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Economic Valuation of Mining Heritage from a Recreational Approach: Application to the Case of El Soplao Cave in Spain (Geosite UR004)

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Abstract: Heritage tourism can increase incomes and stimulate the economy in former mining areas. Recreational tourism is one of the main sources of value of heritage. People from urban areas are willing to pay for access to these tourism options. The measurement of the economic impact of this availability is one of the main problems to confront, due to the immeasurable possibilities of heritage resources. The use of non-market values and their estimation by means of revealed preference methods should help to assess the economic value of this sort of resources from a recreational perspective. The travel cost method (TCM) is widely used to value areas with recreational uses, such as lakes, beaches or forests, but there are not references to previous applications of this methodology in the field of mining heritage. In this work, TCM has been applied to obtain the economic value of El Soplao Cave (Geosite UR004, Cantabria, Spain) as a recreational site, providing an estimated result of 34,961,162 euros.

Keywords: mining heritage; economic valuation; travel cost; mining reclamation; tourism

1. Introduction

Considering the definition provided by the Convention Concerning the Protection of the World Cultural and Natural Heritage, which was signed in Paris in 1973, natural heritage includes all of the physical, biological and geological formations with an exceptional character, any habitat whose fauna or flora could be menaced and areas of scientific, aesthetic or conservational intrinsic value [1]. A particular type of natural heritage is comprised of geological elements. That is to say, any superficial manifestation that provides a certain degree of knowledge about the evolution of the Earth, the processes that conditioned its modeling, paleoclimatic aspects, the development of landscapes and the origin and evolution of life [2]. The Global Geosites Project (Wimbledon, 1999) emerged with the support of The International Union of Geological Sciences. Its main objective is the development of a Global Network of Geological Sites, in order to promote the protection of these locations, due to their intrinsic values. The implementation of this Project started in Spain in 1996, the IGME (Instituto Geologico y Minero de España) being the organization responsible for this work. As an initial step, 20 international geologic contexts were proposed. More than 200 geological sites are related to these contexts due to their mining character in Spain. It is worth highlighting Almaden, the Iberian Pyritic Belt and the Basque-Cantabrian Basin [3]. La Florida Zn-Pb Deposit and Cave El Soplao, which are coded as a single unit (UR004) in the Geosites Inventory and are objects of study in this research, belong to the latter.

The definition of Cultural Heritage provided by the Convention Concerning the Protection of the World Cultural and Natural Heritage [4] includes three main categories: monuments, groups of buildings and sites. The latter comprises "works of man or the combined works of nature and man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological point of view". Taking into account this third category, mines are sites where nature and man combine their works, leaving elements and structures that can be considered as cultural heritage elements.

A more recent definition was presented in the Mexico City Declaration on Cultural Policies [5], including in the concept of the cultural heritage of a people "the works of its artists, architects, musicians, writers and scientists and also the work of anonymous artists, expressions of the people's spirituality, and the body of values which give meaning to life. It includes both tangible and intangible works through which the creativity of that people finds expression: languages, rites, beliefs, historic places and monuments, literature, works of art, archives and libraries". The mining industry has been an engine for life and development in certain territories for centuries, and the elements derived from these activities must be considered as part of their cultural heritage.

In 1997, a section devoted to mines and collieries was created within the International Committee for the Conservation of the Industrial Heritage. This thematic section aims to identify, promote and preserve mining heritage, identifying sites of national or international relevance, generating lists and sharing knowledge about them. Since the development of the Recommendation on Industrial Archaeology in 1979, the Parliamentary Assembly of the Council of Europe (PACE) has held several meetings in this regard. In their meeting held in Bochum in 1987, the issue of mining heritage preservation (Mining Monuments) was treated, considering it as cultural heritage [1].

On the basis of the preceding, it can be assumed that mining heritage implies one of the most perfect combinations of natural and cultural heritage, since it is impossible to conceive of a mine (anthropic element and, therefore, cultural good) without the required mineral deposit [6]. Considering the legal framework in Spain, mining heritage is mainly related to Law 16/1985 of 25 June of Historical Heritage, and Law 45/2007 of Natural Heritage and Biodiversity, which encourage spreading and developing the sustainable use of geological heritage [2].

As considered by Spanish Law 22/1971 of Mines and Royal Decree 975/2009, on waste management in mining, protection and rehabilitation of areas affected by mining activities, the exploitation of a certain mineral deposit includes all the works aimed to explore, extract and process the ore, the development of infrastructures and also the decommission of the natural area affected by these activities. Therefore, the extractive activities must be considered as a temporal use of the affected land: the restoration plan and related expenses must be included in the exploitation project, the economic estimations and the budget. A global life cycle of the mine must be studied taking into account future applications and an adequate integration for the affected land, so as to increase its final socio-economic value.

The inclusion of mining heritage in urban planning can become a capital support for the economic development of mining districts after closure [7]. An adequate and intensive inventory of heritage goods must be held (works, structures, rock dumps, accessories, archives, *etc.*), and their different potential uses must be assessed, in order to guarantee that the final applications and the impacts associated with the enabling project are compatible with their conservation [8].

Tourism is probably the most suitable economic sector to absorb these actives. This affirmation can be supported by a simple analysis of the statistics about motivation in tourism activities in 2013 [9]. Considering non-resident visitors, Spain had 60.661 million tourists during that year: 50.9% of these displacements implied an attendance to cultural activities; 4.6% were related to hiking or mountaineering; and 10.7% of these international visitors chose theme parks. These alternatives can be easily related to initiatives based on the enhancement of mining heritage: the ideal composition of available activities can satisfy the expectations of various social targets with different interests. The adoption of mining heritage elements in the development and consolidation of new alternatives of cultural tourism meets the approaches derived from the evaluation of the efficiency of the Spanish tourism sector and the objectives to be satisfied according to the 2020 planning. These premises pursue an adequate diversification of the tourism offer, with new options characterized by their own identity or a differentiating value that makes them attractive for visitors (and turns them into an alternative to the traditional offer of sun and beaches), the reduction of seasonality and relocation with respect to massive tourism destinations [10].

Given the importance of these resources, the definition of a method that provides a quantitative value to a certain element on the basis of the visitor's interest can be a worthy decision tool. The results obtained for an active heritage site could be extrapolated to other potential alternatives that share some common characteristics with that adopted as the standard.

This paper includes the following sections. The second section presents the main characteristics of El Soplao Cave (Section 2.1) and the methodology proposed, considering the main description of the travel cost method (Section 2.2) and its particular application to the case study (Section 2.3). The results of this application and their discussion are presented in Section 3. The paper finishes with some conclusions (Section 4).

2. Materials and Methods

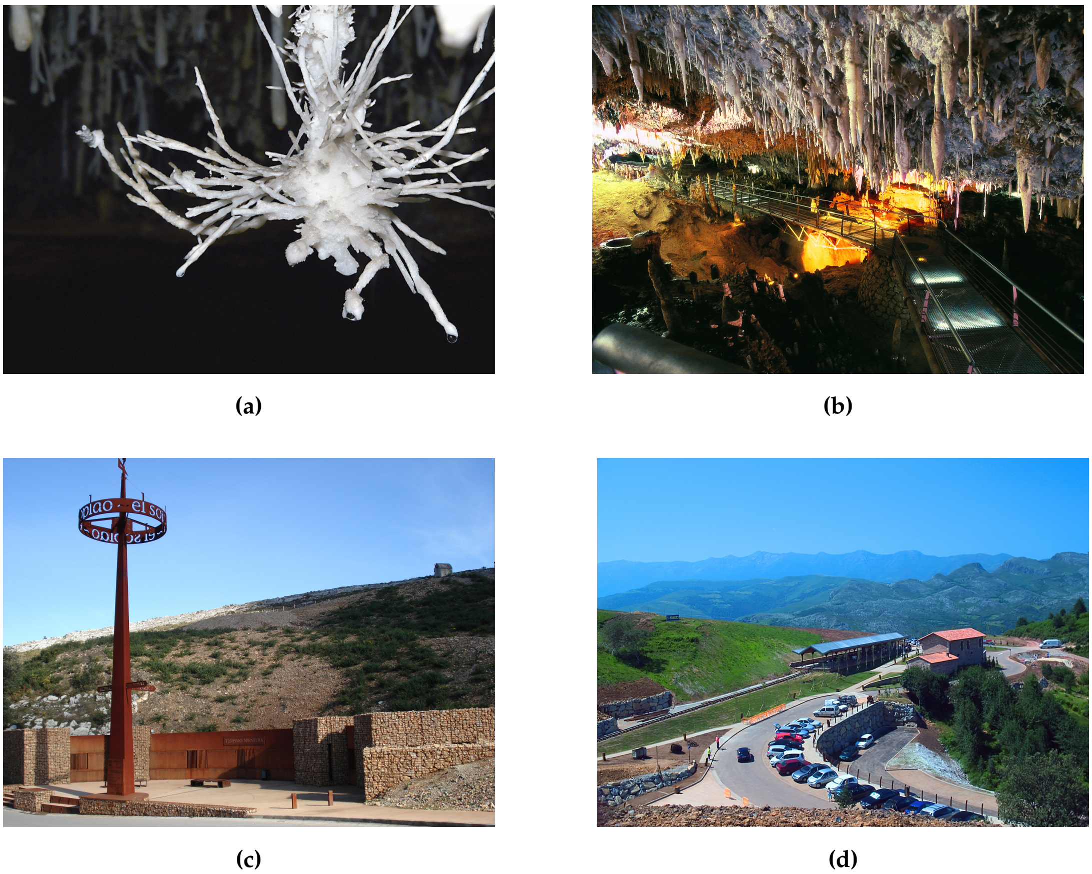
2.1. El Soplao Cave and La Florida Pb-Zn Deposit (Geosite UR004)

El Soplao Cave (Cantabria, Spain; see Figure 1) was discovered in 1908 as a consequence of the mining activities developed in La Florida Mining Group (1856–1979). The average production during the last 20 years of activity was about 75,000 t, with grades for Zn and Pb of 4.5% and 0.6%, respectively [11]. Due to their intrinsic geological value, La Florida Zn-Pb Deposit and El Soplao Cave are coded as a single unit (UR004) in the Global Geosites Inventory, a network of geological sites supported by The International Union of Geological Sciences [3].

Figure 1. Map of Spain with the El Soplao Cave location, capital cities of autonomic communities and the limits for Spanish provinces.

With more than 19.8 km of explored galleries [12], the cave stands out due to the profusion of speleothems, such as stalagmites, stalactites, columns, false floors, flags, gours, pisolites, aquatic crystallizations and ambarine formations [13]. The abundance of eccentrics (non-gravitational speleothems with different directions of development) has turned El Soplao Cave into a worldwide reference. Eccentrics with different shapes can be observed (Figure 2a), being particularly close to the visitor in the Gallery of Opera, which is commonly known as the Sistine Chapel of Geology. The profusion and beauty of the speleothems is not the only singularity of this cave, it being possible to mention the stromatolites [14], the identification of a new polytype of the hydrotalcite [15] or the numerous new cretaceous species trapped in the amber found in the Paleontological Site of Rábago-El Soplao [16]. The latter was discovered as a consequence of the works developed to enable the access to the cave. All of these aspects have turned the cave and its surrounding territory into an on-field laboratory of great dimensions and incalculable value.

In 2004, the Government of Cantabria published the Governance Plan, which included the El Soplao Cave enhancement project, setting a horizon for its completion of three years. Three main milestones were considered: the adaptation of the first 1200-meter-long route (Figure 2b), which was inaugurated in the year 2005 (with an access equipped with a mining train, available since 2007), the development of a second route (ready to be visited in the year 2005 and comprising five galleries, which constituted the so-called "Tourism-Adventure Visit"; Figure 2c) and the construction of the Museum of Mining (which is pending completion at the time of the writing of this article). The visitor center (Figure 2d) was inaugurated in March 2007 [17].



(a) (b) (c) (d)

Figure 2. Different photographs of El Soplao Cave: (**a**) Eccentrics. (**b**) Gangway inside the cave. (**c**) Facilities for the "Tourism-Adventure Visit". (**d**) General view of the site during the implementation of the works.

The works of restoration were arranged on grids, with a detailed study aimed to analyze the real necessities and to concretize the actions to be taken. Five main tasks were considered: movable elements' cleaning, mud elimination, removal of graffiti and marks made with carbide lamps, restoration of speleothems [18] and the inventory and recovery of mining elements. This last task enhanced the visitor's experience, enriching the environment and providing a better approach to the reality of the activities developed in the Cave during the period of activity of La Florida Mining Group [19]. Graffiti was removed from the sections available for visitors. The criteria for this cleaning process was clear: marks would be removed if they were developed on the speleothems themselves, and they were not originated by mining activities, but by unauthorized access during the period comprised between the date of closure of the mines and the beginning of the enhancement project. Mine-related graffiti found includes numbers used for the designation of works, names of miners, initials or dates. These marks remained untouched, being considered as a valuable testimony of mining activities.

From the economic perspective, different sources of value arise from the cave (Table 1). First of all, it was part of a mining exploitation. The different elements of mining heritage that were found in the cave or are located in its surroundings add historical value. The recovery of these heritage elements helps with the restoration of the natural environment, so a new source of economic value appears related to the improvement of an industrial degraded area. Inside the cave, important geological heritage with international recognition exists. This geological wealth and other potential elements that could be discovered in the following years provide an important and immeasurable value from the natural heritage perspective. The neighboring amber outcrop strengthens this idea.

Table 1. Main sources of value and services (as defined in the Millennium Assessment [20]) provided by El Soplao Cave and La Florida Pb-Zn Deposit (Geosite UR004).

<table>
<tr><th>Source of value</th><th>Service</th><th>Valuation Method</th></tr>
<tr><td>Geological wealth (abundance of eccentrics, speleothems, ambarine speleothems, new hydrotalcite polytype, stromatolites, La Florida Pb-Zn deposit, paleontological site of Rábago-El Soplao)</td><td>Cultural heritage values</td><td rowspan="5">Direct observed behavior methods

Indirect observed behavior methods</td></tr>
<tr><td>Rehabilitation project of the mine site</td><td>Aesthetic values, sense of place, regulating services</td></tr>
<tr><td>Speleothems (dating, endemisms), stromatolites, Zaccagnaite-3R, amber outcrop, new technologies (modelization with Terrestrial Laser Scanner)</td><td>Educational values</td></tr>
<tr><td>Abundance of elements of mining heritage</td><td>Cultural heritage values</td></tr>
<tr><td>Recreational and tourism site</td><td>Recreation and tourism</td></tr>
</table>

The rehabilitation of the cave has also allowed developing important lines of research in the area, related to the geological findings. They imply a new source of value related to scientific production. Lastly, the enabling works aimed to adapt the cave as a tourism attraction have raised two additional sources of value. The first one is related to the economic revitalization of the valley where the cave is situated, due to the increasing number of visitors. The second source is provided by the tourism value that the cave has gained.

2.2. Travel Cost Method

From an economic point of view, monetary valuation of heritage resources can be viewed from different perspectives. A great distinction can be made between valuation methods based on stated and revealed preferences [21]. Among the latter, the travel cost method (TCM) is widely used to value areas with recreational uses, such as lakes, beaches or forests. TCM is based on the displacement necessities a user has to assume in order to enjoy a recreational site. This fact allows estimating a demand function. In order to do so, it must be accepted that the costs to be supported when visiting recreational sites represent the price that visitors are willing to pay to access the site [22]. TCM tries to establish this relationship between the costs of recreational activities and the characteristics of the resource. Travel costs include and measure monetary values of fuel and entrance fees, but also the cost of time for traveling to a site [23]. An important concept of the methodology is the visitation rate, being understood as the number of visits per total population. An increase in the distance to the visitation hotspot raises the total travel costs, and this results in a reduction of the visitation rate [24].

The travel cost method was proposed in 1947 by Harold Hotelling to assess the value of U.S. parks, linking the travel cost that visitors must face to enjoy a natural resource with its economic value. Hotelling's model was proposed as a response to a request from the National Park Authority to defend the existing natural heritage from the pressure of new industrial spatial needs. From its very beginning, it implies an approach to what the collectivity would lose if the asset were destroyed, not to what it produces in terms of a direct benefit. Based on this idea, the method was later developed principally in works by Clawson [25] and Clawson and Knetsch [26].

The travel cost method has gained popularity in recent years, especially when applied to environmental areas [22,27–29], but also to cultural heritage [30–32]. In Spain, some applications of this methodology to natural areas [33–35], environmental damages [36] or cultural heritage [37] can be found.

Two main types of TCM are identified in the literature: the individual and the zonal. The individual methodology uses the number of trips as the dependent variable and is commonly applied when multiple visits to a site (normally local and frequent) are made during the same year. The zonal method uses the number of travels to a site relative to the population of a defined zone as the dependent variable, and it is more appropriate when there are no frequent visits [22,24]. In both cases, there is not a predefined form for the relationship between visits and travel costs, but a logarithmic adjustment is usually applied. The data input for this model should be obtained by surveys made at the entry of the resource, asking visitors questions about the number of visits per year, socioeconomic issues and the travel costs incurred to reach the recreational site.

Visitors to a cultural or heritage site tend to visit it only once per year. The visits to El Soplao Cave also fit well with this description: visitors are normally people who have not visited the cave before, and the return rate is quite low, even for the local population. Based on these characteristics, the application of the zonal travel cost method seems more suitable for this case study.

2.3. Data Collection and Management

A survey aimed to identify visitor's origin was taken at El Soplao Cave facilities. This survey recorded data from all of the visitors that buy their ticket at-site (tickets can be bought online in advance, but these visitors are not included in the sample). The information obtained from this survey and the total number of annual visitors (also recorded at the entrance of the facilities) are the main data used for this research. For the years studied (2011 and 2012), the number of visitors to the cave was 203,202 and 175,609, respectively (Figure 3). The number of surveys made was 44,880 for 2011 and 38,788 for 2012, which implies an average relative size of samples of 22% with respect to the total number of visitors.

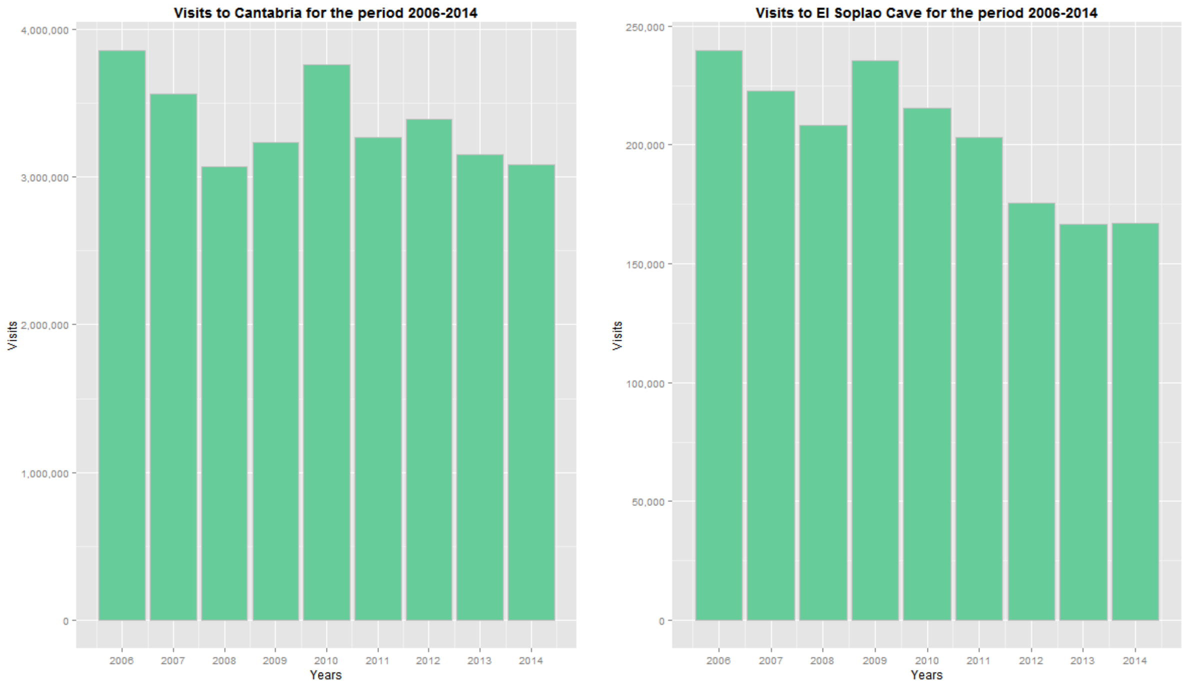


Figure 3. Visitors to Cantabria and El Soplao Cave for the period 2006–2014 [38].

Visitors to El Soplao Cave are mainly Spanish residents (with an average of 95%). The most frequent origins are Madrid, Asturias, Barcelona, Vizcaya, Coruña and Burgos. About 10% of visitors are from Cantabria. Considering the 5% of international visitors, France is the most common origin, followed by the United Kingdom, Germany, Portugal, Italy and the United States. During the year, the months with the highest number of visitors are July and August, while the period from November–February provides lower values (also, the number of hours the cave remained opened is restricted).

To apply the zonal travel cost method, Spain has been divided according to the limits of the administrative provinces. Only national mainland zones are consider (the rest of the country, Ceuta, Melilla, Balearic and Canary Islands are excluded from the analysis). Estimates of total annual visits were calculated for each zone using the data provided by the survey. The distance from the capital city of each area to El Soplao was also calculated (Google Maps was used for this).

At this point, several assumptions must be made:

- The sample is representative of the total visitors to the cave. There are no spatial differences between visitors who bought their tickets at-site and online.
- Some areas are relatively near the cave (the distance of which is less than 260 km), so a one-day visit is possible. In this case, the travel cost includes all of the displacement costs.
- The rest of the zones are far enough to suppose that a multiple-day visit is made to the region. In this case, the displacement costs are divided into the average visit duration in Cantabria [39].
- In both cases, it has been considered that another tourism site can be visited on the same day, so only half of the cost is computed.
- The rest of the parameters used are shown in Table 2. Although the choice of these parameters could look arbitrary, it is quite realistic.

Table 2. 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	12 €

Two different outputs could be obtained with these data. The first one is the demand curve for El Soplao Cave. To obtain this, a logarithmic adjustment is proposed.

$$\log(V_i) = \alpha + \beta \log(C_i) + \gamma \log(r_i) \quad (1)$$

where V_i is the number of visits from zone i divided by the population of the zone, C_i is the total travel cost to visit the cave from zone i and R_i is the average rent in zone i. α, β and γ are parameters to be estimated.

The second output that can be obtained is an appraisal of the economic value for the cave. Once the demand curve is estimated, it can be simplified for one value of the rent, obtaining a single relationship between total visits and travel cost, which can be plotted in an XY axis graph. The area under the curve represents the sum of the consumer surplus, which can be used as an estimate of the value of the resource.

The use of the proposed methodology, including the different assumptions made, involves several limitations of and comments for the results. The most important is that the total economic value obtained from the analysis will be a lower estimate. Firstly, only recreational use of the cave is assessed (despite other value sources having been identified; see Table 1). Secondly, only national mainland visits have been considered. Visitors from both national islands and international locations should face important costs to reach the cave. This should be translated into a major estimate of the total value.

Another problem that arise from the application of the TCM to recreational and cultural sites is related to multipurpose trips [40]. This circumstance is difficult to manage, but several assumptions have been made to solve it. Hence, only the corresponding part of a larger trip has been imputed to a visit to this location. Obviously, some of the visitors will reach El Soplao Cave as their sole destination, but with the available data, it is quite difficult to identify them. A lower estimation is obtained again, assuming the absence of exclusive visits.

Finally, the value of time is a recurrent problem in valuation assessments. No major agreement about these valuations has been granted, so further estimations must be done. In this proposal, a value of 10€/h is estimated according to HEATCO studies for recreational road trips in the EU [41]. The average speed of travel is proposed to be 100 km/h. From both values arises a trip time cost of 0.10€/km, which could be considered conservative. Once more, the use of these values will lead one to obtain a lower limit estimation of the recreational value of El Soplao Cave.

3. Results

The final output to obtain is the total value estimate of El Soplao Cave. This can be determined by adding the present value of a series of years. The available data series comprises visits, origin and average rent for 2011 and 2012. Working with each of these two years provides different analyses, and a third one could be proposed by merging the two annual series into a single one and applying the resultant as belonging to just one series. These analyses will permit estimating the demand curve, which should be useful to obtain the economic value of the cave.

3.1. Demand Curve

The results of the adjustment with the time series to the logarithmic equation proposed in Equation (1) are shown in Table 3.

Table 3. Results of the logarithmic adjustment.

Parameter	Value	Significance
2011 data		
α	-6.2329	0.17680
β	-2.5959	1.04×10^{-14}
γ	1.2467	0.00522
Adjusted R-squared	0.8088	
p-value	$< 2.2 \times 10^{-16}$	
2012 data		
α	-10.8568	0.01745
β	-2.1504	6.08×10^{-13}
γ	1.5138	0.00059
Adjusted R-squared	0.7983	
p-value	$< 2.2 \times 10^{-16}$	
2011 and 2012 data merged		
α	-9.0596	0.00537
β	-2.3522	$< 2 \times 10^{-10}$
γ	1.4245	5.95×10^{-6}
Adjusted R-squared	0.7994	
p-value	$< 2.2 \times 10^{-16}$	

As seen from the results, all three analyzed options are quite similar. Due to the higher significance and the use of a larger data series, the results from the combination of 2011 and 2012 series are finally chosen to characterize the demand curve (shown in Figure 4), obtaining Equation 2:

$$\log(V_i) = -9.0596 - 2.3522 \log(C_i) + 1.4245 \log(r_i) \tag{2}$$

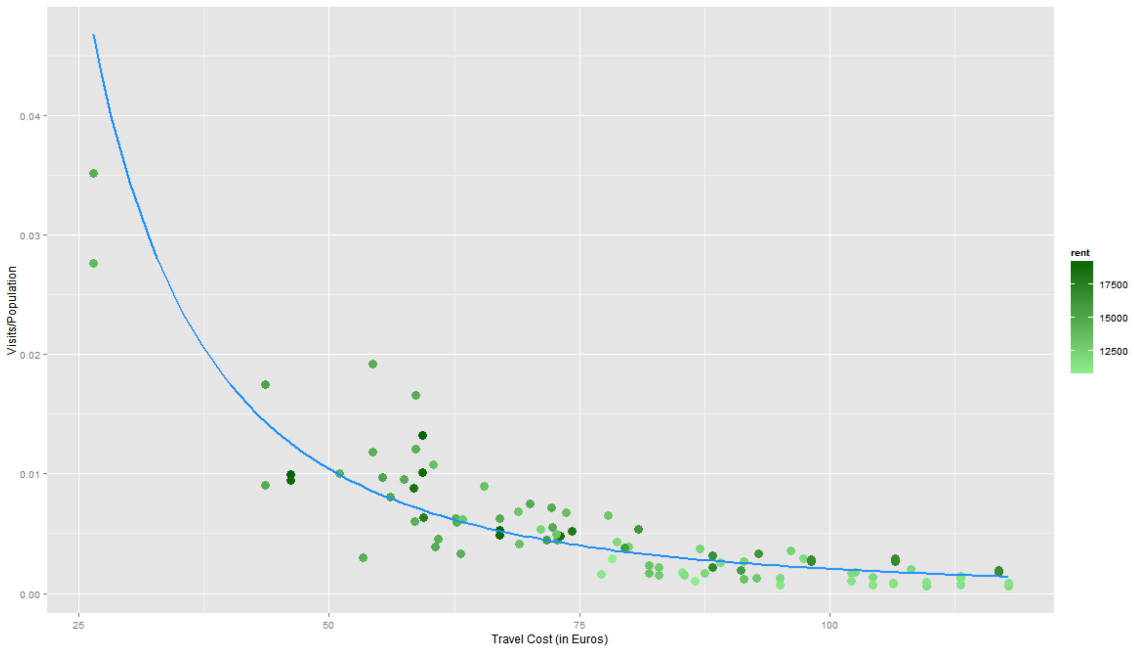


Figure 4. El Soplao Cave demand curve.

Each point in Figure 4 represents a different visitors origin point and comprises the visitation rate (y-axis) and the travel cost (x-axis). The rent of each region is represented by a color scale and reflects differences in the cost of living among regions.

Further information about the behavior of visitors can be gleaned from the curve, which should be useful for both management and marketing strategies. Firstly, it establishes the relationship between distance, rent and the percentage of visitors from the total population of a region. Secondly, the study of the parameters' values permit identifying the existence of an annual rent threshold under which no visitors are expected (578 euros).

Further comments should be made about the use of the annual rent as a variable in the demand curve. Changes in rent increase the number of visitors (*i.e.*, a 10% growth in annual rent results in an increase of 3% in the number visitors). Yearly changes in the rent values could not be used to estimate these changes in the number of visitors, but it should be noted that only intra-annual rent has been applied in the methodology proposed.

3.2. Economic Value

In order to estimate the economic value of the cave, the integration of the demand curve must be done. Nevertheless, some problems arise when dealing with it. First of all, the visitation rate is used instead of the total number of visitors from each region. Secondly, the rent is a geographically-distributed value. A spatial integration should be done to solve both problems, but this could transform the continuous distribution proposed into a discrete one based on regions.

So as to avoid these facts, a new regression is obtained, considering only the number of visitors and travel costs. A logarithmic adjustment is also proposed, providing the values summarized in Table 4. This new regression should estimate the number of visitors based on costs not only for the reference point proposed for each region, but also for the continuous distribution of distances and costs.

Table 4. Results of logarithmic adjustment.

Parameter	Value	Significance
2011 data		
α	17.1351	1.24×10^{-11}
β	-2.1706	1.06×10^{-5}
Adjusted R-squared	0.3390	
p-value	1.056×10^{-5}	
2012 data		
α	14.995	8.74×10^{-10}
β	-1.720	0.000374
Adjusted R-squared	0.2308	
p-value	0.0003742	

The results from the year 2011 are chosen, so the simplified demand curve results:

$$\log(TV_i) = 17.1351 - 2.1706 \log(C_i) \quad (3)$$

where TV_i now stands for the total number of visits from zone i.

Two points are remarkable in Figure 5, Madrid and Barcelona. Asturias and Vizcaya could be mentioned as relevant, too, but they are not in the same range as the previous two regions. Due to the high population of Madrid and Barcelona, a major number of visitors come from these areas. The adjustment for the demand curve (Section 3.1) was much better, because the visitor rate per total population of the area was used in that case. The parameters in this new adjustment are significant anyway, but the existence of these outliers implies an under-estimation of the final value of the cave as many more visitors than estimated will reach the site from these areas. A rapid estimation of this loss of value shows an amount of 3,268,000 euros per year, but the use of this enlarged amount is not followed, as it appears to be unrealistic.

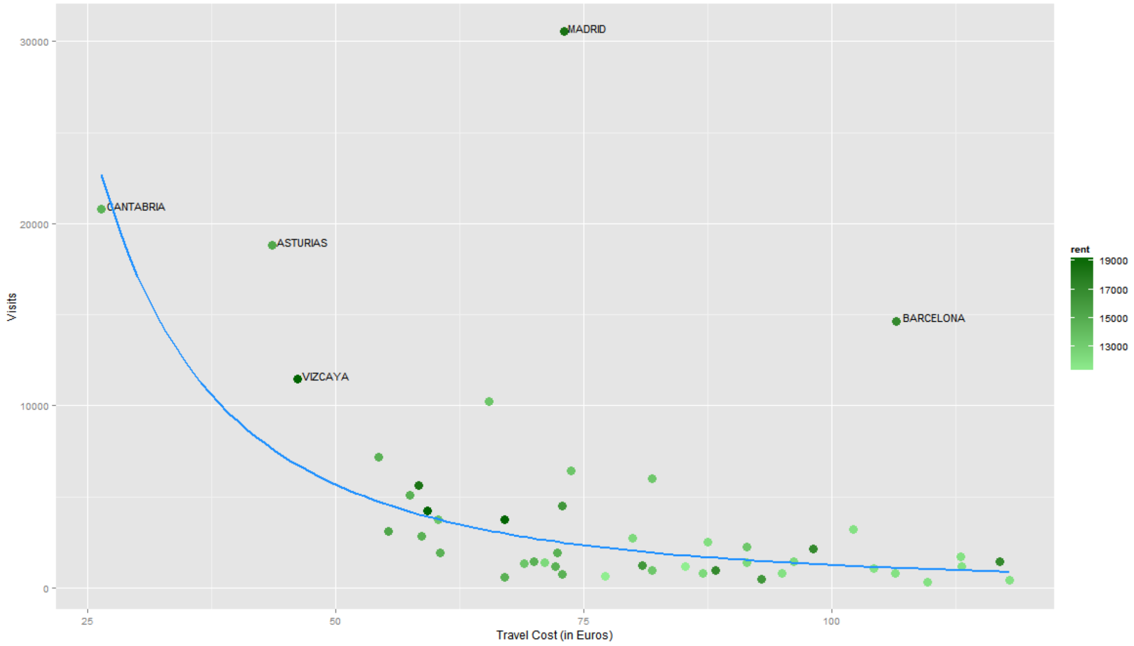


Figure 5. Demand curve used for the estimation of the economic value of El Soplao Cave.

As the entrance fee (in this case, 12 euros) sets a lower limit for this simplified demand curve, it should be assumed when estimating the value. The curve should be integrated between it and a higher limit (fixed at 150 euros). An estimated annual value of 1,221,240 euros per year results from this calculation.

Having obtained this annual value, the final step is to obtain the total value of the cave by calculating the present value of the time series. Two parameters must be defined: time horizon and discount rate.

Considering recent recommendations for the use of broader time horizons [20], a value of 50 years is adopted. The use of a social discount rate of 3% is proposed for the first 30 years and then 2% for the rest of the time horizon (the recent approach for a declining discount rate is followed [42–44]). With these assumptions, the recreational economic value of El Soplao Cave is estimated as 34,961,162 euros.

4. Conclusions

In this research, the travel cost method has been implemented to obtain the economic value of a heritage site. Although the use of the method is not a novelty in other fields, there are no previous references of its application to the enhancement of mining and geological heritage. Adequate knowledge of the economic value of resources such as El Soplao Cave can help to increase their visibility by authorities, companies and policy makers. The better assessed the value of a site is, the better these agents can develop rehabilitation and tourism exploitation plans, which help to obtain a social welfare benefit and to preserve these heritage sites. A second step in these plans should be to assess the economic incomes.

The application of this methodology to the case study adopted in this work leads to several aspects that must be highlighted as conclusions.

Although the cave offers some other services or sources of value that have not been considered (such as the surrounding environmental areas), only tourism and recreational values have been estimated. The management of all of the parameters and the methodology itself has been developed through a conservative approach. These facts imply an underestimation of the total economic value of El Soplao Cave, which could be significantly higher if all of the sources of value were considered.

The demand curve for a heritage element such as El Soplao Cave allows improving the management of the site. The knowledge of this relationship should help in decision making, but also in the planning of future visits, the scheduling of investments for the improvement and rehabilitation of new mining and geological zones or the development of marketing campaigns clearly targeted on the basis of the different origins of the visitors. The availability of longer time series data should be useful to complete this analysis in intra-annual and interannual terms and to obtain differences in the demand curve over time.

Regarding the generalization of the method and its use in other sites, two issues arise: firstly, the use of the method itself in other situations; secondly, the possible transfer of results between different sites.

The travel cost method can be perfectly applied to other sites if proper visitor data are available. There are several approaches for the enhancement of mining heritage for tourism purposes [45], and several examples developed in Spain can be mentioned. Traditional initiatives imply the foundation of museums for the exhibition of mineral collections (such as the Historic Museum D. Felipe de Borbón, y Grecia, or the Geomining Museum of Spain, in Madrid). More recent approaches include simulated mines (Mining Museum of Asturias) and the enhancement of actual mines (Pozo Sotón, in Asturias, or El Soplao Cave, in Cantabria) or cultural landscapes (Mining Geoparks of Riotinto and Almadén, in Andalucia).

In the rest of the world, there are many examples where an economic valuation of mining heritage should be assessed. The International Committee for the Conservation of Industrial Heritage (TICCIH) [46] or the European Route of Industrial Heritage (ERIH) [47] are organizations aimed to protect industrial heritage sites and use them as an attraction for the improvement of the economy of the regions where these sites are located. The European Route of Industrial Heritage (ERIH) considers several categories for both sites and routes. Sites are arranged on routes, taking into account two main criteria: location (regional routes) and shared features (theme routes). Considering the incidence of mining, a special category (Mining Routes) includes 212 sites, 60 being included in regional routes. Twenty seven of these locations are considered as "anchor points" (locations with many features that help to illustrate the industrial past of Europe at a local level). The economic valuation of the sites enlisted by these organizations could help to raise concern about the importance of these heritage elements. The travel cost method is suitable for any of these possibilities, as the only requirement is the collection of data about the origin of visitors by means of surveys.

The open question that arises from this research is whether the obtained demand curve is exclusive for the site considered or if it could be applied to similar heritage or natural resources, located in the same region or with the same attributes. Further studies with an application of the travel cost method should obtain new demand curves for each site considered, and the comparison of these curves should help to answer this open question.

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