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Impact of High-Speed Rail on Cultural Tourism Development: The Experience of the Spanish Museums and Monuments

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Abstract: Although transport infrastructure is one of the prominent factors that make Spain a major tourist destination, the international literature has revealed that the opening of new High-Speed Rail (HSR) lines is not sufficient by itself in order to increase tourist outputs in the new connected destinations. Nevertheless, the roles played by different characteristics of both travelers and destinations are of interest but they still remain not sufficiently explored. This paper focuses on the role played by HSR in fostering cultural tourism by applying a fixed-effect econometric model to a panel database (1988–2017). The database includes the number of tourists to some of the major Spanish cultural centers. The results show different impacts based on the regions, the characteristics of the museums, and the expected tourists. For destinations with previous cultural attraction, a positive effect is more evident. Moreover, the centrality of the HSR station as an enabling factor as well as the growth of the tourist market to the surrounding municipalities has been detected. Another interesting result is related to the cooperation effect between HSR and air transport, which encourages the arrivals of foreign tourists. These findings should help planners to develop policies that optimize tourist revenues by exploiting the potential of HSR development in the future.

Keywords: cultural tourism; high-speed rail (HSR); panel data; econometric model; museums; monuments

1. Introduction

In the past few decades, Spain has massively invested in the expansion of the High-Speed Rail network despite the recent economic crisis and criticism for its low or even negative profitability [1,2]. This was primarily due to its high construction and operating costs and also due to the low number of travelers, which turned out to be lower than predicted in previous studies [3]. As a result, Spain has a High-Speed Rail (HSR) network of more than 2800 km in operation (see www.uic.org) and thus becomes the first country in Europe and the third worldwide with a HSR network this long, only behind Japan with 3041 km and far behind China with more than 31,000 km. The Spanish HSR network has a radial structure and connects Madrid, which is in the center of the country, with the peripheral regions of the east and the south, whereas new sections to Portugal and to the northern coast are still being planned or constructed. The construction order of the Spanish lines, has often been criticized for being the product of political decisions by the different governments of the country rather than issues of economic profitability or integration of the connected regions [4].

Tourism is considered as one of the key contributing sectors of the Spanish economy. It is the top export sector of the country, with a contribution of 11.7% in the Spanish gross domestic product (GDP) and 12.8% in creating employment in 2017 [5]. It not only generates a direct impact on the national economy but also produces a significant effect on the rest of the sectors, with an estimated linkage effect of 1.68 [6]. Furthermore, it has been observed that the contribution of this sector in the Spanish economy has been constantly increasing since 2014, performing well during economic growth and with lower die-off rates during the economic crisis. The growth of this sector is not only because of the recovery of the consumption expenditure of households, but it is primarily due to the increase of foreign tourism revenues, which is attributed to the low crude oil prices, the growing importance of business travel, and the increasing security risks in some Mediterranean tourist destinations that compete with Spanish ones.

Spain is one of the most visited countries worldwide with more than 80 million tourists, which is the second rank in terms of foreign arrivals as well as incomes, following the United States, which has a larger size, comparable to the whole European Union [7]. Its advantageous position in Southern Europe, with its almost 6000 km of seashores, gastronomy, and cultural heritage along with the modern infrastructure and moderate pricing are considered the primary contributing factors for this remarkable performance. Bringing new tourists and raising their high rate of fidelity to Spanish destinations is a priority in all the national regions by public and private stakeholders that strive to attract as many tourists as possible and increase their expenditure and its positive impact on the national economy. In this context, although sun and beach destinations are still considered the preferred ones, cultural tourism is promoted by authorities due to its by higher expenses and less seasonal outputs [8].

The cultural tourism of museums and monuments emerges as one of the pillars of cultural tourism. The growing interest runs alongside the process of transformation of these landmarks that are now often conceived as places of attraction of masses for their exhibitions and architecture. Indeed, these cultural sites are viewed with new interest nowadays, attracting many tourists who consider these places not just as a small, minority resource, but a mass consumption product.

When the nationality of tourists to the Spanish cultural sites is analyzed, different behaviors appear. Although cultural tourism is not the main reason for travelling, cultural activities are amongst the preferred traits by national travelers. Thus, 64.6% of domestic travelers reported to have benefited from visiting museums or monuments [9], while cultural reasons are declared to be the main ones for only 4.4% of the trips [10]. As Table 1 shows, the different motivations result in different preferred destinations. The special importance of cultural tourism is intuited in some regions (Madrid and Andalucía), while a *sun and beach* leisure profile appears in others coastal ones (Cataluña, Comunidad Valenciana, Islas Canarias, and Islas Baleares). Concerning the expense incurred per trip, destinations with higher cultural attractiveness also seem to result in higher incomes, with Madrid (388.8 €/trip), Asturias (360.7 €/trip), and La Rioja (360.3 €/trip) at the top of the ranking. [11].

Foreign visitors also exhibit different interests. Although 16.8% of foreign tourists reported that "cultural motivations" was the main incentive when selecting a tourist destination [12], the predominance of coastal destinations is more evident. Therefore, though domestic visitors prefer both the coastal and inland regions, with Andalucía, Cataluña, Comunidad Valenciana, and Castilla y León as preferred regions of destination, contributing 18.5%, 14.3%, 10.5%, and 9.9% share, respectively, only coastal "*sun and beach*" destinations show higher ranking for foreign tourists, with Cataluña, Canarias, Baleares, and Andalucía contributing 23.3%, 17.4%, 16.9%, and 14.1% shares, respectively [13], as can be seen in Table 2. However, cultural resources are also appreciated and recognized as an important factor in the choice of Spain as a destination by foreign tourists [14].

Table 1. Number of domestic trips 2017. National Statistics Institute (INE).

Spanish Region of Destination	Total Trips		Trips due to Cultural Reasons		Difference
Andalucía	32,589,227	(18.49%)	1,699,241	(21.90%)	(3.42%)
Aragón	8,087,891	(4.59%)	390,490	(5.03%)	(0.45%)
Asturias, Principado de	4,813,351	(2.73%)	257,472	(3.32%)	(0.59%)
Balears, Illes	3,352,137	(1.90%)	91,128	(1.17%)	–(0.73%)
Canarias	6,267,175	(3.56%)	183,152	(2.36%)	–(1.19%)
Cantabria	4,627,295	(2.62%)	244,851	(3.16%)	(0.53%)
Castilla y León	17,518,646	(9.94%)	857,070	(11.05%)	(1.11%)
Castilla - La Mancha	12,872,481	(7.30%)	464,604	(5.99%)	–(1.31%)
Cataluña	25,227,941	(14.31%)	633,968	(8.17%)	–(6.14%)
Comunitat Valenciana	18,540,291	(10.52%)	424,389	(5.47%)	–(5.05%)
Extremadura	5,169,183	(2.93%)	251,863	(3.25%)	(0.31%)
Galicia	10,287,583	(5.84%)	537,138	(6.92%)	(1.09%)
Madrid, Comunidad de	13,478,592	(7.65%)	1,051,146	(13.55%)	(5.90%)
Murcia, Región de	4,177,476	(2.37%)	116,236	(1.50%)	–(0.87%)
Navarra	2,927,216	(1.66%)	111,047	(1.43%)	–(0.23%)
País Vasco	4,651,131	(2.64%)	349,744	(4.51%)	(1.87%)
Rioja, La	1,701,644	(0.97%)	89,781	(1.16%)	(0.19%)
Total number of trips	176,289,260	(100.00%)	7,753,320	(4.40%)	

Table 2. Total number of foreign visitors to the different Spanish regions. National Statistics Institute.

Spanish Region of Destination	2018		2017	
Andalucía	11,681,256	(14.27%)	11,518,262	(14.07%)
Aragón	545,530	(0.67%)	562,352	(0.69%)
Asturias, Principado de	299,357	(0.37%)	294,129	(0.36%)
Balears, Illes	13,851,598	(16.92%)	13,792,296	(16.85%)
Canarias	13,752,022	(16.80%)	14,214,222	(17.36%)
Cantabria	381,181	(0.47%)	414,489	(0.51%)
Castilla y León	1,374,464	(1.68%)	1,458,546	(1.78%)
Castilla - La Mancha	235,011	(0.29%)	226,221	(0.28%)
Cataluña	19,196,344	(23.45%)	19,118,421	(23.35%)
Comunitat Valenciana	9,206,908	(11.25%)	8,925,959	(10.90%)
Extremadura	468,286	(0.57%)	380,914	(0.47%)
Galicia	1,512,511	(1.85%)	1,291,086	(1.58%)
Madrid, Comunidad de	7,139,775	(8.72%)	6,699,785	(8.18%)
Murcia, Región de	1,134,189	(1.39%)	991,209	(1.21%)
Navarra, Comunidad Foral de	323,730	(0.40%)	333,317	(0.41%)
País Vasco	1,552,389	(1.90%)	1,514,765	(1.85%)
Rioja, La	142,926	(0.17%)	124,189	(0.15%)
Total number of visitors	82,808,413		81,868,522	

Although the availability of an efficient transport plays an essential role in the destination development as well as in tourism choices [15–17], in the growth of cultural tourism, the specific role that HSR can play has been underestimated in the current literature. Nevertheless, since most of the museums are located, equally close to HSR stations and to the city centers, HSR fulfils the desirable a priori conditions that can foster an increase in the number of tourists.

This paper is organized as follows. The literature on cultural tourism and HSR is reviewed in Section 2. Section 3 presents the data, main characteristics, and model equations. The results and findings are presented in Section 4. Finally, the conclusions are summarized in Section 5.

By analyzing the growth of the number of tourists to museums and cultural monuments in several Spanish regions, this is the first study that tries to shed some light on whether HSR has an impact on cultural tourism. Three econometric models have been formulated wherein the existence of an HSR

station, its different location, and the distance to the museums and the possible interaction with air transportation are considered as important factors.

2. Literature Review

The literature shows that rail infrastructure is a prominent factor in tourism competitiveness [18]. HSR is considered to be not only a comfortable, safe, flexible, and environmentally sustainable [19] mode of transport, but also a fast one. Given that tourists have time constraints that they intend to optimize [20], the advantage of HSR includes providing more time at a destination (though sometimes at the expenses of the trip cost) [21]. In this context, there is a consensus among researchers that the introduction of HSR increases accessibility to destinations and increments previous attractions, maximizes pre-existing infrastructure, or even serves as a change agent for the implementation of new other policies. In the Spanish case, the distance between most Spanish cities is in the range in which HSR competes with advantage against the alternative modes (car and air). As a consequence, in order to boost new opportunities for tourism in the connected destinations, HSR seems most promising.

The impacts of HSR on tourism have been reported in previous studies [22,23] and are as follows: Opening of new tourist markets, increase in the number of tourists, increase in occupancy rates, decrease in the overstays in long terms although there is an increase in short terms, and, finally, development of urban tourism. As a result, a general positive effect is generally observed [24] although detailed studies report important differences in the behavior of tourists and different impacts on the destinations that are being studied.

The existing literature is summarized in Table 3, wherein the cited studies have been ordered by year of publication. Moreover, the countries and, when applicable, the region studied, selected type of approach, specification of the variable under study, and main findings are also included.

Table 3. Existing literature concerning the impact of High-Speed Rail (HSR) on tourism.

Authors	Country/Area	Type of Approach	Variable under Study	Findings/Conclusions
Guirao and Soler, 2009 [25]	Spain (Toledo)	Survey analysis	General impact on a small size city with a city edge station.	HSR frequencies and accessibility to HSR station must be reinforced to promote tourists.
Masson and Petiot, 2009 [26]	France and Spain. (Connection between Perpignan and Barcelona)	Ex-ante prospective analysis	Tourist demand.	Spatial competition may reinforce the agglomeration of the tourists in more developed areas (Barcelona) to the detriment of Perpignan.
Bazin, Beckeric, and Delaplace, 2010 [27]	France (Rheims)	Qualitative analysis	Urban and business tourism outcomes.	Only marginal profits are perceived due to the lack of reinforcement policies.
Wang, Chou, and Wu, 2010 [28]	Taiwan	Qualitative analysis	Tourism outcomes.	A "*day visit market*" has emerged because of HSR. Reduction in the days spent on visits and a simultaneous increase in the frequency of travel. Widening the tourist markets for more distant tourists.
Bazin, Beckerich, and Delaplace, 2011 [29]	France (Tous, Le Mans, Lille, Reims)	Qualitative analysis	Tourist impact.	HSR can valorize the city's accessibility and image, what requires reinforcement are strategies from local actors.

Table 3. *Cont.*

Authors	Country/Area	Type of Approach	Variable under Study	Findings/Conclusions
Albalate and Bel, 2012 [30]	European and Japanese networks	Research digest		Business tourism and conferences benefit from HSR service. A reduction in the number of overnight stays, decrease in tourism expenditure, and consumption of hotel services is found.
Chen and Haynes, 2012 [31]	China (27 provinces and 4 municipalities)	Econometric model	Number of total overseas tourist arrivals, numbers of foreign tourist arrivals, and tourism revenue from oversea tourist arrivals.	Significant impact on tourism outputs was found.
Wang, S. Huang, T. Zou, and H. Yan, 2012 [23]	China HSR network	Gravitational model	Accessibility to destinations.	Redistribution and transformation of tourist markets due to increased market competition.
Bazin, Beckerich, and Delaplace, 2013 [32]	France (Arras, Auray, Charleville-Mézières et Saverne)	Qualitative analysis	Increase in tourism outcomes.	Profits in small and medium size cities are low due to limited touristic attractivity and reinforcement policies.
Delaplace, Pagliara, Perrin, and La Pietra, 2013 [33]	France (Futuroscope and Disneyland Paris Themes Parks)	Survey approach combined with an econometric model	Impact of HSR in the choice of destination.	Direct positive impact found in the case of Disneyland, but no effect in the case of Futuroscope.
Delaplace, Pagliara, Perrin, and Mermet, 2014 [34]	France (Paris) and Italy (Rome)	Survey approach combined with an econometric model	Probability of choosing and revisiting the city.	Existence of HSR is not found as a main factor in the choice of either of the destinations. Unlike in Rome, French TGV does play a role in the willingness to revisit Paris.
Yan, Zhang, and Ye, 2014 [35]	China (three provinces along the Wuhan–Guangzhou HSR)	Econometric model	Domestic tourism receipts.	Considerable positive effects in two provinces while limited effect in the third one. Beneficial spillover effects along the HSR routes.
Sánchez Ollero, García Pozo, and Marchante Mera, 2014 [36]	Spain (Andalucía Region)	Qualitative analysis	Tourism outcomes.	Little or no positive impact was found.
Wang, Qian, Chen, Zhao, and Zhang, 2014 [37]	China (Beijing-Shanghai line)	Social network structure method	Accessibility to destinations.	An enhancement in the attraction for destinations with high standards was detected. Benefits in low popularity resource points were not so clearly detected.
Chen and Haynes, 2015 [38]	China	Econometric model	International tourist arrivals from 21 different countries.	Low level elasticity of new HSR implementation (0.057%), but important network effect elasticity (29%).

Table 3. *Cont.*

Authors	Country/Area	Type of Approach	Variable under Study	Findings/Conclusions
Pagliara, La Pietra, Gomez, and Vassallo, 2015 [39]	Spain (Madrid)	Survey approach and econometric model	Probability of revisiting Madrid and probability of choosing HSR for visiting cities near Madrid.	HSR does not play a role in the destination choice of Madrid, but has a great influence on the choice of visiting nearby cities.
Shyr, Chao, and Huang, 2015 [21]	Taiwan	Econometric model	Tourism outcomes.	Low influence of HSR on tourism.
Albalate and Fageda, 2016 [40]	Spain	Econometric model	Number of tourists and number of overnight stays.	No clear effect was found.
Campa, Lopez-Lambas, and Guirao, 2016 [41]	Spain (50 provinces)	Econometric model	Number of foreign and domestic tourists, and revenue from foreign tourists.	Low-value effects limited to foreign arrivals and tourists.
Guirao and Campa, 2016 [42]	Spain (7 provinces)	Econometric model	Number of domestic and foreign tourists, and number of overnight stays.	There is no direct positive impact on the destinations analyzed.
Hiramatsu, 2016 [43]	Japan (Kyushu's HSR)	GCE econometric model	Number of tourist arrivals and GP of arrival of tourism goods.	Only some stations served by HSR experience an increase in the tourist arrivals, although economy of all prefectures is benefited due to general equilibrium effects.
Kurihara and Wu, 2016 [44]	Japan (Tohoku and Kyushu Regions)	Statistical analysis and Ordinary Least Square econometric model	Tourist arrivals.	HSR significantly increases tourist arrivals, sharper in the areas closer to stations, although the influence decays over time.
Ortuño, Bautista, Fernández-Aracil, Fernández, and Sánchez Galiano, 2016 [45]	Spain (Alicante)	Survey approach	Voyaging by HSR tourist profile.	15–20% of new trips induced, especially from Madrid central node.
Saladié, Clavé, and Gutiérrez, 2016 [46]	Spain (Tarragona)	Survey approach	First time/Repeat tourists.	High repercussion found: Almost 25% of expenditures in the destination by first-time tourists and 12.9% by repeat tourists can be attributed to the availability of the Camp de Tarragona HSR station.
Wang, Wang, Chen, Lu, and Niu, 2016 [47]		Analysis of accessibility using GIS applications	Tourism outcomes.	Reinforcement of tourist attraction at the tourism nodes with a certain level of previous attractivation. Increase in the competition between destinations.

Table 3. *Cont.*

Authors	Country/Area	Type of Approach	Variable under Study	Findings/Conclusions
Albalate, Campos, and Jimenez, 2017 [48]	Spain	Fixed effect econometric model	Number of tourists, number of nights spent at the destination, and hotel occupancy.	Minimal or even negative effects that are restricted to large cities. No overall effect detected.
Gutiérrez and Ortuño, 2017 [49]	Spain (Tarragona and Alicante)	Survey approach and econometric model	Tourist profile and preferences.	Different tourist profiles at the two destinations were detected. Those who visit Alicante tend to make longer stays, arrive in larger groups, and are older than those that are most likely to visit Tarragona.
F. Pagliara, Mauriello, and Garofalo, 2017 [50]	Italy (77 municipalities)	GEE econometric model	Number of Italian tourists and number of overnight stays.	Positive impact on the number of Italian tourists and overnight stays. A denser network intensifies this effect.
Wang, Niu, Sun, Wang, Qian, and Li, 2017 [51]	China	Calculation of temporal distance and field strength index of urban tourism	Accessibility to urban destinations.	Increase in general accessibility due to HSR network that benefits most regional central cities.
Campa, Arce, Lopez-Lambas, and Guirao, 2018 [52]	Spain (7 regions)	Econometric model	Number of foreign tourists.	No overall effect of the presence of HSR or extension of the network was detected although some positive effects on peripheral destinations that then decrease progressively in profit for inland destinations
Gao, Su, and Wang, 2019 [53]	China (provincial level)	Differences in differences econometrical model	Domestic revenues and arrivals.	General negative effect due to the decrease in revenues while the number of domestic tourist increases.
Moyano, Rivas, and Coronado, 2019 [54]	Spain (all the connected HSR network)	Calculation of efficiency index	One-day trip traveler global benefit.	Large cities in the peripheral location of the network are most favored for business connections, while intermediate cities achieve higher efficiency for tourism.
Yin, Pagliara, and Wilson, 2019 [24]	China (13 cities in the Capital Region)	Econometric model	Tourist flow, and attraction of destinations.	The small and end-line cities connected to core cities are the most benefited while the effect is limited for larger cities.

The literature shows that although the increase of attraction ranges provided for touristic nodes are generally detected, benefits and their persistence are very dependent on the previous features of these touristic nodes. For some of them, negative factors such as distance or prices are determined to be moderated by other motivations such as broadening cultural knowledge or discovering new places [55]. In the Spanish case, the existence of different tourist targets in the connected cities, such as urban business tourism (Barcelona, Madrid, Sevilla, and Zaragoza), cultural tourism (Cordoba and Segovia), or sun and beach destinations (Alicante, Tarragona, and Málaga), make HSR the most convenient mode of transportation, especially when it can advantageously compete with the private car. This fact is more evident in intermediate cities along the HSR corridors, that often benefit from a

large number of services ending not just in these intermediate cities, but also in cities further away in the same line.

The location of HSR stations with reference to the cities centers also provides a higher or lesser access to the general HSR network. Effective time reductions become more apparent when stations are placed downtown, where access to efficient municipal public transportation and the proximity to the final destination maximize utility for users. In this context, these are the most accepted outcomes, which usually depend on the size of the city. Major urban areas tend to reinforce a central location. In such cases, the station is often linked with larger scale strategies, such as the reinforcement of the image of the city. For example, in Zaragoza, the "Delicias" station was the part of a wider plan in order to modernize the city for organizing the 2008 World Exhibition. In small or medium sized cities, the planning of stations significantly depends on the budget criteria of the infrastructure builder, and city edge and peripheral stations are the most common [56], although, their utility for tourists is drastically reduced. The Spanish HSR network and the relative positions of the Spanish stations with respect to the cities they are located in are shown in Figure 1.

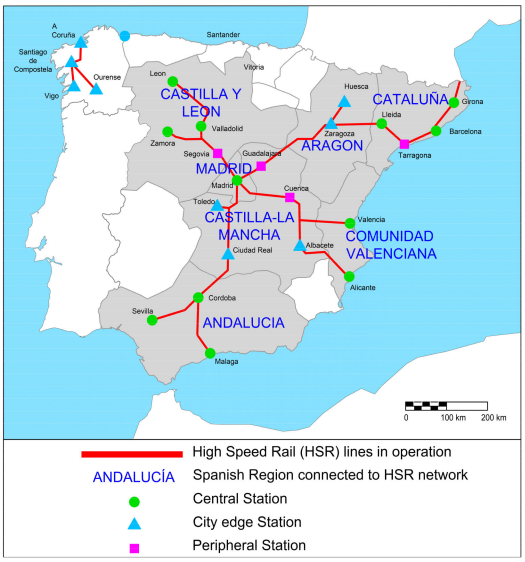


Figure 1. HSR network (2018) and the situation of the Spanish HSR stations.

According to the literature, with regard to the competition between HSR and alternative modes of transport, a primary substitution effect and a later positive impact is expected for national tourists who use mainly private cars as a transportation mode. In the case of foreign tourists, for which airplane is preferred, the substitution effect is more difficult to define. Nevertheless, the possibility of secondary internal trips by these travelers, which could not have been possible otherwise, has been detected in the previous study [51] and may generate positive impacts on the revenues and employment in these secondary connected cities. Considering these factors, HSR acts as a feeder to hub airports [57] and its increased demand compensates the possible decrease in the number of passengers that air services may suffer.

3. The Methodology

Considering that museums and cultural resources are one of the pillars on which cultural tourism is based, the number of tourists who visit these museums and cultural resources is considered as a proxy for evaluating the growth of cultural tourism markets in HSR-connected destinations. Therefore, a search in the main databases at the national or the regional level was conducted and the data on the visitors to 64 cultural landmarks in 11 Spanish provinces were collected. The resulting data base included the most visited museums, such as "Museo Reina Sofía" and "Museo del Prado".

The advantage of the resulting database is that it is not aggregated by provinces or regions of destination and in consequence will provide more detailed information.

The econometric model was designed following on Lim's classical demand model [58], which has been widely applied in the previous studies concerning the relationship between HSR and tourism [38,44,48,52,53]. The advantage of this econometric approach lies in its ability to analyze caudal effects [59], in line with the intended purpose presented in this paper.

It follows

$$DT_{ij} = f\left(Y_j, TC_{ij}, RP_{ij}, ER_{ij}, QF_{ij}\right) \quad (1)$$

where

- *DTij* represents the tourist demand between "*i*" and "*j*" where "*i*" is destination and "*j*" is the origin. In this study, the yearly number of tourists who visit museums and monuments ("$Visit_{it}$" variable) is considered as the indicator of its demand. Data was obtained from the following agencies: State museums and monuments: www.patrimonionacional.es and www.mcu.es; regional and municipal ownership museums and monuments: www.gencat.cat for museums in Cataluña and www.juntadeandalucia.es for museums in Andalucía; municipal ownership museums and monuments: www.madrid.org for museums in Madrid, www.barcelona.cat for museums in Barcelona, and www.jcyl.es for museums in Castilla and Leon; and private ownership museums: www.cabildocatedraldecordoba.es and www.valencia.es.
- Y_j represents the incomes in the origin "*j*". The average Spanish GDP per capita deduced from the Spanish National Statistics Institute (INE) is used to measure it, and is available at www.ine.es. The GDP of the rest of the main countries of origin, primarily European, has not been included in the model because a serial correlation was found between them.
- TC_{ij} is the travel cost from origin "*j*" to destination "*i*". Its effect could not be measured as the database does not provide the country or the region of origin of tourists.
- RP_{ij} is the relative cost, that measures the likely cost of goods to tourists at the destination (such as accommodation, local transportation, food, and entertainment). The difference in the DGP per capita between the European Union (source of most of the travelers) and Spain is represented by the variable "Dif Gdp", which provides a proxy to the perceived difference of level of prices between these originating countries and the destination.
- The currency exchange rate is represented by *ERij*. As Euro is the legal currency in both the destination and the majority of the origin countries, this variable was not included.
- QF_i stands for the quality factors in destination "*i*". The size of the population at the province of destination "*POP*" and the lagged variable "$Visit_{t-1}$" have been considered.
- The policy variables that have been separately considered are as follows: "Hsr_t" is a dummy variable that takes a value of 1 if a High-Speed Rail is available at the province of destination, otherwise it takes a value of 0; "$Centr_t$", "$Cedge_t$", and "$Periph_t$" are dummy variables that take a value of 1 if HSR is available at the province of destination and the station location in the city is central, city edged, or peripheral, respectively; "*ST Dist*" are dummy variables that take a value of 0 if HSR is not available at the province of destination, otherwise it takes the value of the distance in kilometers "as the crow flies" from the HSR station to the museum considered.

Three different models with the following specifications have been developed:
Model 1:

$$\begin{aligned} \ln Visit_{i,t} = \beta_1 \times & \quad \ln Visit_{i,t-1} + \beta_2 \times \ln Pop_t \\ & + \beta_3 \times \ln \text{ Gdp}_t + \beta_4 \times \text{Dif Gdp}_t + \beta_5 \times \text{Hsr}_t + a_i \end{aligned} \quad (2)$$

Model 2:

$$\ln Visit_{i,t} = \beta_1 \times \ln Visit_{i,t-1} + \beta_2 \times \ln Pop_t + \beta_3 \times \ln \text{Gdp}_t + \beta_4 \times \text{Did Gdp}_t + \beta_5 \times \text{Centr}_t + \beta_6 \times \text{Cedge}_t + \beta_7 \times \text{Periph}_t + a_i \quad (3)$$

Model 3:

$$\ln Visit_{i,t} = \beta_1 \times \ln Visit_{i,t-1} + \beta_2 \times \ln Pop_t + \beta_3 \times \ln \text{Gdp}_t + \beta_4 \times \text{Dif Gdp}_t + \beta_5 \times \text{ST Dist}_t + a_i \quad (4)$$

where a_i represents the error term, that includes the time-invariant province-specific effect and the individual mean-zero random error, respectively.

Moreover, a preliminary collinearity analysis was carried out resulting in no undesired correlation between the variables in any of the models. It could be argued that an endogenous biasing of the results could emerge as a consequence of the construction order of the different lines. Nevertheless, the fact that tourist activity has not been one of the main drivers of HSR investment decisions, makes Spain a good case study due to the "absence of this kind of endogeneity" [48].

In order to provide as much diverse and detailed information as possible, a disaggregate level of demand analysis is carried out. Thus, at a regional scale, models are separately and successively applied to the complete database. As a result, the regions of Madrid, Cataluña, Andalucía, and Castilla (gathering Castilla and Leon and Castilla-La Mancha) have been considered. Hence, all three models are also applied to cities that benefit from a HUB airport. Finally, the analysis has been separately performed for museums located in the same and different municipalities than the HSR station.

The museums and monuments considered in the database, including the region and province they are located, are presented in Table 4. As the Madrid HSR station has been considered the most suitable HSR gateway, the museums in Badajoz, Burgos, Cáceres, and Cantabria have been assigned to the Region of Madrid.

Table 4. Descriptive statistics for the considered museums.

Province/Museum	Number of Obs.	Min. Year	Max. Year	Mean	Min.	Max
Region of Andalucia						
Province of Cádiz						
Museo de Cádiz	25	1992	2016	73,316	40,712	118,487
Province of Córdoba						
Mezquita cathedral	23	1994	2016	1,217,666	791,700	1,818,633
Museo Arqueológico de Córdoba	24	1993	2016	47,552	18,533	86,499
Museo de Bellas Artes de Córdoba	25	1992	2016	55,874	27,489	73,892
Province of Granada						
Museo de Bellas Artes de Granada	25	1992	2016	154,558	42,141	325,419
Museo de la Alhambra	25	1992	2016	174,484	68,825	285,001
Province of Sevilla						
Museo Arqueológico de Sevilla	25	1992	2016	63,507	45,296	115,028
Museo Artes y Cost. Pop. de Sevilla	25	1992	2016	58,835	21,153	87,826
Museo de Bellas Artes de Sevilla	25	1992	2016	190,300	22,379	362,951
Region of Castilla la Mancha						
Province of Toledo						
Museo del Greco	19	1999	2017	221,813	166,992	288,664
Museo Sefardí	19	1999	2017	294,402	218,868	375,170

Table 4. *Cont.*

Province/Museum	Number of Obs.	Min. Year	Max. Year	Mean	Min.	Max
Region of Castilla Leon						
Province of Valladolid						
Real Mon. Santa Clara de Tordesillas	3	2015	2017	30,150	26,597	33,424
Museo Nacional de Escultura	19	1999	2017	113,289	63,577	193,665
Province of Segovia						
Fuentes de La Granja	3	2015	2017	87,354	81,665	95,440
Palacio Real Granja de San Ildefonso	3	2015	2017	187,131	171,499	204,350
Region of Cataluña						
Province of Barcelona						
Colegiata de Sant Vicenç de Cardona	18	1999	2016	30,600	18,947	40,823
Fundació Antoni Tàpies	17	2000	2016	71,496	61,385	92,305
Fundació Joan Miró	17	2000	2016	490,300	425,067	583,831
Museu d'Art Contemporani de Barcelona	17	2000	2016	343,703	192,351	568,469
Museu de Ceràmica	6	2000	2005	58,783	48,834	80,640
Museu Ciències Nat. Ciutadella	17	2000	2016	145,852	61,501	234,574
Museu d'Història de Catalunya	16	2001	2016	190,006	142,601	302,326
Museu F.C.Barcelona	14	2000	2013	1,352,926	1,156,090	1,626,990
Museu Militar de Barcelona	5	2000	2004	105,338	58,458	130,614
Museu Monestir de Pedralbes	9	2000	2008	59,639	51,536	64,668
Museu Nacional d'Art de Catalunya	6	2011	2016	634,500	448,525	820,516
Museu Picasso	17	2000	2016	1,048,917	887,958	1,313,086
Temple Expiatori de la Sagr. Família	4	2010	2013	2,982,461	2,317,349	3,233,526
Province of Gerona						
Monestir San Pere de Rodes	18	1999	2016	103,775	91,635	114,161
Province of Lérida						
La Seu Vella de Lleida	9	1999	2007	47,228	37,125	67,373
Province of Tarragona						
Cartoixa d'Escaladei	13	2000	2012	20,011	17,699	22,290
Castell de Miravet	18	1999	2016	31,337	19,205	47,936
Museu Nac. Arqueològic Tarrag.	5	2012	2016	67,406	54,407	85,043
Reial Monestir de Santes Creus	18	1999	2016	74,899	57,266	88,346
Region of Madrid						
Province of Madrid						
Arqueológico	20	1988	2007	218,805	169,300	281,900
Cervantes	29	1988	2016	103,184	18,900	211,200
De Cera	13	2004	2016	290,238	248,300	341,200
Del Prado	29	1988	2016	2,215,041	1,567,200	3,156,700
El Valle de los Caídos	3	2015	2017	266,732	254,059	283,277
Ermita de San Antonio de la Florida	22	1995	2016	66,750	32,200	109,100
Falías Reales de Aranjuez	3	2015	2017	56,727	49,473	62,641
Lope de Vega	8	2009	2016	47,488	19,100	106,500
Monasterio de las Descalzas Reales	3	2015	2017	50,881	50,210	51,419
Museo Casa de Cervantes	19	1999	2017	15,445	11,330	26,431
Museo de Altamira	1	2000	2017	256,626	58,314	368,737
Museo de América	19	1999	2017	71,990	47,621	120,063
Museo del Traje	12	2006	2017	99,029	67,453	138,889
Museo Nacional de Antropología	19	1999	2017	45,413	25,175	81,790
Museo Nac. de Artes Decorativas	30	1988	2017	26,868	18,227	71,472
Museo Sorolla	19	1999	2017	120,805	19,803	255,051
Nacional de Ciencias Naturales	14	2003	2016	215,214	147,900	298,700
Nacional Etnológico	29	1988	2016	39,910	23,200	73,600
Palacio Real de Aranjuez	3	2015	2017	207,044	199,398	219,884
Palacio Real Madrid	3	2015	2017	1,413,899	1,303,496	1,494,245
Picasso-Colección Eugenio Arias	21	1996	2016	12,743	4,800	26,200
Planetario	29	1988	2016	171,407	86,700	260,000
Real Mon San Lorenzo de El Escorial	3	2015	2017	496,327	467,959	514,385
Reina Sofía	29	1988	2016	1,600,214	562,100	3,744,700
Sorolla	29	1988	2016	91,708	33,600	215,400

Table 4. *Cont.*

Province/Museum	Number of Obs.	Min. Year	Max. Year	Mean	Min.	Max
Templo de Debod	29	1988	2016	162,196	53,200	424,700
Thyssen-Bornemisza	23	1994	2016	760,074	433,600	1,255,300
Province of Badajoz						
Museo Nacional de Arte Romano	19	1999	2017	206,191	188,576	239,798
Province of Burgos						
M. de Sta. M. Real Huelgas de Burgos	3	2015	2017	64,401	61,421	67,901
Province of Cáceres						
Monasterio de San Jerónimo de Yuste	3	2015	2017	96,808	87,143	103,648
Province of Cantabria						
Museo de Altamira	18	2000	2017	256,626	58,314	368,737

In order to determine the most suitable econometric technique (generalized least squares (GLS), GLS with fixed effects, or GLS with random effects), a preliminary analysis was carried out. The Breusche-Pagan Lagrange multiplier test combined with the Hausman test confirms that the fixed-effect model is the most suitable technique and provides a robust estimation.

Stata/SE 12.0 is used to execute the models and the results are shown in Tables 5–7.

Table 5. Results for fixed effect panel regression. Models 1. (****), (***), (**), and (*) denote significant levels at 1%, 5%, 10%, and 20%, respectively. Numbers in parentheses indicate *p*-value.

Model 1	**Complete Database**			**Museums in Madrid**			**Museums in Cataluña**			**Museums in Andalucia**			**Museums in Castilla**		
Ln $visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $visit_{t-1}$	0.772	0.00	****	0.829	0.00	****	0.67	0	****	0.464741	0.000	****	−0.155	0.33	
Ln pop	0.005	0.60		−0.013	0.26		−0.01	0.958		1.851769	0.001	****	0.498	0.42	
Ln gdp	0.141	0.00	****	0.242	0.00	****	0.10	0.329		0.17967	0.164	*	0.106	0.57	
Dif gdp	0.000	0.90		0.000	0.24		0.00	0.68		−5.9E–05	0.098	**	0.000	0.69	
Hsr	0.042	0.14	*	0.199	0.00	****	0.01	0.806		2.773055	0.000	****	0.049	0.73	
Cons	1.290	0.00	****	−0.099	0.88		3.18	0.385		−22.9803	0.000	****	6.154	0.46	
F	2.400	0.000	****	2.100	0.000	****	3.480	0	****	13.07	0.000	****	12.390	0.000	****
Obs	964			450			214.000			208.00			39		
Groups	63			29			19.000			9.00			5		
R2	0.947			0.976			0.983			0.0444			0.171		

Model 1	**Hub**			**No Hub**			**Same Municipality**			**Different Municipality**		
Ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $Visit_{t-1}$	0.813	0.00	****	0.551	0.00	****	0.746	0.00	****	0.852	0.00	****
Ln Pop	0.004	0.70		0.666	0.04	***	0.001	0.91		0.033	0.21	
Ln Gdp	0.155	0.01	****	0.084	0.43		0.207	0.00	****	−0.083	0.43	
Dif Gdp	0.000	0.52		0.000	0.60		0.000	0.49		0.000	0.21	
Hsr	0.049	0.16	*	−0.063	0.37		0.028	0.42		0.092	0.06	**
Cons	0.757	0.15	*	−4.713	0.22		1.042	0.04	***	2.055	0.03	***
F	2.130	0.000	****	4.540	0.000	****	3.030	0.000	****	1.240	0.240	
Obs	672			292			749			215		
Groups	45			18			45			18		
R2	0.973			0.705			0.966			0.962		

Table 6. Results for fixed effect panel regression. Models 2. (****), (***), (**), and (*) denote significant levels at 1%, 5%, 10%, and 20%, respectively. Numbers in parentheses indicate *p*-value.

Model 2	**Complete Database**			**Museums in Madrid**			**Museums in Cataluña**			**Museums in Andalucia**			**Museums in Castilla**		
Ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $Visit_{t-1}$	0.771	0.00	****	0.829	0.00	****	0.671	0.00	****	0.465	0.00	****	−0.155	0.33	
Ln Pop	0.004	0.69		−0.013	0.26		−0.143	0.67		1.852	0.00	****	0.498	0.42	
Ln Gdp	0.146	0.00	****	0.242	0.00	****	0.121	0.27		0.180	0.16	*	0.106	0.57	
Dif Gdp	0.000	0.84		0.000	0.24		0.000	0.75		0.000	0.10	**	0.000	0.69	
Centr	0.054	0.10	**	0.199	0.00	****	0.009	0.81		2.773	0.00	****	0.000	(omitted)	
Cedge	0.022	0.79		0.000	(omitted)		0.000	(omitted)		0.000	(omitted)		0.049	0.73	
Periph	0.0033	0.959		0.0000	(omitted)		0.0519	0.473		0.0000	(omitted)		0.0000	(omitted)	
Cons	1.268	0.005	****	−0.096	0.881		4.858	0.269		−22.980	0.000	****	6.165	0.457	
F	2	0.000	****	3	0.001	****	3	0.000	****	13	0.000	****	13	0.000	****
Obs	964.000			450.000				214.000		208.000			39.000		
Groups	63.000			29.000				19.00		9.000			5.000		
R2	0.969			0.927				0.95		0.044			0.156		

Model 2	**Hub**			**No Hub**			**Same Municipality**			**Different Municipality**		
Ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $Visit_{t-1}$	0.813	0.00	****	0.544	0.00	****	0.746	0.00	****	0.851	0.00	****
Ln Pop	0.004	0.70		0.763	0.02	***	0.001	0.94		0.030	0.27	
Ln Gdp	0.155	0.01	****	0.079	0.45		0.209	0.00	****	−0.070	0.52	
DIF Gdp	0.000	0.52		0.000	0.54		0.000	0.51		0.000	0.20	*
Centr	0.049	0.16	*	0.025	0.80		0.032	0.39		0.116	0.09	**
Cedge	0.000	(omitted)		−0.086	0.40		0.002	0.98		0.000	(omitted)	
Periph	0.0000	(omitted)		−0.1222	0.159	*	0.0000	(omitted)		0.0713	0.264	
Cons	0.757	0.158	*	−5.959	0.136	*	1.035	0.040	***	1.991	0.041	***
F	2	0.000	****	5	0.000	****	3	0.000	****	1	0.237	
Obs	672.000			292.000			749.000			215.000		
Groups	45.000			18.000			45.000			18.000		
R2	0.973			0.638			0.966			0.942		

Table 7. Results for fixed effect panel regression. Models 3. (****), (***), (**), and (*) denote significant levels at 1%, 5%, 10%, and 20%, respectively. Numbers in parentheses indicate *p*-value.

Model 3	**Complete Database**			**Museums in Madrid**			**Museums in Cataluña**			**Museums in Andalucia**			**Museums in Castilla**		
Ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $Visit_{t-1}$	0.767	0.00	****	0.827	0.00	****	0.670	0.00	****	0.465	0.00	****	−0.148	0.35	
Ln Pop	0.003	0.75		−0.006	0.58		−0.016	0.95		1.852	0.00	****	0.581	0.32	
Ln Gdp	0.149	0.00	****	0.236	0.00	****	0.105	0.33		0.180	0.16	*	0.106	0.57	
DIF Gdp	0.000	0.55		0.000	0.36		0.000	0.68		0.000	0.10	**	0.000	0.67	
ST Dist	−0.000	0.01	***	−0.000	0.01	***	−0.000	0.81		−0.000	0.00	****	0.000	0.83	
Cons	1.379	0.00	****	0.050	0.94		3.195	0.40		−20.817	0.002	****	4.979	0.51	
F	2.470	0.000	****	2.080	0.001	****		3.480		12.800	0.000	****	12.450	0.000	****
Obs	964			450				214.000		208			39		
Groups	63			29				19.000		9			5		
R2	0.969			0.976				0.983		0.153			0.148		

Model 3	**Hub**			**No Hub**			**Same Municipality**			**Different Municipality**		
Ln Visitt	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Ln $Visit_{t-1}$	0.8115761		****	0.5630129		****	0.7422611		****	0.8471965		****
Ln Pop	0.004256	0.667		−0.00065	0.998		−0.00041	0.969		0.027663	0.288	
Ln Gdp	0.162	0.01	****	0.179	0.10	**	0.214	0.00	****	−0.076	0.46	
DIF Gdp	0.000	0.50		0.000	0.29		0.000	0.73		0.000	0.12	*
ST Dist	−0.000	0.16	*	−0.000	0.04	***	−0.000	0.12	*	−0.000	0.01	****
Cons	0.759	0.15	*	3.502	0.36		1.106	0.03	***	2.277	0.02	***
F	2.130	0.00	****	4.620	0.00	****	3.080	0.00	****	1.430	0.13	*
Obs	672.0000			292.0000			749.0000			215.0000		
Groups	45.000			18.000			45.000			18.000		
R2	0.973			0.942			0.966			0.962		

4. Results

In almost all models, a strong significance of the lagged variable "$Visit_{t-1}$" is observed, which confirms the previous studies [38,52]. Thus, on average, 77% of the visits can be explained by previous experiences, in line with the repetition rate of tourists of 80.2% found for the Spanish sector [10]. The population at the province level does not show a clear effect when the whole database is considered. When the regional scale is adopted, it is only in Andalucía region where a significant positive coefficient of 1.85 is observed. An expected different impact is observed in the provinces with and without hub airports. The accessibility in destination drastically increases and the relative importance of domestic tourists (and especially the inhabitants of the same province) reduces where a hub airport is available. Consequently, it is only in "no hub" airport provinces models where a positive effect of the province population is observed.

In terms of the economic variables, the GDP per capita of the Spanish population is relevant for the complete database. This is an expected result confirming that it is people with higher incomes, who benefit from a greater amount of leisure time and, normally, have greater cultural concerns [60,61]. But simultaneously, regional differences have also been observed. When only the museums in Cataluña or Castilla La Mancha and Castilla y Leon are considered, no clear influence is shown; however, when only Madrid's or even Andalucía's database are considered, a clear positive influence appears. No influence of the "Dif Gdp" variable is observed in any of the models except in those that consider museums only in Andalucía. The negative sign of the coefficient indicates that when the relative purchasing power of tourists increases, they tend to visit alternative destinations. This result was already verified in other Spanish "sun and beach" destinations studies [62] that claim that "the higher the number of beds in medium and high-quality accommodation establishments, the lower the number of beach trips generated by a location".

Concerning the policy variables, the primary objective of this study, and when the whole database is considered, the presence of a high speed rail connection, represented by the variable "*HSR*" seems to be relevant in Model 1 with a low significance level of 13.6%, with the expected positive sign and with an elasticity of 0.041. Hence, the commissioning of a new HSR connection shows signs of increasing the number of tourists to museums with a modest rate of 0.04% in that province. Moreover, significant differences are observed when the analysis is made regionally. Though the HSR does not induce an impact in Cataluña or Castilla, the variable is considered to be strongly significant for the case of Madrid and Andalucía with elasticities around 0.2% and 2%, respectively. However, differences are also observed when databases with provinces including hub airports are considered. The existence of HSR shows only signs of significance, (although with a low significance rate of 15.8%) in provinces including hub airports with an elasticity of 0.05%. On the contrary, no influence is observed in provinces without these hub airports. This suggests that the attraction of the city and the impact of HSR may increase by the presence of this alternative mode of transportation and that a mutual feedback is developed when a cooperation is established with airline passengers that can use the HSR for secondary trips and thus may increase the access range to other Spanish regions.

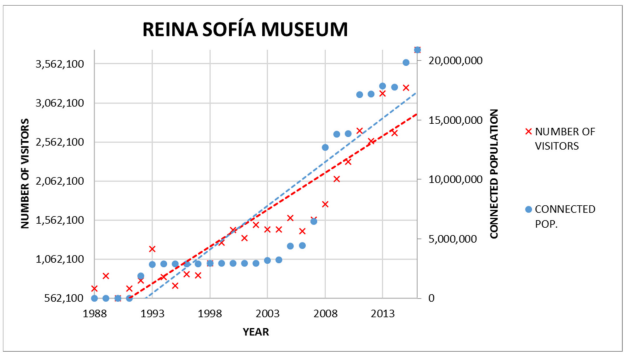
In the analysis of Model 2, which evaluates the location of the stations, evidence of the influence of HSR is observed, but only in the provinces with a central station with an average impact of 0.053%, which is similar to the value obtained in Model 1. This result conforms to the previous finding that "central locations generally benefit from better efficiency for tourism trips" [53]. Moreover, no effect is observed when the HSR station is in either the city edge or in a peripheral situation. Surprisingly, the effect of HSR in Barcelona, the main HSR station in Cataluña, is not found to be significant even though its central position makes it an a priori excellent push factor for the increase in the number of tourists. Only when the central location of the station is considered, the presence of a hub airport seems to induce a relevant impact, although the low significance value of 15.8% must be noticed.

Model 3, which evaluates the influence of the distance to HSR, the policy variable, "ST Dist", shows that there is a low-value overall inverse relation between the distance from the HSR stations to the museums and the number of the tourists. This effect is observed when the museums are considered only in the Madrid, Andalucía, and Castilla regions. Similar to Model 2, no effect is observed for museums

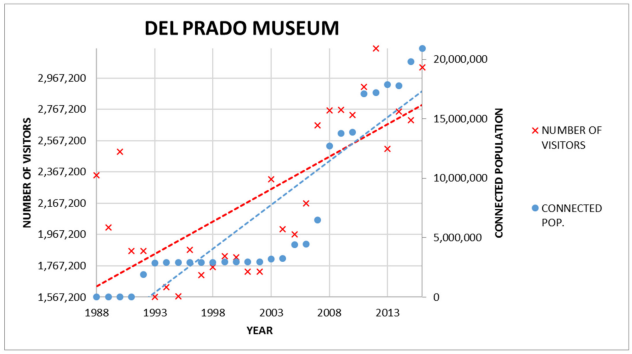
in the Cataluña region. Moreover, the impacts are found to be significant in the three models only for the museums located in a different municipality (but in the same province) than the HSR station when databases that include museums in the same or different municipalities are considered separately. This result completes the outcomes of Model 3 and indicates that the existence of an HSR link can also increase the potential of Spanish museums located farther from the station that especially benefits the widening of tourist markets and the increase in the amount of time off available at destinations. When the existence of a hub airport is examined, the negative impact of distance from the HSR station is shown, although it is especially significant when the hub airport is not available. Consequently, it can be concluded that the development of integrated transportation plans in the cities where intermodal links are required, can result in an effective increase in the cultural tourism market in connected destinations.

In addition, the nationality of tourists visiting museums and cultural resources seems to be an important variable which would require further investigation. The analysis of outcomes of databases with and without hub airports at destinations (and considering that the existence of these hub airports is a well-studied relevant factor in promoting foreign tourists [57]) provide primary indications that the increase in accessibility provided by the joint effects of these two modes of transportation results in a higher number of foreign tourists.

With regard to national tourists and considering that database do not show the nationality of visitors, the models do not provide sufficient information. A first approach to this question can lie in analyzing the comparative evolution in the number of tourists to museums and the national population connected by HSR in every HSR node with cultural attractiveness. Figures 2–4 graphically show the evolution of the number of tourists to some museums and monuments in the main cities of the regions of Madrid, Cataluña, and Andalucía, and for the same time periods, the number of served population. In order to exclude tourists inhabiting in the same city as the cultural resource, which is already represented by the "*Pop*" variable in the previous models, residents in the cities where the museums are located have not been considered as "served." In order to coincide with the extreme values in the database, the scale has been adjusted in the two "*y*"-axes to the ranges of both series. The lineal tendency lines are shown and provide an indication about the time effect on both series.

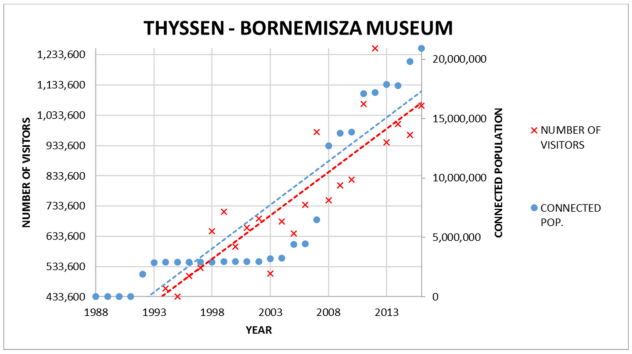


(**a**)



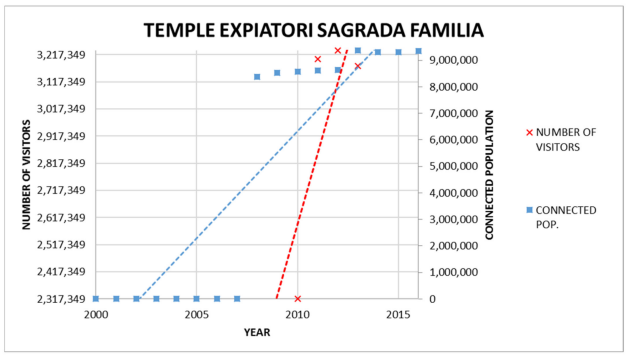
(**b**)

Figure 2. *Cont.*

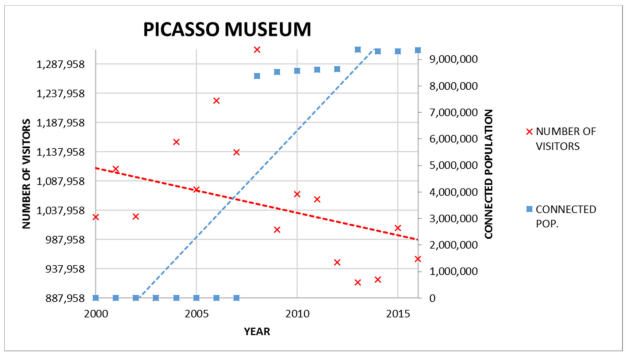


(c)

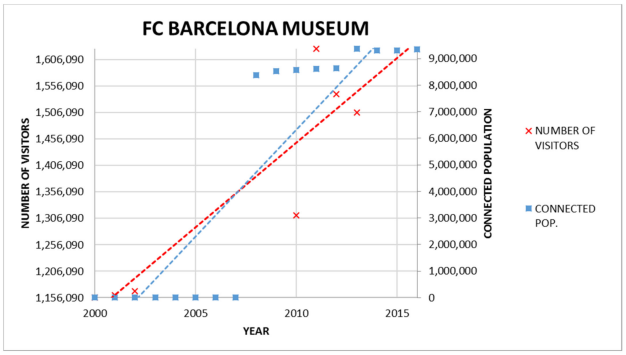
Figure 2. Number of tourists per year to main museums in Madrid versus population served by HSR to Madrid.



(a)

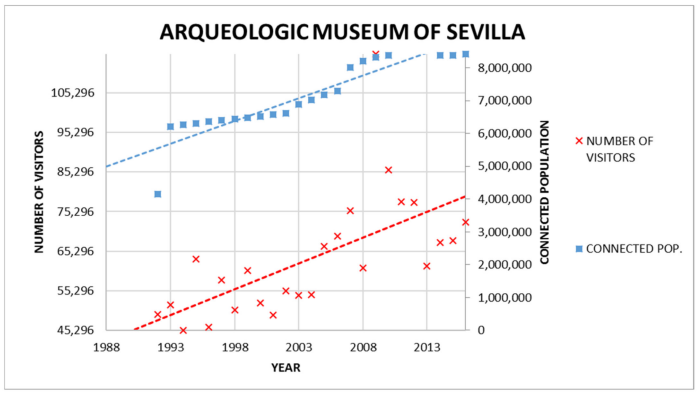


(b)

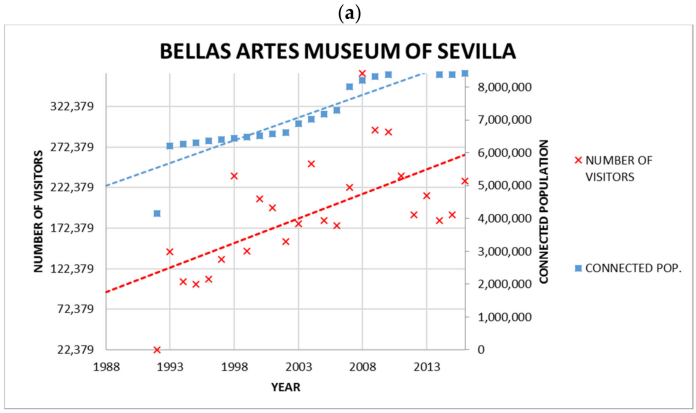


(c)

Figure 3. Number of tourists per year to main museums in Barcelona versus population served by HSR to Barcelona.



(**a**)



(**b**)

Figure 4. Number of tourists per year to main museums in Andalucía (Sevilla and Cordoba) versus population served by HSR.

A linear model including the number of tourists as a dependent variable has also been designed for these main museums in order to complement previous results. The time trend has been included as independent variables. In order to make it independent from the possible influence of the served population, as shown in the figures, the population of the cities where the museums are located is not required to be included. Tables 8–10 present the results.

Table 8. Visitors to main museums in Madrid. (****), (***), (**), and (*) denote the significance levels at 1%, 5%, 10%, and 20%, respectively. The numbers in parentheses indicate *p*-value.

	Reina Sofia Museum			**Del Prado Museum**			**Thyssen-Bornemisza Mus.**		
Dep. Var.: Ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Year	0.046	0.000	****	–0.000	0.965		0.037	0.002	****
Connected Pop.	0.000	0.040	***	0.000	0.009	****	0.000	0.838	
Const	–77.223	0.000	****	15.046	0.305		–60.050	0.009	****
OBS	29			29			23		
R^2	0.9289			0.5865			0.7848		

Table 9. Visitors to main museums in Barcelona. (****), (***), (**), and (*) denote significant levels at 1%, 5%, 10%, and 20%, respectively. Numbers in parentheses indicate *p*-value.

	T. Exp. Sagrada Familia			**Picasso Museum**		**FC Barcelona Museum**		**Contemporary Art Museum**	
Dep.Var.: ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$	Coef.	$p > t$	Coef.	$p > t$
Year	0.179	0.002	****	−0.007	0.321	0.029	0.365	0.029	0.310
Connected Pop	−0.000	0.838		−0.000	0.491	−0.000	0.790	−0.000	0.685
Const	−341.389	0.009	****	27.685	0.332	−45.683	0.466	−45.683	0.423
Obs	4			17		17		17	
R^2	0.3878			0.1222		0.0231		0.0231	

Table 10. Visitors to main museums in Sevilla and Cordoba. (****), (***), (**), and (*) denote significant levels at 1%, 5%, 10%, and 20%, respectively. Numbers in parentheses indicate *p*-value.

	Sev. Archaeolog Museum			**Sevilla Fine Arts Museum**			**Cordoba Mezq. Cathedral**		
Dep. Var.: ln $Visit_t$	Coef.	$p > t$		Coef.	$p > t$		Coef.	$p > t$	
Year	0.002	0.855		−0.053	0.028	***	0.048	0.000	****
Connected Population	0.000	0.098	**	0.000	0.000	****	−0.000	0.001	****
Const	5.840	0.797		113.466	0.017	***	−81.404	0.000	****
Obs	25			25			23		
R^2	0.4989			0.6712			0.8256		

Moreover, the results also suggest different influences depending on the considered destination. The connected population seems to be an influencing factor only in some museums in Andalucía, whereas in other museums the impact is not found to be significant. Furthermore, none of the analyzed museums in Barcelona seem to reflect any influence of potential domestic travelers by HSR. However, a weak influence seems to appear with regard to the museums in Andalucía although not always with the expected sign. Finally, it is concluded that an increase in the HSR network does not seem to result in a general growth in the affluence of domestic tourists, hence further research is required in this regard.

5. Conclusions

The effects of HSR on cultural tourism are a subject of interest though the scarcity of bibliography shows that sufficient attention has not been paid in this regard up to now. Although some analytic studies using the econometric models have already emerged dealing with the influence of HSR on tourism, some of them even with a meritorious high level of disaggregation, the specific impact on the cultural tourism, and, more specifically, on museums and monuments, remain unexplored up to now. Hence, the higher returns and greater positive effects on society by the tourist industry, and in an outstanding way by cultural tourism, make it an appropriate field of research that should receive special attention.

This paper provides a deeper insight into this interesting subject for the first time by implementing an econometric model and taking into consideration the number of tourists of 64 museums and monuments in 25 Spanish municipalities, using a validated methodology which could be suitable in other countries with a HSR network and cultural attractiveness. Although the previous studies focused on general tourism in Spain, little or no influence of HSR was detected, the results in this paper show signs that this mode of transportation can play a positive role in the reinforcement of cultural tourism. This study also highlights the different roles that HSR has played in the Spanish cultural tourist markets of museums and monuments, with a significant increase in the number of tourists in some regions (Madrid and Andalucía) while these outcomes are not significant in other regions (Cataluña and Castilla). A doubly controversial effect of distance to the HSR stations is also observed. While little or no effect is detected in museums located in the same municipality, museums located in a different municipality receive an appreciable significant increase in the number of tourists. This is

interpreted as an indication that HSR increases the action radius of tourists surely due to the gain in available time at a destination and reinforces hidden potentialities of further museums. Moreover, the central position of the HSR stations is also detected as a significant beneficial factor and suggests that the location of the HSR with respect to the city is also an important factor in addition to the mere connection to the HSR network. With regard to the nationality of tourists, a need for the integration of HSR and air transportation is perceived in order to favor the affluence of foreign tourists. With regard to domestic tourists, the analysis of the evolution in the number of tourists and the expansion of the network report that HSR may be, in some cases, considered a determinant factor in increasing the tourist demand.

Hence, some considerations about these finding should be addressed despite the above results. First, the limitation of the database should be recognized. Although it has been created with official data from public entities, the presence of unexpected gaps in the series and the small range of time that the HSR has been operating in some destinations limits the number of registers in the database and affects the conditions of the performance of models. On the other hand, the distance from the foreign originating countries to a cultural destination is considered to be beyond the range in which HSR reveals itself as the most competitive mode of transportation. Moreover, the actual limited connection between European and Spanish HSR networks is also considered to be a deterrent against the use of HSR by foreign tourists. Future research should focus on improving the performance of models by using a more complete and detailed database so that further and more accurate information could be concluded.

In conclusion, and although the debate of the impulse given to cultural tourism by HSR remains open, the results reveal that HSR can become a relevant instrument to aid planners and authorities in the promotion of national cultural sites which may yield economic growth returns and improvements in the profitability of HSR investments

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