




Article

Economic Valuation of Cultural Heritage: Application of Travel Cost Method to the National Museum and Research Center of Altamira

Saúl Torres-Ortega ^{1,*} , Rubén Pérez-Álvarez ² , Pedro Díaz-Simal ¹ ,
Julio Manuel de Luis-Ruiz ² and Felipe Piña-García ²

¹ Environmental Hydraulics Institute, University of Cantabria, 39011 Santander, Spain; pedro.diaz@unican.es

² Cartographic Engineering and Mining Exploitation R+D+i Group, University of Cantabria, 39316 Torrelavega, Spain; ruben.perez@unican.es (R.P.-Á.); julio.luis@unican.es (J.M.d.L.-R.); felipe.pina@unican.es (F.P.-G.)

* Correspondence: saul.torres@unican.es; Tel.: +34-942-201616 (ext. 1218)

Received: 11 June 2018; Accepted: 19 July 2018; Published: 20 July 2018



Abstract: The economic assessment of non-marketed resources (i.e., cultural heritage) can be developed with stated or revealed preference methods. Travel cost method (TCM) is based on the demand theory and assumes that the demand for a recreational site is inversely related to the travel costs that a certain visitor must face to enjoy it. Its application requires data about the tourist's origin. This work aims to analyze the economic value of the National Museum and Research Center of Altamira, which was created to research, conserve, and broadcast the Cave of Altamira (UNESCO World Heritage Site since 1985). It includes an accurate replica known as the “Neocave”. Two different TCM approaches have been applied to obtain the demand curve of the museum, which is a powerful tool that helps to assess past and future investments. It has also provided the annual economic value estimate of the National Museum and Research Center of Altamira, which varies between 4.75 and 8.00 million € per year.

Keywords: economic valuation; travel cost method; Altamira; Neocave; UNESCO

1. Introduction

When managing a cultural resource (i.e., a museum, a heritage asset, a historic venue . . .), it is necessary to know its value in order to give visibility and assist in management decision making. The economic valuation of non-marketed resources (as the previously enlisted) can be developed from two different approaches: stated and revealed preference methods. In the former, individuals are asked to give a value (defined by their willingness to pay, WTP) for the resource. Methodologies such as contingent valuation or choice modelling are applied. Revealed preference methods are based on observed behaviors and indirectly obtained data. These two approaches usually return different estimates, and several studies have tried to find an explainable relationship [1–3].

In 1947, Harold Hotelling proposed a method to link travel costs faced by visitors to a natural area and its economic value, trying to solve an enquiry by the US National Park Authority to assess the economic value of natural heritage. With further development [4,5], travel cost method (TCM) has been widely applied to areas with strong recreational uses (lakes, beaches, forests, etc.). This work aims to assess the economic value of the Museum of Altamira with the application of the TCM.

The museum was created to research, broadcast and preserve the Cave of Altamira, which is on a hill in Santillana del Mar (Cantabria, Spain, Figure 1), at depths ranging between 3 m and 22 m. Its only known entrance (153 m a.s.l.) has been closed. It is hosted in a Cenomanian limestone succession [6].

The Polychromes Chamber is 60 m away from the entrance, at a lower level. The cave was generated by rock falls and gravitational collapses [7].



Figure 1. Location of the Cave of Altamira.

The cave was discovered around 1875 by Modesto Cubillas, who notified it to Marcelino Sanz de Sautuola. After attending the International Exposition Universelle, Sanz de Sautuola reproduced the French campaigns in Altamira. Her daughter Maria discovered the famous bison [8]. He presented them as Palaeolithic art [9], and received a discredit that would last until 1897, when the Société d'Anthropologie de Paris accepted other decorated caves.

Eight levels of human occupation, from the Late Gravettian to the Middle Magdalenian, have been identified at the entrance hall. The art corresponds to a wide time span and different stages (35,559–15,204 cal BP). The uranium-series dating of the calcite that covers some graphics at the polychrome chamber shows that they belong, at least, to the Aurignacian period [10]. 13,000 years ago, a collapse closed the cave [7]. Other rock falls occurred in 1924 and 1930 [11]. To avoid further affections, hidden walls and pillars were constructed.

In 1955, more than 50,000 people visited the cave. Experts advised a reduction, but politicians considered it a menace for tourism [12]. 177,000 people visited the cave in 1973 [13]. This inflow would have erased the paintings due to variations in moisture and temperature. After an evaluation by researchers, the cave was closed in 1977 [14]. In 1978, the Ministry of Culture became its holder. In 1979, the National Museum and Research Center of Altamira was created, and a study to regulate the tourism activity within the cave started. The negative influence of this closure on tourism was discussed, and a concern about the necessity of a replica arose.

The cave was opened in 1982 under strict standards. It was inscribed in the UNESCO World Heritage List as a cultural site in 1985. The replica of Lascaux Cave stirred requests for an alternative in 1983. The recovery of tourism reduced the social pressure by 1991, and the project evolved towards the

aims of the museum. The construction of the replica started in 1997, and the new Museum of Altamira (Figure 2) was inaugurated in 2001.

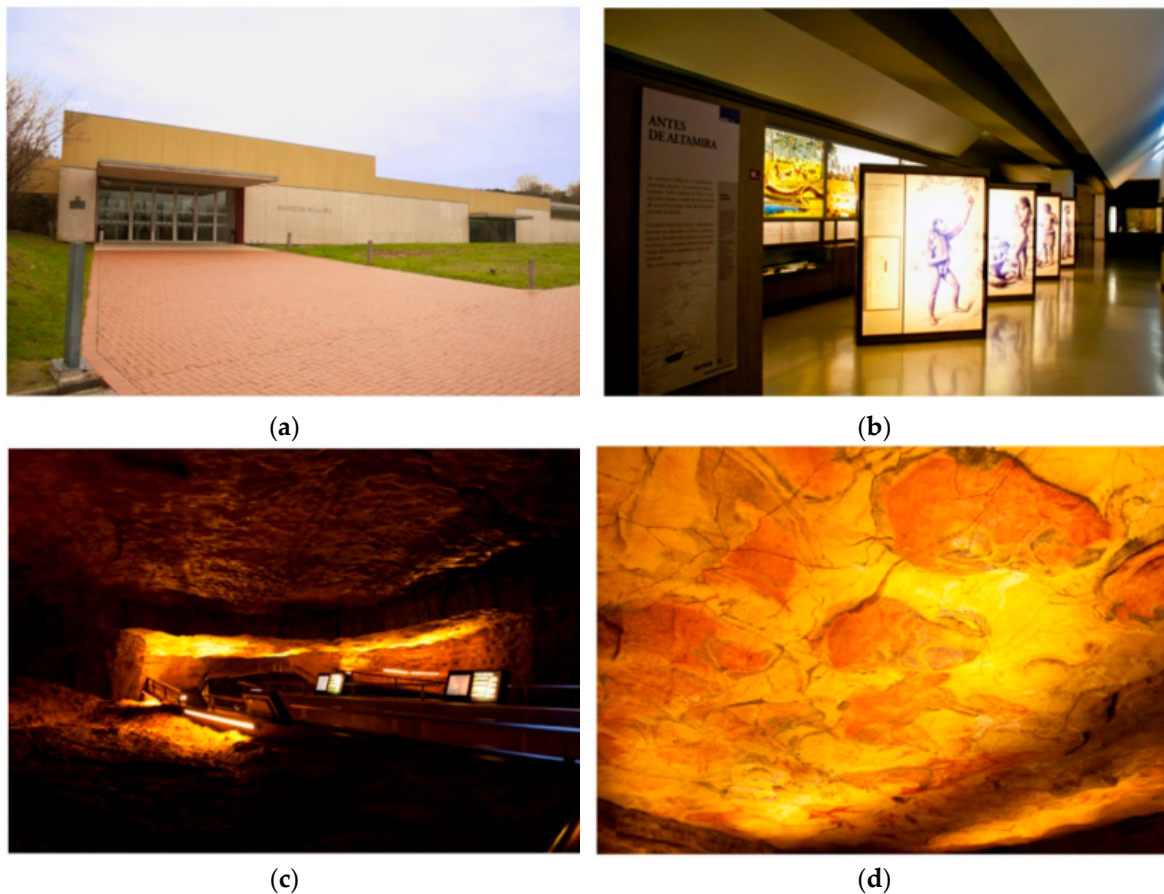


Figure 2. National Museum and Research Center of Altamira. (a) External view; (b) Exhibition area. (c) Neocave; (d) Detail of the ceiling of the Neocave.

The complex has a total built surface of 6748 m². It hosts the Neocave, which reproduces the former appearance of the cave. The IGN (National Geographic Institute of Spain) obtained the volume of the cave and an accurate definition of the polychrome ceiling [15]. The latter was surveyed with terrestrial photogrammetry [16]. A *.tiff file of 80 Mb and 140 million pixels was obtained [17]. An exact physical model of 200 m² was carved in blocks of expanded polyurethane [18]. After applying actual textures with wax patterns, drawing each crack or animal, and carving them, it was cut into pieces to obtain molds. They were filled with mortar (80% limestone, agglutinant, ochre pigments, and a fireproofing agent). Each drawing was represented on the final model with the same process, positions, and materials. Even concretions were reproduced. Coatings preserve the paintings and simulate moisture.

The museum includes exhibitions [19], multiple use rooms, an assembly hall, a cafe–restaurant, and a shop. It implied direct advantages for the conservation of the cave: the buffer area reached 16 Ha. The total cost was estimated to be 14.4 million € [20].

In 2002, the cave was closed to update the studies on conservation. No voices arose against this closure. In January 2014, the Altamira board approved experimental visits [21] within the Research "Program for the Preventive Conservation and the Regime of Access to the Cave of Altamira" [22]. It implied the access during 37 min of two guides and five visitors drawn by lot each week to assess their impact. The study found no negative influence due to human presence. In March 2015, the board continued this regime within the preventive conservation [23]. However, controversy arose, as other

experts [24] consider that visits can damage the art [25]. The most recent periodic report of World Heritage Committee about Altamira dates from October 2014. It indicates that visits are a risk factor, but they are controlled to avoid alterations [26].

2. Materials and Methods

TCM is a revealed preference method [27] which tries to relate the costs of recreational activities and the characteristics of the resource. It is based on the demand theory and assumes that the demand for a site is inversely related to travel costs [28]. TCM can comprise a wide range of parameters, including the monetary values of fuel, entrance fees, and travel time. The rent and other socioeconomic variables can be also considered in the analysis as dependent variable.

Following the utility maximization framework, the optimization problem presented in TCM can be described as

$$\text{Max } U(q, I, z); \text{ subject to } TC \cdot q + z = I, \quad (1)$$

where, U represents utility obtained from consuming a quantity of a good q ; I is income; z stands for the consumption of other goods; and TC are the travel costs.

From (1), the Marshallian demand for a site is

$$R = f(q, TC, z, I), \quad (2)$$

Consumer surplus (CS) is the difference between the total amount that consumers are willing and able to pay for a good or service and the total amount that they actually pay, so it can be used as a measure of the visitors' net benefit. CS can be estimated as the area below the demand curve and above the price line [29], which can be also obtained by the integration of Equation (2).

TCM can be classified into three different categories:

1. The individual travel cost method (ITCM) seeks the relationship between the number of trips taken by the same individual, and the travel costs incurred when reaching the destination.
2. Zonal travel cost method (ZTCM) analyzes the relationship between the number of trips to the site in relation to the population of a zone and the travel costs.
3. The random utility model (RUM) combines a TCM and a contingent valuation to determine the number of trips to a site among a set of possibilities.

RUM aims at determining how the several attributes of different sites affect visitor's decision process and allows quantifying these characteristics. However, it also requires specific surveys to ask visitors about a valuation of the site attributes. Therefore, the required questionnaire is more complex and longer. ITCM is suitable for recurrent visits to a site and provides more information about individual behaviors, while ZTCM fits better when repeated visits are scarce [1,30], and requires visitors' origins and travel costs, which can be surveyed at the entrance of the resource. For a detailed analysis of the limitations, requirements, and difficulties in the application of TCM see [30,31].

This coexistence of multiple applications with different data requirements has increased TCM popularity for the valuation of environmental areas [30–34] or cultural heritage [35–37]. In Spain, TCM has been applied to natural areas [38–40], environmental damage [41], cultural heritage [42] and geological assets [43].

In this paper, both an ITCM and a ZTCM will be applied. This dual approach will allow comparison of the obtained results.

2.1. Individual Travel Cost

The individual travel cost method is based on the premise that the number of visits a given user makes to a cultural site is a function of the total cost of the trip and other possible variables that contribute to explain the user's behavior. As with any demand function, an inverse relationship is

established between demand quantity and price, so that for higher travel costs, the demand is lower. For a given visitor, the demand of visits to a site follows the expression

$$V_i = f(TC_i, X_i) + \varepsilon_i, \quad (3)$$

where V_i is the number of visits the user makes to a site in a given period of time; TC_i is the total cost of travel to the site; X_i is a vector of additional features including income, age, or gender; and ε_i is an error term. The concept of total cost includes travel costs, entry costs, and other possible additional costs (such as time).

When estimating the previous function, the number of visits (V_i) cannot take continuous values (only integer values), so the use of a regression with ordinary least squares (OLS) can lead to errors of inconsistency and inefficiency [44]. The simplest solution is to use a regression model based on a Poisson distribution [45].

The Poisson distribution meets the assumption that the average number of visits is the same as the variance. When this situation is not met, and the data show a greater dispersion (common in practice), the use of negative binomial (NB) distributions can be an alternative. NB models introduce an error term into the hypothesis above mentioned of equality of mean and variance, allowing the consideration of unobserved systematic differences [46].

Another common issue when dealing with ITCM results from the data obtention in two different ways. Firstly, only visitors to the site are surveyed, so only $V_i > 0$ are observed. Secondly, the sample presents endogenous stratification, as the probability of being sampled is affected by the number of visits made [47–49]. These problems can be solved using a zero-truncated distribution.

In all cases, considering the mentioned distributions, Equation (3) can be transformed into

$$\log V_i = \beta_0 + \beta_{TC} TC_i + \beta_X X_i, \quad (4)$$

Once the function setting parameters have been estimated, and assuming that the coefficient on TC is representative of cost trade-offs [50], the consumer's surplus (CS) can be obtained as [45,51–53]

$$CS = -1/\beta_{TC}, \quad (5)$$

Confidence intervals for the 95% confidence level can be constructed as [31]

$$CS_L = -1/[\beta_{TC} + 1.96(\text{se } \beta_{TC})]; CS_U = -1/[\beta_{TC} - 1.96(\text{se } \beta_{TC})], \quad (6)$$

The aggregation of this CS for all visitors to the site for a period of one year can obtain the annual economic value of the site.

2.2. Zonal Travel Cost

In the zonal travel cost method, visitors to the cultural site are grouped according to the distance travelled for the enjoyment of the site. In this case, the dependent variable is the number of visitors over the population of the area considered to make the grouping. In its earliest versions, Clawson & Knetsch [4,5] proposed the use of concentric zones around the site under analysis, but recent studies suggest the possibility of using population-based, geographic, or even administrative boundaries. Different studies provide arguments for or against the use of either approach [30,41,54].

The demand function of the site is therefore

$$V_i/P_i = f(TC_i, X_i) + \varepsilon_i, \quad (7)$$

where V_i is the number of visits from zone i to the site in a given period of time; P_i is the total population of zone i ; TC_i is the total cost of travel to the site; X_i is a vector of additional features

including income, age, or gender; and ε_i is an error term. The concept of total cost includes travel costs, entry costs, and other possible additional costs (such as time) again.

If the percentage of visits over the total population is calculated, as many points could be obtained as areas are designed. The adjustment of these points will again allow the obtention of the demand function of the site under study. This adjustment supports several functional forms, in which linear, semilogarithmic, or logarithmic forms are combined, so a study comparing the possible adjustments and results obtained is often recommended.

The consumer surplus is then obtained from the area under the demand curve, which is calculated by integrating the demand curve from the minimum price (normally equal to the entrance fee if it exists) to the maximum price where demand is zero [55].

2.3. Available Data and Working Hypothesis

In 2013, the University of Santiago and the Spanish National Research Council (CSIC) estimated the impact of the Museum of Altamira in the regional economy [56]. 1067 visitors were asked about their visit and origin between August 2013 and February 2014. This microdata is available on the CSIC website. The places of origin of the visitors to the Museum of Altamira is the basic input for this work.

To apply the zonal TCM to this site, several steps were followed. Spain was divided into 52 zones, according to the administrative provinces (NUTS Level 3). Only national mainland visitors were considered.

For both TCM applications, the distances between the capital of each province, Santander (capital of Cantabria), and the Museum of Altamira were obtained with Google Maps. They were used to distinguish between visitors who can perform a one-day visit to Altamira and those that must stay overnight. The limit distance for the return trip was set on 225 km, based on average travel and visiting times, and a maximum return trip of 8 h. For zones with distances from their capital to the museum higher than 225 km, displacement costs have been passed on to the average duration of a visit to Cantabria [57].

Another relevant methodological problem in TCM applications is the incidence of substitutes and multi-purpose or multi-sites visits [54,58]. These issues can bias obtained CS. In this study, the Museum of Altamira is considered as a major attraction due to its classification as a World Heritage Site by UNESCO, which can lead to the assumption that visiting the museum is the main purpose of the trip. Therefore, the total travel costs are passed on the visit. Although other sites can be visited during that day, all costs are allocated to the museum.

The travel cost was calculated for each region based on these assumptions. Table 1 shows the values for other parameters applied.

Table 1. Parameters used for the calculation of travel costs.

Parameter	Value
Average speed	100 km/h
Car consumption	0.065 €/km
Other car expenses	0.050 €/km
Time cost	10 €/h = 0.100 €/km
Entrance fee	3 €

There is a great agreement in the literature on the need to consider opportunity costs when valuating travel time [52,59–61], and the determination of an appropriate value for doing this has been studied in depth. Following HEATCO recommendations for recreational road trips in the EU [62], the proposed value for time was 10 €/h. This value and those summarized in Table 1 could be considered conservative, but a major agreement about the economic valuation of time is a common challenge.

Average rent data of each region (from the National Statistics Institute of Spain, INE) were applied. TCM can use this information, the estimation of visits from each region and the associated costs to obtain the demand curve and an economic value estimation for the museum.

3. Results

3.1. Individual Travel Cost

As there are no theoretical preferences for choosing one functional form over another, different approaches (linear, log–linear, linear–log, log–log) were estimated and tested. Finally, the following model was proposed to estimate the demand function (see Table 2 for the definition of the variables)

$$V_i = \exp[\beta_0 + \beta_{TC}TC_i + \beta_{AGE}AGE_i + \beta_{GENDER}GENDER_i + \beta_{EDUC}EDUC_i + \beta_{LABO}LABO_i + \beta_{INCO}INCO_i], \quad (8)$$

The dependent variable V_i (visits to Altamira) presents a mean of 1.244, a variance of 0.617, and a standard deviation of 0.785, suggesting a lack of overdispersion. To contrast the effects of using a Poisson or a Negative Binomial regression, both models were obtained by using zero-truncated distributions, with no appreciable results between both situations, so a Poisson regression was finally selected.

The results of the demand model are presented in Table 2.

Table 2. Parameters used for the calculation of travel costs (ITCM).

Variable	Coefficient	Standard Error
Constant	0.774783	0.432031
Travel cost (TC)	−0.031299 ***	0.002810
Age (AGE)	0.011288 *	0.005475
Gender (GENDER)	−0.176996	0.132768
Education (EDUC)	−0.057772	0.072726
Labor situation (LABO)	0.063141	0.052895
Income (INCO)	−0.042843	0.048324
Number of observations	833	
Log-likelihood	−521.6198	

Signif. codes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The TC estimate is highly significant and negative, confirming the premise that the number of visits decreases as the cost of travel increases. The remaining variables are not statistically representative.

Using the obtained estimate for TC variable in Equation (8), CS per visitor and visit is obtained

$$CS \text{ per visit} = -1/\beta_{TC} = -1/(-0.031299) = 31.95 \text{ euros}, \quad (9)$$

5 and 95 percent confident intervals are also estimated, obtaining that CS can range from 27.16 to 38.77 euros per visit.

The number of visitors to the Museum of Altamira in 2012 was 256,227. Multiplying this value by the CS, an annual economic value of 8.18 million euros is obtained, with a 95% confidence interval ranging from 6.95 to 9.93 million euros.

3.2. Zonal Travel Cost

To obtain the demand function, the data from visitation rates, travel costs, and average income for all the zones were tested using different regression models: linear, log–linear, linear–log, and log–log. Results are shown in Table 3. All regression models tested were highly significant, as their p -values indicate. ITCM determines that no relevant statistical information is provided by socioeconomic data. Given that the adjustment is better, the linear–log model without income is considered as the most

valuable alternative, and it is finally applied to obtain a regression without taking into account the income variable.

Table 3. Parameters used for the calculation of travel costs (ZTCM).

Variable	Linear	Log-Linear	Linear-Log	Log-Log	Linear-Log without Income
Constant	0.008679 * (0.003.860)	−5.234 *** (0.5745)	0.00666 (0.0253935)	−11.6254 * (4.4411)	0.036916 *** (0.003596)
Travel cost	−0.0001134 *** (0.00002261)	−0.01873 *** (0.003365)	−0.00728 *** (0.0009607)	−0.9937 *** (0.1680)	−0.007766 *** (0.000876)
Income	0.0000002694 (0.0000002123)	0.000006783 * (0.00003159)	0.00296 (0.0024650)	1.0703 * (0.4311)	-
Adjusted R ²	0.4585	0.5508	0.6135	0.5779	0.6278
Log likelihood	207.972	−27.1612	217.0174	−25.6986	216.2563
F-statistic	20.47	29.2	40.41	32.49	78.59
p-value	5.192×10^{-7}	8.508×10^{-9}	1.091×10^{-10}	2.164×10^{-9}	1.967×10^{-11}

Signif. codes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

For the estimation of the consumer surplus, the Chotikapanich and Griffiths [55] methodology is followed. The CS is obtained through the integration of the demand function for each zone.

$$V_i/P_i = 0.036916 - 0.007766 \ln(TC_i), \quad (10)$$

$$V_i = P_i(0.036916 - 0.007766 \ln(TC_i)), \quad (11)$$

$$CS_i = \int_{TC_{\min}}^{TC_{\max}} P_i(0.036916 - 0.007766 \ln(TC_i)) \quad (12)$$

$$CS_i = P_i(0.036916 TC_i - 0.007766(TC_i \ln(TC_i) - TC_i)) \quad (13)$$

To obtain the total CS, all the zonal estimates are added, which implies a surplus of 4.75 million euros per annum. This value represents an 18.55 euros surplus per visitor.

A 95% confidence interval is calculated using Equation (14), as proposed in [55].

$$\text{var}(\widehat{CS}) = \left(\frac{\delta(CS)}{\delta \beta_0} \right)^2 \text{var}(\widehat{\beta_0}) + \left(\frac{\delta(CS)}{\delta \beta_{TC}} \right)^2 \text{var}(\widehat{\beta_{TC}}) + 2 \left(\frac{\delta(CS)}{\delta \beta_0} \right) \left(\frac{\delta(CS)}{\delta \beta_{TC}} \right) \text{cov}(\widehat{\beta_0}, \widehat{\beta_{TC}}) \quad (14)$$

The resulting confidence interval varies total economic surplus from −48.97 to 58.47 million euros per annum, and −191.11 to 228.19 euros per visitor. Possible caveats in the interpretation of the results are evident if the confidence intervals are observed. They are wide and include negative values which can be explained due to the lack of more valuable data or the inherent uncertainty of the process followed, but this fact is considered as a common situation in numerous studies [30,31,55,63].

4. Discussion

The obtention of a demand curve, as the one determined for the Museum of Altamira, is useful to set management strategies. It allows foreseeing the effect of changes in ticket prices on visitors. It can be applied on the optimization of marketing actions, with different pricing policies or advertising campaigns targeted at zones which are likely to provide visitors. The estimation of an economic value of the museum allows communicating in a simple and comprehensible way the cultural service provided.

There is little consensus in the literature about which method (individual or zonal) produces better results [31]. The findings from this study show the difficulty to obtain a consistent result when applying TCM, both in its individual and zonal approaches.

Although both approaches produce statistically significant results (there is high correlation between the number of trips demanded and the travel costs), the results of the consumer surplus

provided by both approaches can be considered as significantly different (31.95 versus 18.55 euros per visitor), especially in the case of the ZTCM, whose confidence interval presents a dispersion that shows the uncertainty that exists in the method.

Results confirm those obtained by previous studies, which highlight the high dependence on the outputs provided by the TCM, according to the approach used, the variables considered or the function of the demand curve. All these alternatives translate into multiple combinations that, in practice, result in different methodologies that can produce very different outcomes with high variability.

Regarding the coefficient estimates, the travel cost coefficient obtained both for ITCM and ZTCM is negative, as a priori expected, and it is consistent with the demand theory. This means that, the higher the travel costs, the lower the visits to the museum. Other variables different to travel costs seem to be no representative, so the age, income, or education do not affect the demand function.

The elasticity of the demand curve provides information about the visitor's behavior when facing changes in costs. The travel cost elasticity, which is evaluated at variable mean, 63.81 euros, and with an average rent of 14,418 euros—Spanish average—is -2.02 . An increase of 1% in the total travel costs is translated into a 2% decrease in the visitation ratio. This indicates that the demand for the museum is elastic: changes in travel cost will affect the total revenue in an important manner. This suggests that if the aim is to promote the number of visitors to the museum, a reduction in total travel costs must be the objective, which can be reached by different ways (such as reducing travel costs, travel time, or entrance fees).

Visitor surplus average is approximately 0.17% of the average annual income in Spain, a value that differs slightly from the national authorities' expenditure on culture (0.44% of GDP) [64].

This estimation of the CS cannot be directly compared to those obtained in other studies, as there are a set of important differences between the assumptions, data gathering, location, socioeconomic characteristics, etc. that affect the obtained results in an important way. Nevertheless, the CS as well as the demand functions obtained should be useful for policy makers and managers to identify how visitors to the museum could react when changes in their travel costs appear.

5. Conclusions

The management of a UNESCO world heritage site is a complicated task. The evaluation of the different options that are presented when facing the conservation and management problems of the asset can be better understood if the positive and negative aspects of each alternative are known, as well as their costs and benefits.

The purpose of this paper was twofold: firstly, the application of the TCM to obtain a demand curve and an economic value estimate for the National Museum and Research Center of Altamira; secondly, the comparison of two different approaches to obtain the previous objective and identify mechanisms for optimizing management.

This study demonstrates the applicability of both TCM methods (individual and zonal) to estimate the cultural value of a worldwide known site. The National Museum and Research Center of Altamira provides different services to the cave and to society. It helps to research, disseminate, and preserve the cave. It contributes to capitalizing and providing new uses to previous investments or initiatives. Finally, it is a major international tourism site. Only the latter source has been considered to estimate its total economic value. In addition to other advantages, the availability of this estimation allows the assessment of past and future investments in the Museum of Altamira.

The development of a simple survey among the visitors to the resource provides all the data required for the TCM. This fact highlights the ease to replicate the method in other non-marketed resources. The importance of its application relies on the usefulness of the demand curve in all management processes related to the resource (pricing policy, marketing, maintenance, or long-term investments on the site).

Considering the case of the Museum of Altamira, the demand curve has served to study tourists' behavior when the travel costs to reach the resource changes. It is now possible to predict how the

number of visitors is expected to vary when changes in the tickets or in the transportation network costs happen. It has been found through price elasticity of demand estimates that visitors to the Museum of Altamira are slightly responsive to price changes, which turns increases in total travel costs into a reduction in the visitation rate.

A by-product of this work is the estimate value of the Museum of Altamira. As TCM depends on the parameters, a wide range of variation of the value has been provided. This estimate only reflects the visitor's assessment in terms of tourism value of the recreational and cultural services or amenity value, regardless the cultural value of the museum or the cave, which is, without doubt, priceless, and does not include external indirect effects on the tourism sector.

Future studies could mix the obtained results with other valuation methodologies such as hedonic prices, contingent valuation, or choice experiments to complete the assessment of visitors' decisions. A sensitivity analysis of all the possible decisions on TCM application (variables considered, functional forms) can be also useful to clarify how all these options affect results. The obtained economic value can be jointly used with the managing costs of the site in a possible cost–benefit analysis which should allow obtaining a total estimate of the museum benefits.

Author Contributions: Conceptualization, S.T.-O., R.P.-Á., and P.D.-S.; Formal analysis, S.T.-O. and R.P.-Á.; Investigation, S.T.-O. and R.P.-Á.; Methodology, S.T.-O.; Supervision, P.D.-S. and J.M.d.L.-R.; Writing—original draft, S.T.-O. and R.P.-Á.; Writing—review & editing, S.T.-O., R.P.-Á., P.D.-S., J.M.d.L.-R., and F.P.-G.

Funding: This research received no external funding.

Acknowledgments: The authors want to thank the National Museum and Research Center of Altamira and its Director, Pilar Fatás, for their collaboration.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Armbrecht, J. Use value of cultural experiences: A comparison of contingent valuation and travel cost. *Tour. Manag.* **2014**, *42*, 141–148. [[CrossRef](#)]
2. Herath, G.; Kennedy, J. Estimating the economic value of Mount Buffalo National Park with the travel cost and contingent valuation models. *Tour. Econ.* **2004**, *10*, 63–78. [[CrossRef](#)]
3. Shrestha, R.K.; Loomis, J.B. Meta-analytic benefit transfer of outdoor recreation economic values: Testing out-of-sample convergent validity. *Environ. Resour. Econ.* **2003**, *25*, 79–100. [[CrossRef](#)]
4. Clawson, M. *Methods of Measuring the Demand for and Value of Outdoor Recreation*; Resources for the Future: Washington, DC, USA, 1979.
5. Clawson, M.; Knetsch, J.L. *Economics of Outdoor Recreation*; Johns Hopkins Press for Resources for the Future: Baltimore, MD, USA, 1966.
6. Cuezva, S.; Fernández-Cortes, A.; Benavente, D.; Serrano-Ortiz, P.; Kowalski, A.S.; Sánchez-Moral, S. Short-term CO₂(g) exchange between a shallow karstic cavity and the external atmosphere during summer: Role of the surface soil layer. *Atmos. Environ.* **2011**, *45*, 1418–1427. [[CrossRef](#)]
7. Lasheras, J.A. La reproducción facsímil de Altamira. *Litoral Atlántico* **2004**, *4*, 21–26.
8. de las Heras Martín, C. El descubrimiento de la Cueva de Altamira. In *Redescubrir Altamira*; Lasheras Corruchaga, J.A., Ed.; Turner Ediciones: Madrid, Spain, 2002; pp. 17–28.
9. Sanz de Sautuola, M. *Breves Apuntes Sobre Algunos Objetos Prehistóricos de la Provincia de Santander*; Imp. y Lit. de Telesforo Martínez: Santander, Spain, 1880.
10. García-Diez, M.; Hoffmann, D.L.; Zilhão, J.; de las Heras, C.; Lasheras, J.A.; Montes, R.; Pike, A.W.G. Uranium series dating reveals a long sequence of rock art at Altamira Cave (Santillana del Mar, Cantabria). *J. Archaeol. Sci.* **2013**, *40*, 4098–4106. [[CrossRef](#)]
11. Martínez, A.; Trimállez, A. Museo de Altamira ¿Museo para todos? In *Museos para la Participación. Proceedings of the 15 Jornadas Estatales DEAC*; Mosquera Cobián, M., Ed.; Museo de Belas Artes da Coruña: A Coruña, Spain, 2009; pp. 289–297.

12. Lasheras Corruchaga, J.A.; Fatás Monforte, P. The new Museum of Altamira. Finding solutions to tourism pressure. In *Of the Past, For the Future: Integrating Archaeology and Conservation, Proceedings of the Conservation Theme and the 5th World Archaeological Congress, Washington, DC, USA, 26–22 June 2003*; Agnew, N., Bridgland, J., Eds.; The Getty Conservation Institute: Los Angeles, CA, USA, 2003; pp. 177–183.
13. Lasheras, J.A.; Martínez, A. Museums for society: Altamira and its museum. In *Proceedings of the First International Conference on Best Practices in World Heritage, Menorca, Spain, 9–13 April 2012*; Castillo, A., Ed.; Universidad Complutense de Madrid: Madrid, Spain, 2012; pp. 621–636.
14. Fatás Monforte, P. La cueva de Altamira y su museo: Un caso extremo en la relación entre turismo y patrimonio. In *El Patrimonio Arqueológico a Debate: Su Valor Cultural y Económico*; Domínguez Arranz, A., Ed.; Gobierno de Aragón: Huesca, Spain, 2009; pp. 185–194.
15. IGN. Trabajos topográficos y fotogramétricos en la cueva de Altamira para la construcción de una réplica exacta. *Bol. Inf. Inst. Geográfico Nac.* **2000**, *1*, 4.
16. Piña Patón, B.; Mañero García, A.; Pascual Sanz, F. Trabajos Topográficos y Altimétricos en la Cueva de Altamira. *Rev. Fund. Patrim. Hist. Castilla León* **2002**, *8*, 31–32.
17. Piña Patón, B. Fotogrametría terrestre con cámaras métricas y topografía clásica de alta precisión. Datos para confeccionar la réplica de Altamira. In *Proceedings of the XII Cursos de Patrimonio Histórico, Reinosa, Spain, 23–27 July 2001*; Iglesias Gil, J.M., Ed.; Servicio de Publicaciones de la Universidad de Cantabria: Santander, Spain, 2002; pp. 299–310.
18. Musquiz Pérez-Seoane, M.; Saura Ramos, P.A. *El facsímil del techo de los bisontes de Altamira*; Redescubrir, A., Lasheras Corruchaga, J.A., Eds.; Turner Ediciones: Madrid, Spain, 2002; pp. 219–241.
19. Lasheras, J.A. ¿Didáctica o divulgación? In *Proceedings of the Enseñar, informar, contar, mostrar . . . en el museo. Present at Seminario-Encuentro Taula D’Història, El valor social y educativo de la Historia, Barcelona, Spain, 9–10 July 2007*.
20. Consorcio para Altamira. Proyecto Altamira. *Informes Constr.* **1997**, *49*, 58–62.
21. Ministry of Education, Culture and Sports. *El Patronato del Museo de Altamira aprueba la realización de visitas experimentales a la Cueva*; Press Note; Ministry of Education, Culture and Sport of Spain: Madrid, Spain, 2014.
22. De Guichen, G.; Muñoz Cosme, A.; Cirujano, C.; del Egado, M.; Blanco, M.; Arroyo, I.; Herráez, J.A.; Vicente Navarro, J.V.; García Diez, M.; Quindós, L.S.; et al. *Programa de Investigación para la Conservación Preventiva y Régimen de Acceso de la Cueva de Altamira (2012–2014)*; Technical Report; Ministry of Education, Culture and Sport of Spain: Madrid, Spain, 2014.
23. Ministry of Education, Culture and Sports. *El Patronato del Museo de Altamira aprueba continuar las visitas experimentales a la cueva en el marco del Plan de Conservación Preventiva*; Press Note; Ministry of Education, Culture and Sport of Spain: Madrid, Spain, 2014.
24. Sánchez-Moral, S.; Cuezva, S.; Fernández-Cortés, A.; Janices, I.; Benavente, D.; Cañaveras, J.C.; Élez, J.; González, J.M.; Jurado, V.; Láiz, L.; et al. *Estudio Integral del Estado de Conservación de la Cueva de Altamira y su Arte Paleolítico (2007–2009). Perspectivas Futuras de Conservación*; Ministry of Education, Culture and Sport: Madrid, Spain, 2014.
25. Cuezva, S.; Jurado, V.; Fernández Cortés, A.; García-Antón, E.; Rogerio-Candelera, M.A.; Ariño, X.; Benavente, D.; Cañaveras, J.C.; Saiz-Jimenez, C.; Sánchez-Moral, S. Scientific data suggest Altamira Cave should remain closed. In *Microbial Life of Cave Systems. Life in Extreme Environments*; Summers Engel, A., Ed.; Walter de Gruyter GmbH: Berlin, Germany, 2015; pp. 303–320.
26. World Heritage Center. *Periodic Report—Section II-Cave of Altamira and Paleolithic Cave Art of Northern Spain*; UNESCO: Paris, France, 2014.
27. Pearce, D.; Atkinson, G.; Mourato, S. *Cost-Benefit Analysis and the Environment: Recent Developments*; OECD Publications: Paris, France, 2006.
28. Prayaga, P. Estimating the value of beach recreation for locals in the Great Barrier Reef Marine Park. Australia. *Econ. Anal. Policy* **2017**, *53*, 9–18. [[CrossRef](#)]
29. Gravelle, H.; Rees, R. *Micro-Economics*; Pearson Education LTD: Essex, UK, 2004.
30. Fleming, C.M.; Cook, A. The recreational value of Lake McKenzie, Fraser Island: An application of the travel cost method. *Tour. Manag.* **2008**, *29*, 1197–1205. [[CrossRef](#)]
31. Lansdell, N.; Gangadharan, L. Comparing travel cost models and the precision of their consumer surplus estimates: Albert Park and Maroondah Reservoir. *Aust. Econ. Pap.* **2003**, *42*, 399–417. [[CrossRef](#)]

32. Gürlük, S.; Rehber, E. A travel cost study to estimate recreational value for a bird refuge at Lake Manyas, Turkey. *J. Environ. Manag.* **2008**, *88*, 1350–1360. [[CrossRef](#)] [[PubMed](#)]
33. Latinopoulos, D. The impact of economic recession on outdoor recreation demand: An application of the Travel Cost Method in Greece. *J. Environ. Plan. Manag.* **2004**, *57*, 254–272. [[CrossRef](#)]
34. Zhang, F.; Wang, X.H.; Nunes, P.A.L.D.; Ma, C. The recreational value of gold coast beaches, Australia: An application of the travel cost method. *Ecosyst. Serv.* **2015**, *11*, 106–114. [[CrossRef](#)]
35. Alberini, A.; Longo, A. Combining the travel cost and contingent behavior methods to value cultural heritage sites: Evidence from Armenia. *J. Cult. Econ.* **2006**, *30*, 287–304. [[CrossRef](#)]
36. Ruijgrok, E.C.M. The three economic values of cultural heritage: A case study in the Netherlands. *J. Cult. Herit.* **2006**, *7*, 206–213. [[CrossRef](#)]
37. Tourkolias, C.; Skiada, T.; Mirasgedis, S.; Diakoulaki, D. Application of the travel cost method for the valuation of the Poseidon temple in Sounio, Greece. *J. Cult. Herit.* **2015**, *16*, 567–574. [[CrossRef](#)]
38. del Saz Salazar, S.; Pérez Pérez, L. El valor de uso recreativo del Parque Natural de L'Albufera a través del método indirecto del coste de viaje. *Estud. Econ. Apl.* **1999**, *11*, 41–62.
39. Riera Font, A. Mass tourism and the demand for protected natural areas: A travel cost approach. *J. Environ. Econ. Manag.* **2000**, *39*, 97–116. [[CrossRef](#)]
40. Samos Juárez, A.; Bernabéu Cañete, R. Valuation of the recreational use of the Calares del Mundo and Sima Natural Park through the Travel Cost Method. *For. Syst.* **2013**, *22*, 189–201. [[CrossRef](#)]
41. Farreras, V.; Riera, P. El método del coste de viaje en la valoración de daños ambientales. Una aproximación para el País Vasco por el accidente del Prestige. *Ekono. Rev. Vasca Econ.* **2004**, *57*, 68–85.
42. Bedate, A.; César Herrero, L.; Sanz, J.A. Economic valuation of the cultural heritage: Application to four case studies in Spain. *J. Cult. Herit.* **2004**, *5*, 101–111. [[CrossRef](#)]
43. Pérez-Álvarez, R.; Torres-Ortega, S.; Díaz-Simal, P.; Husillos-Rodríguez, R.; de Luis-Ruiz, J.M. Economic valuation of mining heritage from a recreational approach: Application to the case of El Soplao Cave in Spain (Geosite UR004). *Sustainability* **2016**, *8*, 185. [[CrossRef](#)]
44. Long, S. *Regression Models for Categorical and Limited Dependent Variables*; Sage Publications: London, UK, 1997.
45. Gillespie, R.; Collins, D.; Bennett, J. Adapting the travel cost method to estimate changes in recreation benefits in the Hawkesbury–Nepean River. *Australas. J. Environ.* **2017**, *24*, 375–391. [[CrossRef](#)]
46. Haab, T.; McConell, K. *Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation*; Edward Elgar: Northampton, UK, 2002.
47. Englin, J.; Shonkwiler, J.S. Estimating social welfare using count data models: An application to long-run recreation demand under conditions of endogenous stratification and truncation. *Rev. Econ. Stat.* **1995**, *77*, 104–112. [[CrossRef](#)]
48. Pascoe, S.; Doshi, A.; Dell, Q.; Tonks, M.; Kenyon, R. Economic value of recreational fishing in Moreton Bay and the potential impact of the marine park rezoning. *Tour. Manag.* **2014**, *41*, 53–63. [[CrossRef](#)]
49. Czajkowski, M.; Ahtiainen, H.; Artell, J.; Budziński, W.; Hasler, B.; Hasselström, L.; Meyerhoff, J.; Nömmann, T.; Semeniene, D.; Söderqvist, T.; et al. Valuing the commons: An international study on the recreational benefits of the Baltic Sea. *J. Environ. Manag.* **2015**, *156*, 209–217. [[CrossRef](#)] [[PubMed](#)]
50. Rolfe, J.; Gregg, D. Valuing beach recreation across a regional area: The Great Barrier Reef in Australia. *Ocean Coast. Manag.* **2012**, *69*, 282–290. [[CrossRef](#)]
51. Ward, F.A.; Beal, D. *Valuing Nature with Travel Cost Models*; Edward Elgar Publishing: Cheltenham, UK, 2000.
52. Richardson, L.; Huber, C.; Loomis, J. Challenges and solutions for applying the travel cost demand model to geographically remote visitor destinations: A case study of bear viewing at Katmai National Park and Preserve. *Hum. Dimens. Wildl.* **2017**, *22*, 550–563. [[CrossRef](#)]
53. Zambrano-Monserrate, M.A.; Silva-Zambrano, C.A.; Ruano, M.A. The economic value of natural protected areas in Ecuador: A case of Villamil Beach National Recreation Area. *Ocean Coast. Manag.* **2018**, *157*, 193–202. [[CrossRef](#)]
54. Mwebaze, P.; Bennett, J. Valuing Australian botanic collections: A combined travel-cost and contingent valuation study. *Aust. J. Agric. Resour. Econ.* **2012**, *56*, 498–520. [[CrossRef](#)]
55. Chotikapanich, D.; Griffiths, W.E. Carnarvon Gorge: A comment on the sensitivity of consumer surplus estimation. *Aust. J. Agric. Resour. Econ.* **1998**, *42*, 249–261. [[CrossRef](#)]

56. Martínez Roget, F.; Pereira López, X. *Estudio Económico. Technical Report. Programa de Investigación para la Conservación Preventiva y Régimen de Acceso de la Cueva de Altamira (2012–2014)*, Consejo Superior de Investigaciones Científicas; Ministerio de Educación, Cultura y Deporte: Madrid, Spain, 2014; Available online: <http://hdl.handle.net/10261/113139> (accessed on 5 January 2017).
57. FAMILITUR Estadística de movimientos turísticos de los españoles. 2016. Available online: <http://estadisticas.tourspain.es/> (accessed on 15 November 2017).
58. Loomis, J. A comparison of the effect of multiple destination trips on recreation benefits as estimated by travel cost and contingent valuation methods. *J. Leisure Res.* **2006**, *38*, 46–60. [[CrossRef](#)]
59. Cesario, F.J.; Knetsch, J.L. A recreation site demand and benefit estimation model. *Reg. Stud.* **1976**, *10*, 97–104. [[CrossRef](#)]
60. Freeman, M. *The Measurement of Environmental and Resource Values: Theory and Methods*; Resources for the Future: Washington, DC, USA, 2003.
61. McConnell, K.E.; Strand, I. Measuring the cost of time in recreation demand analysis: An application to sportfishing. *Am. J. Agric. Econ.* **1981**, *63*, 153–156. [[CrossRef](#)]
62. Bickel, P.; Friedrich, R.; Burgess, A.; Fagiani, P.; Hunt, A.; Jong, G.D.; Laird, J.; Lieb, C.; Lindberg, G.; Mackie, P.; et al. HEATCO Deliverable 5. In *Proposal for Harmonised Guidelines, EU-Project Developing Harmonised European Approaches for Transport Costing and Project Assessment (HEATCO)*; Institut für Energiewissenschaft und Rationelle Energieanwendung: Stuttgart, Germany, 2006.
63. Heldt, T.; Mortazavi, R. Estimating and comparing demand for a music event using stated choice and actual visitor behaviour data. *Scand. J. Hosp. Tour.* **2016**, *16*, 130–142. [[CrossRef](#)]
64. Ministry of Education, Culture and Sports. *Anuario de Estadísticas Culturales*; Ministry of Education, Culture and Sports: Madrid, Spain, 2017.



© 2018 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).