2} \quad (1)$$

where N is the number of observations, y is the dependent variable, $\bar{y}$ is the mean of the y values, and $\hat{y}$ is the value predicted by the model. R^2 is the determination coefficient that ranges from 0 to 1. According to the Efron's R^2:

$$R^2 = 1 - \frac{\sum_{i=1}^{N} \left(y_i - \hat{\pi}_i\right)^2}{\sum_{i=1}^{N} \left(y_i - \bar{y}\right)^2} \quad (2)$$

where $\hat{\pi}$ =probabilistic model predicted value, since the dependent variable in a logistic regression is not continuous while the probabilistic predicted value is. MacFadden introduced the log likelihood of the intercept model.

$$R^2 = 1 - \frac{\ln \hat{L}\left(M_{Full}\right)}{\ln \hat{L}\left(M_{Intercept}\right)} \quad (3)$$

where M_{Full} is the model with predictors, $M_{Intercept}$ is the model without predictors, and $\hat{L}$ is the estimated likelihood. A likelihood falls between 0 and 1, so the log of likelihood is less than, or equal to, zero. If a model has a very low likelihood, then the log of the likelihood will have a larger magnitude than the log of a more likely model. Cox and Snell presented the R^2 as a transformation of the $2\ln\left[L\left(M_{Intercept}\right)/L\left(M_{Full}\right)\right]$ statistic that is used to determine the convergence of a logistic regression:

$$R^2 = 1 - \left\{\frac{L\left(M_{Intercept}\right)}{L\left(M_{Full}\right)}\right\}^{\frac{2}{N}} \quad (4)$$

Note that Cox & Snell's pseudo-R^2 has a maximum value that is not 1; if the full model predicts the outcome perfectly and has a likelihood of 1, then we have $1 - L\left(M_{Intercept}\right)^{\frac{2}{N}} < 1$.

Nagelkerke, Cragg and Uhler, adjusted Cox & Snell's R^2 so that the range of possible values extends to 1.

$$R^2 = \frac{1 - \left\{\frac{L\left(M_{Intercept}\right)}{L\left(M_{Full}\right)}\right\}^{\frac{2}{N}}}{1 - L\left(M_{Intercept}\right)^{\frac{2}{N}}} \quad (5)$$

The non-linear regression models we used are the Probit and the Logit ones. Probit is a popular specification for an ordinal or a binary response model that employs a link function. In this model, the response variable y is binary and may represent a certain condition. A generalized form of this model is the following:

$$\Pr\left(y = 1/x\right) = \Phi\left(x'\beta\right) \quad (6)$$

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:

$y^* = x'\beta + \varepsilon$, where error $\varepsilon \in N\left(0,1\right)$

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

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

The Logit model gives the logistic function:

$$f(z) = \frac{e^z}{e^z + 1} = \frac{1}{1 + e^{-z}} \tag{7}$$

where the variable z is usually defined as:

$$z = \beta_0 + \beta_1 x_1 + ... + \beta_k x_k$$

where β_0 is the intercept and $\beta_1, ..., \beta_k$ are the regression coefficients of $x_1, ..., x_k$, respectively. Actually, R^2, the coefficient of determination, is the relative power of the Probit and the Logit models.

3. Implementation

The methodology described above has been implemented in the case of the Cononian Walls that surround the peninsula of Piraeus, the main port of Athens, Greece (Fig. 2). The Walls (Fig. 3), constructed by Themistocles at the mid-5th century BC and reinforced later by Admiral Conon for increasing protection against uninvited docking, were constructed at a distance of 20-40m from the sea, using the *emplecton* method according to which, the two sides of the wall are structured with blocks of carved stone and the inner part is filled with mud and rocks. The Walls have been preserved in quite good condition at a length of approximately 2.5km from the entrance of the Zea small port to the entrance of Cantharus small port, while the development of the modern city has included the remains within its infrastructure.

The final questionnaire (stage 11) has been circulated by four researchers among a large group of volunteers that participated in a sea-side cleansing project on Sunday 19/09/2010. The descriptors used in the questionnaire are: X_1: the degree of monument degradation; X_2: the extent to which existing near-by enterprises are responsible for the degradation; X_3: the amount to which property values will rise as a result of the restoration of the monument; X_4: the provisions (not) taken during constructing the city infrastructure; X_5: the preferred course of action given the current circumstances; X_6: the proximity of residence to the monument; X_7: the interviewee's departure point; X_8: the opinion of the interviewee on the time and money spent to visit the monument; X_9: amount of money spent to visit the monument; X_{10}: the amount of personal time (in days) the interviewee is willing to offer voluntarily to assist with the cleansing project; X_{11}: the degree of knowledge that the interviewee has regarding the

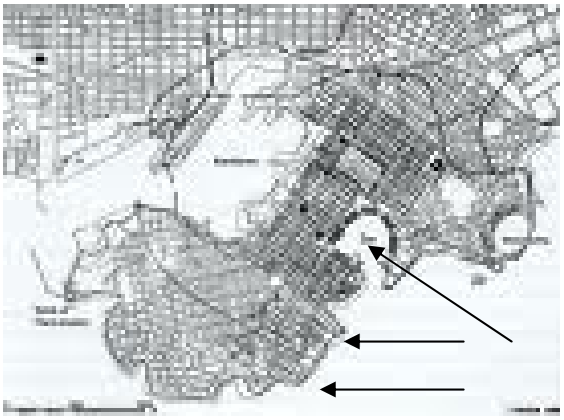

Figure 2. Topographical chart of the Piraeus port showing the extent of the Cononian Walls (indicated by the arrows) that surround the outer southeast bay area, including the horseshoe-like small port.

Figure 3. Several views of the Cononian Walls or their traces on the seaside rocks (indicated by arrows). At some points the wall is preserved up to eight-stones height and along a total of 2 km (at intervals of 45 to 100m, according to the morphology of coastline); 22 rectangular towers (4x6m) have been preserved.

monument's history; X_{12}: the degree of knowledge that the interviewee has on Conon's history; X_{13}: the participation of the interviewee (within the cleansing project) on his/her own or through some organisation; X_{14}: the interviewee's level of education; X_{15}: the interviewee's age; X_{16}: the degree that the interviewee has been affected by the current economic crisis in Greece.

The sample N-valid is 100 responses regarding the Willingness to Pay and N-missing is null. The descriptive statistics (Fig. 4) provide helpful information on the percent frequency of the WTP-value: 36% of the sample suggested WTP=0 €, 16% agreed with WTP=1-10 €, 10% accepted WTP=11-50 €, 20% mentioned WTP=51–100 €, while 18% was willing to pay > 100 €.

One of the principle descriptors investigated in the main study (stages 11-14) concerns X_5, i.e., the preference of the interviewees about the options (i) leave the situation as is, (ii) perform only the necessary remediation, or (iii) proceed with radical restoration (e.g., demolition of the near-by houses shown in Fig. 3). Option (i) has been selected only by 12.5% of those that stated WTP=1-10 €, which gives a 2% of the total sample. Option (ii) is agreed by 51% of the total sample, i.e., 61.1% of those with WTP=0, 37.5% of those with WTP=1-10, 40% of those with WTP=11-50, 70% of those with WTP=51-100 and 27.8% of those with WTP>100. Option (iii) has been proposed by 47% of the interviewees, i.e., 38.9% of those with WTP=0, 50% of those with WTP=1-10, 60% of those with WTP=11-50, 30% of those with WTP=51-100 and 72.2% of those with WTP>100.

It is worthwhile noting the relation between WTP and preference on restoration options. The interviewees that are willing to pay significant amounts tend to prefer a mild intervention, while those that agree with minimal to null amounts demand radical intervention. The latter group, also, considers any contribution of theirs to restoration as unfair judging that this expenditure should be covered exclusively by the State. From a sociopsychological point of view, this attitude may reflect extreme personalities with a tendency to holistic and pure solution (i.e., no mixed strategy involving people and the State is acceptable by interviewees who considered themselves as having no further obligations after regular tax-paying); as a result, they think that the State is exclusively responsible to resolve the situation.

The results of the Logit and Probit regression analysis are shown in Table 1 whereas the ANOVA is shown in Table 2. The correlation coefficient R, the coefficient of determination R^2 and the adjusted R^2 indicate only a weak correlation between the independent variables and WTP, which is more significant in the case of descriptors X_5, (the preferred course of action), X_8 (the opinion of the interviewee on the time and money spent to visit the monument), and X_{12} (the degree of knowledge that the interviewee has on Conon's history). The reduced form of the resulting Logit regression function becomes:

$$WTP = 0.575 + 0.052X_5 + 0.018X_8 + 0.005X_{12}$$

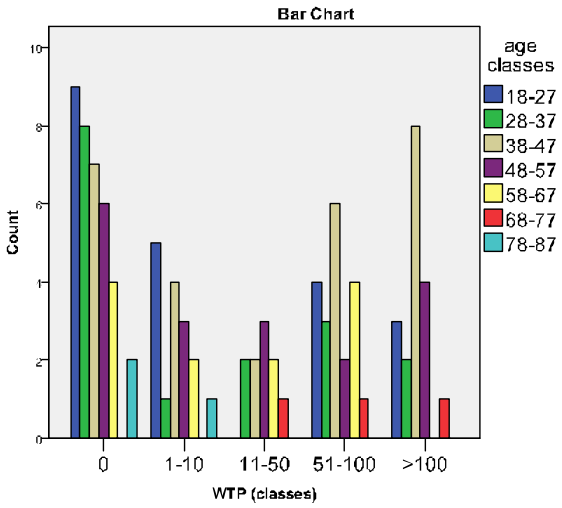

Figure 4. Desriptive statistics (frequencies) between WTP and interviewee age classes. The x-axis lengend indicates the classes of WTP-values, whereas age classes are denoted by different colours.

Table 1. Probit and Logit Regression Analysis.

Probit			
	Chi-square test	Degrees of freedom	Significance
Pearson	397.637	376	0.212
Deviance	277.316	376	1.000
	R^2 test		
Cox & Snell	0.216		
Nagelkerke	0.226		
McFadden	0.080		
Logit			
	Chi-square test	Degrees of freedom	Significance
Pearson	405.009	376	0.145
Deviance	277.686	376	1.000
	R^2 test		
Cox & Snell	0.213		
Nagelkerke	0.223		
McFadden	0.079		

Table 2. The ANOVA results, with predictors: X_1, …, X_{16} and WTP-value as the dependent variable.

Model	*Sum of Squares*	*df*	*Mean Square*	*F*	*Signif*
Regression	171.748	16	10.734	1.803	0.044
Residual	494.252	83	5.955		
Total	666.000	99			

whereas the resulting Probit regression function is given by: $WTP = 0.575 + 0.028X_5 + 0.024X_8 + 0.005X_{12}$

Therefore, $\partial(WTP)/\partial X_5 = 0.028$, $\partial(WTP)/\partial X_8 = 0.024$ $\partial(WTP)/\partial X_{12} = 0.005$, i.e., all partial derivatives of WTP in respect to parameters X_5, X_8 and X_{12}, are positive, signifying that the respective sub-functions are increasing.

The correlation between WTP and parameter X_5 has been examined with the Chi-square test. The results indicate that WTP is affected by the preference to the restoration options, the cost of traveling to the monument, and their knowledge about Conon at a 5% significance level, whereas a 10% significance level is given to residents or not. We may conclude that parameter X_1 (the degree of degradation) is not correlated with parameter X_5 at a 5% significance level: *P*-value =0.210, Linear by Linear Association (LLA)=1.574, *df*=1). Kendall index gave similar results (*P*-value = 0.209, *R* = 0.125). According to the Linear – trend test, parameter X_1 is correlated with parameter X_2 (the influence of the business activities) at a 10% significance level (*P*-value = 0.07, LLA=3.73, *df*=1), where *df* = degrees of freedom.

4. Discussion and Concluding Remarks

The significant positive correlation between WTP and X_5, X_8, X_{12}, indicates that financial support for remediation/restoration is most likely expected from people that are (i) already sensitized and ready to participate in collective action, (ii) habituated to visiting monuments and spending time and money for this activity, (iii) well informed in relation with the monument they are visiting. On the other hand, a part of the interviewees disagrees with any financial contribution, judging that this expenditure should be covered exclusively by the State. This discrepancy (indicated in the main and confirmed in the follow-up study of stages 11-14 and 16-17, respectively), can be used as an aid in policymaking: (i) for cultural issues, emphasis should be put on education on regional history in connection with the local monuments, and (ii) for political/economic issues, it must be realized by the citizens that taxation alone cannot cover the high cost of superior common/public goods/services, as the restoration of ancient ruins. Last, discussion between researchers circulating the main questionnaire and experts, within a framework of meta-analysis (stages 12, 18), revealed that a significant number of interviewees do not feel confident that the responses are correct and therefore they frequently hesitate in answering; such an attitude might be turned to a more comfortable situation in case the suggested in [4] usage of conditional WTP, by performing fuzzy reasoning (thus offering the interviewee the possibility to give approximate answers in linguistic terms), is extended from environmental protection (examined therein) to improvement of urban environment and preservation of cultural heritage (examined herein).

In conclusion, the functionality of the methodological framework, developed/presented herein under the form of an algorithmic procedure, for the preservation of cultural heritage, was proved by implementing it in the case of the Cononian Walls that surround the peninsula of Piraeus, the main port of Athens, Greece. Evidently, more cases should be examined to enrich the operability of this procedure, since all activity stages and decision nodes are not used to the same degree in each case, while new stages/nodes might be required to add or replace/modify the old ones for sake of completeness/reliability.

5. Acknowledgements

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