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Original article

# Application of the travel cost method for the valuation of the Poseidon temple in Sounio, Greece



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## ARTICLE INFO

### Article history:

Received 15 December 2013

Accepted 16 September 2014

Available online 11 October 2014

### Keywords:

Travel cost method

Recreational value

Cultural heritage

Greece

## ABSTRACT

In this paper the application of the travel cost method for estimating consumer surpluses and total values attributed to the Poseidon temple in Sounio, Greece, is presented. The monument in question is one of the most important archaeological sites in Greece, built in the middle of the 5th century BC. The implementation of the method was supported by a survey of the visitors of the monument, through the completion of an appropriately designed questionnaire with personal interviews. The results of the analysis show that the consumer surplus for visiting the Poseidon temple ranges from € 1.5–24.5 million per year, giving useful insights for the amount of money that are socially acceptable to be spent by the Greek state for the protection and maintenance of the monument. Treatment of travel costs associated with multipurpose trips as well as the type of functional form used to estimate how travel costs influence visitation rates, seem to be the two most important parameters affecting the final results.

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## 1. Introduction

Environmental economics constitutes a relative new branch of economics, aimed at attributing economic values to elements of the natural environment that are not included in the market mechanism. The developed methodological approaches provide a comprehensive and coherent framework where alternative environmental scenarios, measures and policies can be compared and evaluated in monetary terms. To this end, a number of environmental valuation techniques have been developed, classified in two broader categories [1]:

- stated preference (SP) methods, exploiting survey techniques to directly ask individuals about the value they attach to unmarketable environmental goods and services and to express their preferences towards changes in environmental services provided;
- revealed preference (RP) methods, looking at “surrogate markets” measuring the value of unmarketable environmental goods and services by analyzing the market price fluctuations of related economic goods.

Decision makers in the field of culture have to deal with similar problems to those of environmental policy, as historical monuments and cultural heritage are goods that are not directly included in the market mechanism. Specifically, too often, ministries, agencies and organizations responsible for the protection and preservation of historical monuments have limited resources available, and therefore they are obliged to answer difficult questions like [2]: What is the appropriate level of expenditure that shall be devoted to the protection and enhancement of a historic monument? Which is the right allocation of the available financial resources between different social goods (education, health, security, culture, etc.)? How different actions aiming at the protection, conservation and enhancement of various historical monuments can be prioritized, especially in countries with a rich cultural heritage?

Recently, a growing number of studies have started to apply the above-mentioned environmental valuation techniques to estimate the economic value of cultural goods. The majority of these studies use SP techniques and particularly the contingent valuation method [3–7] as well as choice modelling [8–10]. Among the RP valuation techniques, the travel cost method (TCM) is the most popular for valuing cultural goods [11–13], as it is widely used to indicate a recreational consumer’s value of visiting a site. Poor and Smith [14] implemented a zonal travel cost model to estimate the consumer surplus of visiting the historic St. Mary’s City located in rural southern Maryland. Other applications of the method for valuing building environments with high architectural value,

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specific historic buildings, monuments, etc. are presented in [11,15,16]. Also, several applications of the method concern the estimation of the total value of benefits gained by the visitors of museums as well as their willingness to pay for providing additional facilities [12,13,15]. The method has also been used for valuing specific cultural events such as a cultural artistic event in the Castile-León region of Spain [15], a large temporary blockbuster art exhibition [17], a four-day Gemfest that is taken part annually in the town of Anakie in the sapphire fields of central Queensland [18], etc. Finally, Hedonic pricing presents relatively limited applicability and most applications [19,20] are based on the idea that house prices are affected by a house's bundle of characteristics, which may include non-market cultural factors, while the implementation of the avoided- and maintenance-cost approaches present significant methodological weaknesses [21].

This study presents an application of the TCM to estimate the economic value of the Poseidon temple in Sounio, Greece, which is one of the most important monuments of the ancient Greek civilization. To the best of our knowledge, this is the first time that this method has been applied to a Greek monument and is one of the few applications of the method in the economic evaluation of classical monuments of global importance. Therefore, one of the targets of this study is to investigate the applicability of the method in the cultural sector in Greece, and the extent the existing infrastructure, the availability of data, etc., can support its implementation. We have attempted to estimate the total value of the monument, with a view to identify the level of financing for undertaking conservation, restoration and enhancement interventions that would be socially acceptable (if technically necessary) in the future. Furthermore, as the Poseidon temple in Sounio is a historical monument of global importance, interesting methodological questions arise regarding the application of the method, such as the treatment of the visitors from abroad and the cost associated with multipurpose trips, the cost elements that constitute the total travel cost of a visitor, etc., which are also investigated in this work.

## 2. The study area

The temple of Poseidon on Cape Sounion, which is found along the coastal road in the southeastern tip of the Attica prefecture (about 70 kilometers far from Athens city), is one of the most important archaeological sites in Greece. Built between 444 and 440 BC, it replaced an earlier, unfinished temple that had been damaged by Persians in 480 BC. Poseidon was the God of the seas, one of the 12 Olympian deities of the pantheon in Greek mythology. According to the myth, people visited the temple to ask God favourable conditions for their sea voyages. As with all Greek temples, the Poseidon building was rectangular, with a colonnade on all four sides. It had 6 columns in the shorter sides and 13 in the longer ones, with only 15 still standing today [22]. The columns are of the Doric order, made by locally-quarried white marble. They were 6.10 m high, with a diameter of 1 m at the base and 79 cm at the top. At the centre of the temple's colonnade existed the hall of worship, a windowless rectangular room. Inside the temple stood the huge (6 m in height) bronze statue of the God.

The archaeological site of Sounio being one of the most important archaeological sites in Greece, attracts a large number of visitors exceeding 150,000 annually [23]. Almost 65% of them come from abroad. The visitors of the monument are divided into 3 main categories (data provided by the operator of the archaeological site):

- independent visitors (about 50% of Greek and 15% of foreign visitors);
- organized groups (about 10% of Greek and 60% of foreign visitors);

- schools (40% of Greek and 25% of foreign visitors).

## 3. Methodological framework

### 3.1. Selection of travel cost model

The conceptual idea of the TCM is that information on travel costs and reduction of visitation rates with distance from a site of interest can be used to estimate its recreational use value [24]. Specifically, it is considered that the travel cost represents the people's willingness to pay to visit the site in question and serves as a proxy for its value [25]. By measuring how visitation of a recreational site decreases with increasing travel cost one can construct the demand curve for the examined site and estimate its consumer surplus and total value.

There are three different types of the travel cost method:

- the zonal travel cost model, which is the simplest implementation of the method, is applied by collecting information on the number of visits to the site in question from different distances (zones) and the cost of round trips from each of these zones. Then, visitation rates from different zones are regressed on travel costs and other socioeconomic variables for establishing a mathematical relationship, which allows constructing the demand curve of the site under consideration;
- the individual travel cost model seeks to develop a relationship between the number of visits made by an individual in the site of interest during a period and the travel cost and other explanatory parameters;
- the random utility travel cost model assumes the existence of various alternative sites with different quality characteristics for pursuing recreational activities. Individuals make tradeoffs between site quality and the cost of travel to the site and these choices are used to estimate the demand curve for the site in question.

In the context of this study we have implemented a zonal travel cost model. The implementation of a random utility travel cost model was rejected as the Poseidon temple in Sounio is a unique historical monument of global importance and therefore it is difficult to define alternative sites for providing similar recreation services, which is an essential prerequisite for implementing this type of travel cost model. Furthermore, the results of the survey undertaken in the context of this study showed that only the 19% of the respondents visit the monument two or more times per year and therefore the implementation of an individual travel cost model is inappropriate [26].

### 3.2. The zonal travel cost model

The implementation of a zonal travel cost model comprises the following main steps:

- definition of geographical zones where visitors to the site in question come from. Each of these zones should be defined in a way that the travel cost to the recreation area in question will be more or less the same;
- data collection concerning the number of visitors to the site in question from each defined zone and estimation of the visitation rates from each zone, which is the number of visitors per 1000 or 1,000,000 inhabitants of the zone. In the context of this study, these data were collected through a survey conducted to the visitors of the monument (see Section 4.1). On the basis of the survey sample we estimated the proportion of visitors from each zone and then, given the total number of visitors to the monument

(data provided by the Hellenic Statistical Authority), the number of visitors from each zone and the corresponding visitation rates;

- calculation of the average cost of the round trip from each zone to the recreation site in question. To this end, the following cost elements are taken into account:
  - entrance fees, tour costs and other expenses in recreation site,
  - travel expenses such as tickets, fuel, tolls, etc.,
  - accommodation costs,
  - the cost of time, which is spent by the visitor to travel and visit the site in question. Most of these data were collected through the questionnaires; however as many of the visitors of the area in question come from very long distances currying multipurpose trips, the estimation of the travel cost per zone attributed to the specific visit to the monument under consideration presents significant methodological difficulties, which are discussed more analytically in subsequent sections;
- development and evaluation of regression models correlating the visitation rates from the different zones with the corresponding travel cost. To this end, simple or multiple regression models can be used. The former includes the travel cost as the only independent variable, while the latter incorporates in addition various socioeconomic variables (e.g. income, age, etc.). The choice of the functional form of the regression model is also very important and can influence significantly the estimated consumer surplus and the total value of the site under valuation. To this end, linear, quadratic, semi-log and double-log functional forms can be used [27]. In the context of this study and for all examined scenarios, we have tested four different functional forms for the regression model simulating the visitation rates with the travel cost, namely one linear, two semi-log and one double-log model (eq. (1)).

- linear model:

$$X = B_0 + B_1 \cdot TC + B_2 \cdot N \quad (1a)$$

- semi-log model:
- 1st expression

$$X = \exp(B_0 + B_1 \cdot TC + B_2 \cdot N) \quad (1b)$$

- 2nd expression

$$\exp(X) = B_0 + B_1 \cdot TC + B_2 \cdot N \quad (1c)$$

- double-log model:

$$X = B_0 \cdot TC^{B_1} \cdot N^{B_2} \quad (1d)$$

- where,  $X$  is the visitation rate,  $TC$  is the travel cost per trip,  $N$  can be various socioeconomic variable, and  $B_0, B_1, B_2$  the coefficients of the regression models. The models presenting a high adjusted coefficient of determination ( $R^2$ ) and a satisfactory predictive power are finally selected;
- the regression models selected in the previous step are used to construct the demand curve of the site in question. Specifically, assuming a range of hypothetical access prices of the site under valuation we estimate the total number of visitors at each level of access costs. In the context of this analysis and for all examined scenarios we have finally selected the semi-log 2 and the double-log models for constructing the demand curve of the monument under consideration. For a given travel cost level ( $TC_1$ ) we estimated the visitation rate ( $X_1$ ) on the basis of the eq. (1); then the consumer surplus (CS) has been calculated on the basis of the following equations [28]:

- semi-log 2 model:
 
$$CS = TC_1 \cdot X_1 / (-B_1 - 1) \quad (2a)$$

- double-log model:
 
$$CS = X_1 / (-B_1) \quad (2b)$$

- the total annual recreational value of the site in question is estimated as the sum of the travel expenditures and the estimated consumer surplus of all the visitors during the year.

### 3.3. Treatment of multipurpose trips

One of the difficulties that arise in calculating the travel costs is that in many cases visiting the area in question is part of a larger trip. In this case, the trip serves multiple purposes, and the difficulty lies in determining the share of the resulting travel costs that should be attributed to the visit of the recreation area in question. At the moment, there is no a commonly accepted methodology for apportioning travel costs for multipurpose trips. However, the consideration of multipurpose trips is critical to the valuation of a recreation area and practices applied in the past either ignoring this type of trips or considering them as single purpose trips (and thus taking into account all travel costs) lead to erroneous estimates [29].

Aiming to manage multipurpose trips in the context of the TCM, several approaches have been implemented in the past, the most common of which are the following [15,16]:

- using only a part of the total travel cost, which corresponds to the additional expenditures made to visit the area in question from the last stopover;
- distributing the total travel cost on the basis of the time spent by the visitor at each of the sites visited;
- distributing the total travel cost on the basis of the welfare derived by each of the sites;
- identifying the various profiles of multipurpose trips undertaken by the visitors of the site in question and estimating the demand curve and the recreational value for each of them, while the recreation value of the area in question is estimated at a later stage as a percentage of the recreational value of each type of the multipurpose trips identified.

In the context of this study we implemented and tested two alternative approaches to deal with multipurpose trips, which constitute a very significant part of the total number of visits. Specifically, as suggested in [15], the travel cost of visiting the site in question for visitors performing multipurpose trips was estimated as a percentage of the total travel cost on the basis of:

- the time the visitor spent for visiting the monument in question in relation to the total duration of his/her trip;
- by taking into account the pleasure derived from the visit of the monument as a percentage of the total pleasure attributed to the trip.

The estimation of these indices was based on data collected by the survey undertaken.

### 3.4. The value of time

Another important methodological problem of the TCM is to what extent the time spent to travel and visit a site of interest should be considered as a cost element in estimating the travel cost of this visit. As an individual devotes some time to visit the area of interest, there is an opportunity cost of time, which cannot be allocated to other activities (e.g. working at a second job, participating in other leisure activities, etc.). Consequently, ignoring the value of time implies that the consumer surplus of the good under valuation will be underestimated [15].

In general, valuation of time presents significant methodological problems. Markandya [30] proposed as an initial approximation to assume that the value of non-working time that a newly employed

person will not have available for alternative activities equals to 15% of the corresponding gross wage. The fact that leisure activities usually take place during weekends, holidays, etc., when many people are unable to work, leads to use generally conservative values for time spent in these activities. Furthermore, in some cases the trip itself is part of the recreational experience and thus the time spent on the trip is not a cost but a benefit [15].

In the context of this study two alternative scenarios as regards the value of time were adopted. The former assumes that the time spent for leisure does not have an opportunity cost, while the latter attributes to the leisure time of an individual a value equivalent to 15% of his/her gross wage reduced to the appropriate time interval lasting the visit. The necessary data for these calculations were collected by the questionnaires.

#### 4. Application and results

##### 4.1. Design and conduction of the survey

The survey was conducted from May to July 2011 and included 150 completed questionnaires. The participants originate from various areas of Greece as well as from foreign countries. The survey was implemented utilizing an appropriately designed questionnaire (written in both English and Greek), which was completed through personal interviews. The duration of each interview was approximately about 15–20 minutes, while the response rate of the survey was higher than 60% indicating the willingness of visitors to participate in the survey.

The questionnaire was developed so as to be simple and understandable, acquiring all the necessary information by the participants in the most effective way. It consisted of two different sections. The first part was developed for the collection of respondents' data and information regarding their expenses and costs undertaken for the visit as well as their general attitude towards the monument. The second section focused on the socioeconomic characteristics of the respondents.

Before the beginning of the survey, a pilot phase was implemented in order to identify potential problems during the conduction of the survey. The question, which presented the main difficulties to be answered, was the quantification of the received pleasure by visitors in the case of multipurpose trips, while the necessary modifications were performed so as to reassure the efficient completion of the specific question.

The composition of the sample was based on information collected by the personnel of the monument regarding the number of Greek and foreign visitors to the monument. Specifically, 35% of the visitors come from Greece, while the rest 65% from abroad. Furthermore, the sampling procedure was performed taking into consideration also the gender and the age of the respondents for achieving the participation of a representative sample in the survey.

##### 4.2. Calculation of travel cost

Given the region of origin of the visitors of the monument, 6 zones were finally determined for developing the travel cost model (Fig. 1):

- zone 1 comprises areas adjacent to the monument. The average distance between these areas and the monument was estimated at 19.8 km;
- zone 2 comprises areas near to the monument, located at an average distance of 47.2 km;
- zone 3 is extended to the rest of Attica prefecture and the average distance from the monument was estimated at 70 km;

- zone 4 covers all other regions of Greece and the average distance from the monument was estimated at 405 km;
- zone 5 covers all European countries;
- zone 6 covers all other world regions (namely Asia, Australia, Africa, Russia and America).

Visitors coming in the monument during a business trip, were included in zone 3, regardless of the place of their departure due to the fact that their trip to Athens would have been implemented anyway for business purposes and therefore these costs should not be included in our analysis.

The total travel cost from each zone comprises the entrance fee to the monument, traveling and accommodation costs and the cost of time; the assumptions made for their estimation are presented below.

##### 4.2.1. Entrance fee to the monument

Sixty-five percent of the sample paid regular ticket for their entrance to the monument (4 € during the study period), 15% (students and pensioners) were eligible for reduced ticket by 50% based on the applied tariff policy of the monument and 19% did not pay anything because they visited the monument in free entrance days. Based on these data, the average expenditure per visitor was estimated to 2.91 €, which was applied for all visitors regardless of their area of origin.

##### 4.2.2. Traveling cost

The estimation of traveling cost for the case of road trips by car or motorcycle takes into account various parameters like the specific fuel consumption of the vehicle, the traveled distance, the price of fuel and the number of occupants in the vehicle. The specific consumption of cars was considered equal to 7 L/100 km (assuming 1600 cm<sup>3</sup> vehicle moving in its combined cycle), while the specific fuel consumption of the motorcycles was assumed equal to 6.65 L/100 km. The number of occupants per vehicle was derived from the collected data of the questionnaires. Regarding the average gasoline price, the cost was obtained for each zone individually according to official fuel prices. Furthermore, the cost of tolls was integrated into our analysis for the estimation of the total traveling cost, particularly for visitors coming from zone 4. The road distance for zones 5 and 6 is considered identical to zone 3, assuming that visitors from these two zones arrived by air to Athens and then continued by road to the monument.

The estimation of traveling cost by bus, coach and ferry cruise was based on the cost of the ticket reported during the completion of the questionnaires. Regarding the cost of air transport, visitors from zones 5 and 6 were asked to indicate the ticket price in the questionnaire. In the case that someone did not know the amount, a representative average cost was utilized.

##### 4.2.3. Accommodation cost

The accommodation cost for visitors from zones 1 to 4 was set equal to zero, because their visit to the monument can be performed in a day trip and therefore no additional accommodation costs are required. The accommodation cost for visitors from zones 5 and 6 was calculated on the basis of the incurred costs for accommodation and the number of people with whom they share the hotel room (data filled in the questionnaire).

##### 4.2.4. Cost of time

The quantification of the value of travel time (in cases we assumed that there is an opportunity cost of time) was calculated on the basis of the hourly rate of the employed respondent multiplied by a factor of 15% (as a measure of the value of leisure time) and the hours spent on the visit to the monument, which are specified during the completion of the questionnaires. The estimation of

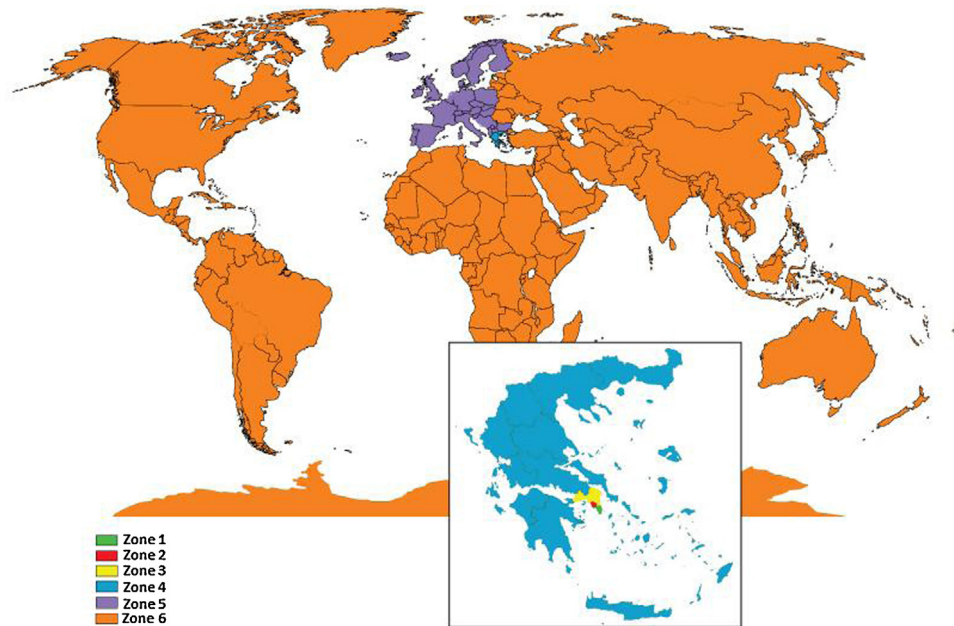


Fig. 1. Graphical depiction of the determined zones for the implementation of the travel cost zonal model.

**Table 1**

Estimated travel cost (€/visitor) for visiting the monument in question from each zone considered.

Zones	Scenario 1	Scenario 2	Scenario 3
1	4.8	4.1	8.5
2	7.1	6.4	9.6
3	12.1	9.0	18.2
4	43.1	31.9	49.8
5	141.2	418.8	154.1
6	213.6	461.7	228.6

the hourly rate was performed combining the total family income, the number of working members per household and the annual working hours.

Based on the above assumptions, the travel cost per zone was calculated for 3 alternative scenarios (Table 1) as the average of the individual travel cost estimated for each visitor who comes from this zone:

- scenario 1 takes into consideration the entrance cost to the monument as well as the traveling and accommodation costs of the visitors. The allocation of the traveling and accommodation cost for multipurpose trips was performed taking into account the total number of travel days;
- scenario 2 takes into consideration the previous cost components, while the allocation of the traveling and accommodation cost for multipurpose trips was performed on the basis of the pleasure derived from the visitors to the monument in relation to the total pleasure derived from the whole trip;
- scenario 3 takes into account not only the cost elements included in scenarios 1 and 2 but in addition the cost of leisure time. The allocation of the traveling and accommodation cost for multipurpose trips was performed on the basis of the total number of travel days approach.

The assumptions adopted lead to similar estimates of the unit costs of travel in zones adjacent to the museum for scenarios 1 and 2 and relatively higher for scenario 3. On the other hand, the

**Table 2**

Estimated visitation rate (VR) to the monument from each specified zone of origin (visitors per million population).

Zones	Visitors	Population	Visitation rate (VR)
1	10,000	63,350	157,853
2	5000	316,913	15,777
3	48,000	3,381,547	14,195
4	5000	7,202,210	694
5	50,000	629,190,543	79
6	32,000	6,228,032,545	5

estimated unit travel costs in the most remote zones are quite similar in scenarios 1 and 3 and considerably higher in scenario 2.

#### 4.3. Demand curves

In the next step, the visitation rate (VR) to the monument from each specified zone was calculated and the obtained results are presented in Table 2.

Then, as mentioned in Section 3.2, several statistical models were developed and tested in order to quantify the influence of travel cost and other socioeconomic parameters to the visitation rate of the monument in question. Regardless of the form of the mathematical function, we examined two different types of regression models, namely:

- TC models assuming the travel cost as the only independent variable of the model;
- full models, which include as independent variables the travel cost and other socioeconomic factors.

The results of the analysis showed that semi-log 2 and double-log models lead to the best identification of the relation between visitation rate and the average cost. Table 3 shows the models presenting the highest adjusted coefficient of determination ( $R^2$ ), the significant independent variables included and other indices related to their performance.

**Table 3**  
Statistical models chosen for the estimation of the relation between visitation rate and the average cost per trip from each zone, and their performance characteristics.

Model	Scenario	Regression function	Adj. R <sup>2</sup>	Predicted number of visitors
Semi-log 2 - TC model	1	$\ln(\text{VR}) = 10.2^* - 0.04(\text{travel cost})^*$	87.2%	168,348
	2	$\ln(\text{VR}) = 9.7^* - 0.02(\text{travel cost})^{**}$	75.0%	219,830
	3	$\ln(\text{VR}) = 10.4^* - 0.04(\text{travel cost})^*$	87.4%	163,600
Semi-log 2 - full model	1	$\ln(\text{VR}) = -25.5^{**} - 0.04(\text{travel cost})^* + 15.7(\text{freelancer})^{**} + 3.7(\text{visit})^{**}$	99.2%	154,923
	2	$\ln(\text{VR}) = 14.8^{**} - 0.02(\text{travel cost})^* \pm 5.5(\text{gender})^* - 2.7(\text{education})^{**}$	99.4%	174,561
	3	$\ln(\text{VR}) = -26.4^{**} - 0.05(\text{Travel Cost})^* + 17.8(\text{Freelancer})^{**} + 0.6(\text{Income})^{***}$	99.3%	167,646
Double-log - TC model	1	$\ln(\text{VR}) = 15.2^* - 2.4 \ln(\text{travel cost})^*$	95.4%	158,849
	2	$\ln(\text{VR}) = 13.5^* - 1.8 \ln(\text{travel cost})^*$	90.9%	177,592
	3	$\ln(\text{VR}) = 16.9^* - 2.7 \ln(\text{travel cost})^*$	93.8%	153,265
Double-log - full model	1	$\ln(\text{VR}) = -15.7^{**} - 2.6 \ln(\text{travel cost})^* + 8.6 \ln(\text{age})^*$	99.1%	205,503
	2	$\ln(\text{VR}) = 24.0^{**} - 1.8 \ln(\text{travel cost})^* - 15.6 \ln(\text{visitation reason})^{***}$	98.0%	238,495
	3	$\ln(\text{VR}) = -21.2^{**} - 3.1 \ln(\text{travel cost})^* + 3.0 \ln(\text{attractiveness})^{***} + 9.7 \ln(\text{age})^*$	99.9%	178,722

Adj.: adjusted; TC: travel cost; freelancer: (freelancer as reported occupation): 1: yes, 2: no; visit: (visit of the monument is performed for first time): 1: yes, 2: no; gender: (participants' gender): 1: man, 2: woman; educational (participants' educational level): 1: graduate of elementary school, 2: graduate of middle school, 3: graduate of high school, 4: superior graduate school, 5: graduate of university, 6: MSc/MBA or PhD; income: (annual gross income of participants' households): 1: less than 6000 €, 2: 6000–12,000 €, 3: 12,000–18,000 €, 4: 18,000–24,000 €, 5: 24,000–36,000 €, 6: 36,000–48,000 €, 7: 48,000–60,000 €, 8: more than 60,000 €; attractiveness: (assessment of the attractiveness of the monument): 1: no attractive, 2: moderate attractive, 3: attractive, 4: beautiful; visitation reason: (as reason was reported the combination of the visit to the monument with another activity in the wider area the same day): 1: yes, 2: no; age: (participants' age): age as continuous variable.

\* Significant at 99% level.  
 \*\* Significant at 95% level.  
 \*\*\* Significant at 90% level.

It is worth mentioning that the selected models present a satisfactory up to very high predictive power, with a R<sup>2</sup> ranging from 80% to 100%, meaning that the independent variables included in each model explain a corresponding percentage of the total number of visitors in the site in question.

The full models finally selected show that visitation rates are positively related to: older people; women; visitors, who do not work as freelancers; visitors, who have revisited the monument; visitors, who stated as main reason the combination of the visit to the monument with another activity in the wider area the same

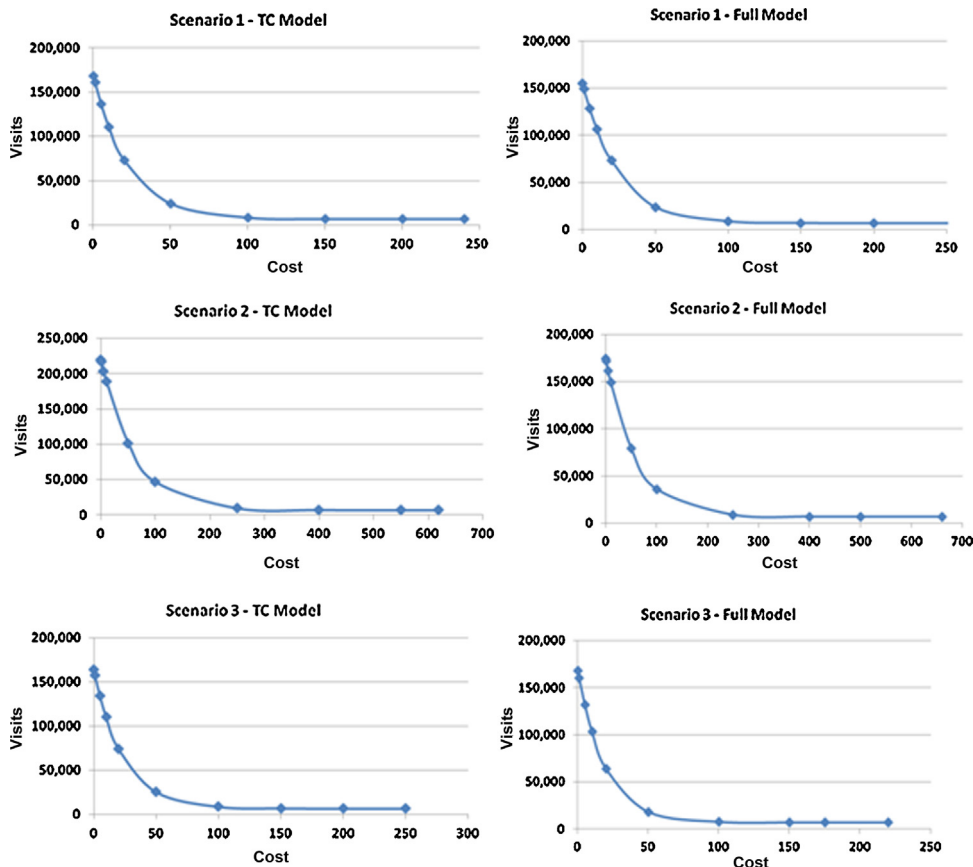


Fig. 2. Demand curves for the monument in question as resulted by the implementation of semi-log 2 model for the three examined scenarios.

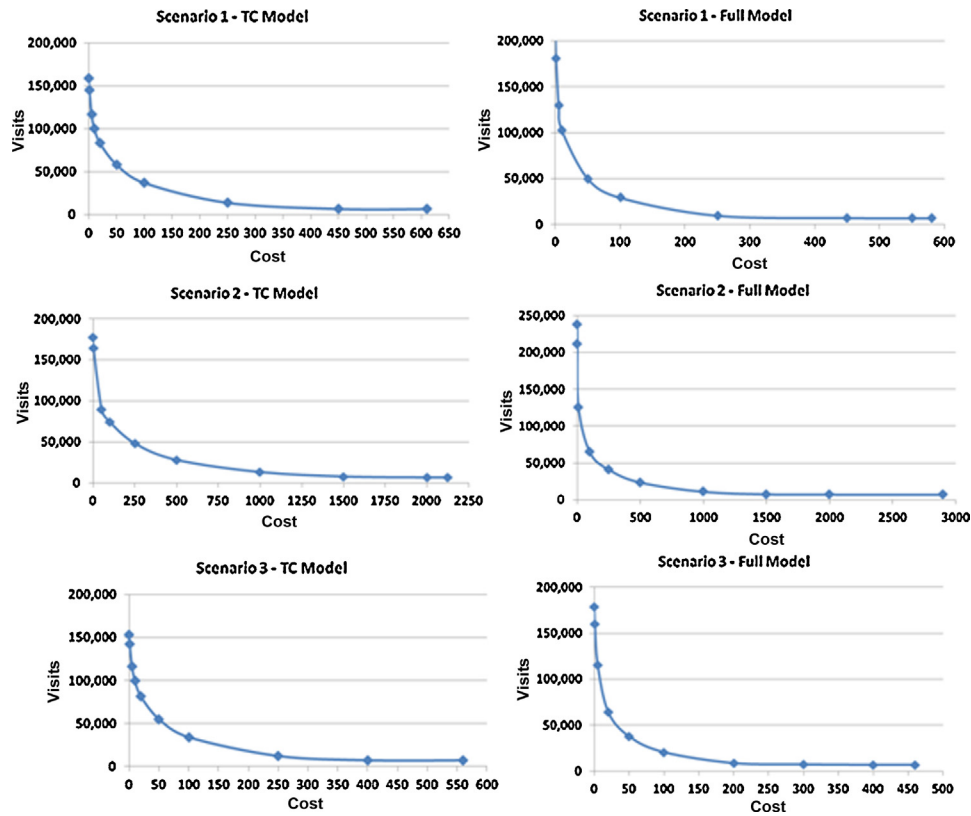


Fig. 3. Demand curves for the monument in question as resulted by the implementation of double-log model for the three examined scenarios.

Table 4

Estimated consumer surplus and total value of the monument for the examined scenarios.

Model	Scenario	Consumer surplus	Total value
Semi-log 2 - TC model	1	3,868,525	18,644,746
	2	13,723,088	50,096,712
	3	3,961,922	20,238,747
Semi-log 2 - full model	1	3,943,024	18,719,245
	2	10,655,450	47,029,074
	3	3,327,784	19,604,609
Double-log - TC model	1	3,053,568	17,829,789
	2	19,291,851	55,665,475
	3	2,321,549	18,598,373
Double-log - full model	1	2,459,507	17,235,728
	2	24,460,529	60,834,153
	3	1,520,896	17,797,721

TC: travel cost.

day; the annual income available; and the attractiveness of the monument in question. On the other hand a negative correlation between visitation rate and educational level was found in one of the selected models. Finally, all models selected show that the higher the travel cost from one zone to visit the monument the lower the visitation rate from this zone.

Having specified the regression models, the demand curves for each of the examined scenarios were developed on the basis of the procedure described in Section 3.2 (Figs. 2 and 3).

#### 4.4. Estimation of consumer surplus and total value of the monument

At the final stage of the method, the consumer surplus of the visitors of the monument, which is the area under the demand

curve identified in the previous step, was calculated, by using the equations presented in Section 3.2 (Table 4).

Summarizing, the consumer surplus for the monument in question ranges between € 2.3 and 19.3 million per year in the case of TC models and between € 1.5 and 24.5 million per year in the case of full models. The combination of total expenditures incurred by visitors in order to visit the monument and the estimated consumer surplus can lead to the total value of the examined monument. Specifically, the total value of the archaeological site of Sounio ranges between € 17.8 and 55.7 million per year on the basis of the examined TC models and between € 17.2 and 60.8 million per year on the basis of the various full models.

## 5. Concluding remarks

This paper presents an application of the TCM for valuing the Poseidon temple in Sounio, Greece, which is one of the most important monuments of the ancient Greek civilization.

The results of the analysis show that the consumer surplus for visiting the site in question ranges from € 1.5 to 24.5 million per year. Treatment of travel costs in multipurpose trips influences significantly the final results. Specifically, the allocation method based on the pleasure derived from the visit to the monument leads to higher estimates (by a factor of 3 to 6) relative to the method based on the total number of travel days. This clearly reveals that a visit in Poseidon temple in Sounio offers welfare and satisfaction to the guests, which is an important part of the total pleasure they derive from their entire trip. However, as the visitors of the monument may be not familiar with allocating the total pleasure of a trip to various activities, the possibility of overestimating the percentage attributed to the activity in question cannot be ignored. Furthermore, integration into the analysis of the value of time that the visitor spent for the trip in question does not influence significantly the total value of the estimated consumer surplus. Also, the type of

the functional form used for estimating how the travel costs influence the visitation of a site seems to have a moderate impact on the final results. More generally, based on the results of this analysis, one can conclude that applying the TCM for valuing sites that a significant part of the visitors come from long distances in the context of multipurpose trips, particular attention should be paid in designing the survey in a way that allows to estimate the share of total travel costs attributed to the visits of the site in question (e.g., through the implementation of alternative approaches and including appropriate questions), while the value of time spent to travel and visit the site of interest seems to have low influence on the final results.

Although the estimated consumer surplus varies significantly in different scenarios examined, the results of the analysis provide useful information for policymakers. The lowest estimate of the consumer surplus gives an indication of the minimum amount of money that is socially acceptable to be spent annually for restoration, maintenance and enhancement activities in the monument under consideration. The estimation of the demand curve can also give useful insights for setting appropriate levels of entrance fees. Last, such approaches can be used to evaluate and prioritize maintenance or protection actions scheduled for various monuments given the budget available.

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