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Cross effects between high speed rail lines and tourism: looking for empirical evidence using the Spanish case study

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Abstract

Tourism supply is a complex phenomenon in terms of both the nature of the product and the process of delivery but, despite its complexity, tourism is a relevant economic activity in many countries of the world. Some of these countries have a High Speed Rail (HSR) network in operation, under construction or are planning a new one, and due to the exorbitant cost of new High-Speed Rail (HSR), there is a big concern on the assessment of the cross effects between tourism and HSR.

There is practically no literature, even in Europe, on empirical methodologies to assess neither the effects of tourism on HSR demand nor the impacts of HSR on tourism demand. The aim of this paper is to assess empirically the main cross effects between HSR and tourism, using a validated multi-criteria corridor selection methodology (tourism effects on HSR demand) and a multivariate regression model for panel data (HSR effects on tourism demand). Spain has been used as a case study, where tourism is one of the main contributions to national GDP (over 10%), with a HSR network length of 2500 km and long operation experience. Results show clearly the positive effects of tourism destinations on HSR demand; however, the effects on tourism demand caused by HSR are controversial and not clear empirical evidence can be derived, due mainly to the drawbacks of the available database. Both types of conclusions will ultimately provide authorities and policymakers with useful tools when planning the construction of a new HSR line.

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1. Introduction

In the literature, transport is recognized to be very important for tourism development. The existence of quality infrastructures of transport is reported to be an ex-ante condition for the development of the tourism sector, as they can make a country attractive as a touristic destination (Chew, 1987) or influence the type of tourist received (Prideaux, 2000). Despite this, the increasing use of HSR for tourism and leisure "is a new issue of interest whose logics and the associated regional processes that generates are still understudied" (Delaplace et al, 2014). While the impact of tourism on HSR demand is usually related to the the difficulties of estimating HSR induced demand in the generation modelling stage (Guirao and Campa, 2015) and can affect the planning process of a new HSR network, the assessment of the inverse impacts (HSR on tourism) is much more complex. Apart from the economic geography models (Masson and Petriot, 2009; Wang et al., 2012) and the choice destination approach, the econometric models have rarely been applied, until now (Chen and Haynes, 2012), to analyse the impact of HSR on tourism. The first approach to study the effects of HSR on tourist destination choice was developed by Delaplace et al. (2014) in Paris and Rome. On the basis of a survey of tourists in Paris and Rome, data collected from the two surveys were used for a quantitative analysis using regression models and results demonstrated that HSR influences destination choice in different ways in the two cities, being in Paris the tourism more dependent on HSR. This interesting contribution was completed by Pagliara et al. (2015) using Madrid case study, where a revealed preference survey was also conducted. Although these results are quite clarifying, the notion that destination choice may be influenced by HSR is no proof that the construction of a new line will automatically reinforce a tourist destination, increasing tourist-sector revenues in this city (accommodation, restaurants, museums and so on).

Econometric models, when used to assess tourism demand, tend to follow a single-equation time-series approach (Lim, 1997; Song and Li, 2008), along with a few advanced studies of demand systems (O'Hagan and Harrison, 1984). This type of model is fairly dependent on the existence of a sound database. As mentioned before, the only approach of this type applied to HSR corridors was developed by Chen and Haynes (2012). Through a multivariate panel analysis, they investigated the impact of Chinese high-speed rail systems on the tourism industry, selecting only the numbers of incoming foreign tourists and tourism revenue as the dependent variables (as data on domestic tourism demand was not publicly available in China). The results of this research confirmed that during the period between 1999 and 2010, the emerging high-speed rail services had significantly boosted tourism in China and provinces with high-speed rail services were likely to have approximately 20 percent more foreign arrivals and 25 percent higher tourism revenues than provinces without these systems. This model structure could be applied to European countries with HSR networks, but introducing some changes in the variables and reducing expectations. Firstly, in China domestic tourists were not considered, and this percentage is quite high in Europe. Moreover, the HSR impacts on tourism in a country like China, where the interurban transport network is less developed than in Europe, are probably of a higher magnitude and easier to detect by an econometric demand model. Spain offers a good case study to test an econometric model of this type and this will be one of the main aims of this paper.

In relation to the assessment of the influence of tourism on HSR demand, there are some research works with interesting results worth mentioning in the literature. These studies describe specific HSR experiences (study cases) but do not lead to a general conclusion. The use of HSR by tourists depends on a number of factors related to the trip as well as to the travelers, mainly distance to destinations, typology of destination or location of the HSR station. In relation to the distance to destination, for distances below 300 km, only 19.2 % of travelers use HSR for leisure tourism purposes, increasing this percentage up to 54.8 % for trips of more than 600 km length. In contrast, business tourism varies only from 28.4% for distances below 300 km, to 36.0 % for distances greater than 600 km (La Rocca, 2008). Nevertheless, this influence of the distance, it is considered differently by other authors who argue that HSR lines can be very useful for trips shorter than one hour where nor the timetable neither the prices make them adequate for commuters (Coronado al, 2013). Guirao and Soler (2008) examined the impacts of Toledo tourism on the new HSR link Madrid-Toledo (30 min. trip time). Through a survey approach, they found that tourism accounts for over thirty percent of weekday HSR ridership, and that this type of user finds it hard to obtain tickets due to the massive presence of commuters. For journeys more than 800 km long, there is a consensus that other means of transport like airplane are more efficient than HSR. In relation to the typology of destination, it is possible to differentiate among isolated destinations (e.g. Disneyland Paris, where the destination point is a “tourist island”), a concentrated destination (several zones of attraction in a geographically limited territory, case of the Valley of the Loire), or a diffuse destination (case of most big cities, with dispersed the points of attraction (Chèze et al, 2015).The location of the HSR station at the journeys end which is also a major factor determining the attractiveness of a touristic destination (Givoni and Banister, 2012, Pagliara et al, 2015) mainly for business tourism.

As the number of systematic studies to assess the impact of tourism impact of HSR demand is very scarce and heterogeneous, the authors of this paper proposed (Guirao and Campa, 2015 a) the inclusion of a tourism variable in the only existing HSR ranking model, a tool designed by Hagler and Todorovich (2009) for application in the US. This model had been used in Spain (Guirao and Campa, 2014a) and in Malaysia (Saat and Aguilar Serrano, 2015) with interesting and consistent results, and in both these studies the original formulation was neither changed nor improved. Unlike Malaysia, in the case of the Spanish application the model was validated using current HSR traffic data, and it may initially appear surprising to use a prioritization method based on existing data. The main reason for applying an ex-ante tool to an ex-post scenario is that this is the only way to validate a planning tool. Transportation planners at present rarely check that their ex-ante theories and conditions for the future are met, and much can be learned from this kind of comparison to avoid repeating certain assumptions in future ex-ante evaluations. In the case of Spain, some deficiencies were detected in the formulation, (as the ex-ante results could be compared to the current situation), a sensibility analysis was carried out (Guirao and Campa, 2014b) and the tourism criterion was clearly lacking. Spain has more than 20 years’ HSR experience, and operates the longest HSR network in Europe (2,900 km). It offered a good scenario for this model improvement and validation, as the tourism sector represented 10.2% of its gross domestic product (GDP) in 2014. The methodology used and results obtained (Guirao and Campa, 2015) are described in section 2 of this paper, and demonstrate the positive influence of tourism on HSR demand. Although results are very useful to understand how tourism should be taken into account in the HSR planning process, this fact does not demonstrate the positive influence of HSR on tourism indicators too, so we will need other kind of methodology, based on econometric models.

This paper contributes to the limited existing literature by developing the analysis of the cross effects between tourism and HSR. The added value of this research lies in the first empirical assessment of the impact of HSR of the main tourism indicators in Spain, comparing the results to the inverse cross effect (Tourism on HSR demand). This article is divided into the following parts: first, a literature review on tourism and HSR (section 1), the evaluation of the impact of tourism on Spanish HSR demand using a prioritization model (section 2); a description of the lineal regression to assess the impact of HSR on Spanish tourism indicators, the modelling process and results (section 3), and finally, the main conclusions (section 5).

2. Effects of tourism on HSR demand: Spanish case study

This section shows briefly the methodology used previously by authors (Guirao and Campa, 2015) to assess the impact of tourism on HSR demand. This methodology was based on some improvements of a model designed by Hagler and Todorovich in 2009. The original equation (see equation 1 without tourism variables) provided a theoretical ranking of pairs O-D. The model was validated in 2014 in Spain, by comparing these results with the ranking derived from the current HSR network operation (Ministerio de Fomento, 2013). This ranking was obtained by recording traffic in each city pair with a HSR link, and only considering pairs in the top 50 theoretical ranking. Real Traffic can be seen to decrease progressively down the theoretical modelled ranking (Table 1), and Madrid-Barcelona continues to be the top origin-destination pair with more than 2.5 million passengers. In general terms, the results can be assumed to be consistent with recorded traffic. Table 2 gives an explanation of the meaning of the variables used by Hagler and Todorovich in this equation, and the values assigned to each variable by the authors can be found in the same paper (Hagler and Todorovich, 2009).Deficiencies found, through a sensibility study of the variables used (Guirao and Campa, 2014), included, among others problems, that tourism was one of the missing factors affecting the ranking.

The type of tourism variable needed in the model was relatively dependent on the availability of a tourism database in each country. The ranking model structure required a variable that represents the tourism value of each city considered in our research (at the provincial capital level) and –as tourism is a compound product– one that should consider both the attraction capacity exerted by the city's offering of leisure and business tourism products, along with the urban environment and local life.

Table 1. Long-distance HSR traffic for the only city pairs in operation in the top 50 in 2011. Source: Ministerio de Fomento, 2013.

Origin	Destination	Theoretical Ranking position	Distance (km)	Year service opened	HSR Travel time (min)	Passengers 2011	Passengers 2013
Madrid	Barcelona	1	621	2008	150	2,545,907	3,070,184
Madrid	Valencia	2	391	2010	100	1,836,500	1,858,436
Madrid	Seville	4	471	1992	150	2,137,026	2,175,808
Madrid	Zaragoza	6	306	2003	75	1,175,053	1,176,841
Madrid	Malaga	9	513	2007	150	1,433,361	1,533,363
Barcelona	Zaragoza	10	260	2008	90	600,511	623,555
Madrid	Cordoba	34	345	1992	105	800,679	757,673
Madrid	Valladolid	25	180	2007	56	1,083,590	1,212,632
Madrid	Lérida	35	442	2003	125	238,754	231,582
Madrid	Tarragona	39	521	2006	150	294,702	300,918
Madrid	Albacete	41	322	2010	90	248,992	238,495
Seville	Malaga	50	270	2008	110	104,317	96,480

In Spain, the most comprehensive study on the tourism competiveness of Spanish cities is UrbanTUR 2012 (Exceltur, 2013). This document is the first to show the 20 most important Spanish urban destinations, obtained by assessing 57 city indicators classified into six categories: attraction capacity offered by leisure products, attraction capacity offered by business tourism products, competitive conditions offered by the urban environment and local life accessibility and mobility, administration and strategic management, economic and social results.

Table 2. Variables of the prioritization model (Hagler and Todorovich, 2009).

Variable	Meaning
CR	Commuter Rail at Origin City
CR_1	Commuter Rail at Destination City
LR	Light Rail at Origin City
LR_1	Light Rail at Destination City
S_LR_Len_I	Origin City Light Rail System Mileage
E_HR_Len_I	Destination City Light Rail System Mileage
HRT	Heavy Rail Transit Origin City
HRT_1	Heavy Rail Transit Destination City
S_HR_Len_I	Origin City Heavy Rail System Mileage
E_HR_Len_I	Destination City Heavy Rail System Mileage
Met_Pop	Metropolitan Area Population of Origin City
Met_Pop_1	Metropolitan Area Population of Destination City
Metro_Main	Is the origin city the largest in the metropolitan area?
Metro_Ma_1	Is the destination city the largest in the metropolitan area?
City_pop	Population Origin City
City_pop_1	Population Destination City
Mega	Is the origin city located in a megaregion?
Mega_1	Is the destination city located in a megaregion?
C_Length	Corridor Length (miles)
C_GDP_Scal	Geometric mean of per capita GDP of the two metro regions (dollars)
TTI_IND	Combined TTI index of the two cities in city pair

Table 3 shows the final ranking obtained for the 20 previously selected cities based on the scores for each category in each city. One of the drawbacks of the UrbanTUR study is that it only considers 20 Spanish cities, two of which are not provincial capitals (Santiago de Compostela and Gijón). Our prioritization model worked with Spanish provinces and our aim was to assign a tourist score to each city in the model database. Gijón was not a problem, as it was included in the original model database from the start, and both cities in the province (Gijón and Oviedo, the provincial capital) are part of the UrbanTUR ranking. Another important issue to discuss is the weight given the tourism variable to be added to the model and the values assigned to it. In the sensitivity study conducted for the initial model, Guirao and Campa (2014b) calculated the percentage of influence of each variable on the RI (Ranking Index) and on the maximum score for each block of variables (population, transit or combined variables). They reported that population variables can account for up to 70% of the RI value, while transit variables and combined variables (length, combined GDP and combined congestion) account for only 18%, and 12% of the total RI respectively. From this point of view, the level of influence of the combined variables is very low, and their evident insignificance does not seriously affect the final results. However the population variables have an excessive and even redundant influence on the results if we consider the marked relationship of dependence between the size of a population and the length of its transit network.

Table 3. UrbanTUR ranking for the 20 top urban Spanish destinations.

City	Ranking 2012	Score	Ciudad	Ranking 2012	Score
Barcelona	1	141.4	Salamanca	11	95.7
Madrid	2	139.1	Gijón	12	94.2
Valencia	3	111.0	Córdoba	13	93.9
Sevilla	4	104.3	La Coruña	14	92.4
San Sebastián	5	103.1	Alicante	15	91.9
Málaga	6	98.3	Santander	16	91.1
Bilbao	7	97.9	Toledo	17	90.8
S. de Compostela	8	97.3	Burgos	18	88.0
Zaragoza	9	96.6	Oviedo	19	86.4
Granada	10	95.9	León	20	85.7

In view of this, the tourism variable (T) has been given a weight of 10 in the model (see Equation 1) in order to balance the importance assigned to population variables. The maximum score for the tourism variable –3.0 (similar to the maximum score for the rest of the variables)– was assigned to Barcelona (see Table 3). The last city in the ranking –León– was assigned 1.0; and all other Spanish cities that do not appear in the UrbanTUR ranking were assigned a value of 0.0. Cities on the UrbanTUR list have been given a linear value between the maximum 2.0 and the minimum 1.0, according to their score in the UrbanTUR ranking.

Equation 1

$$\begin{aligned} RI = &(CR) + 0.5(LR) + 0.5(S\_LR\_Len\_I) + 0.5(HRT) + 0.5(S\_HR\_Len\_I) + (Met\_Pop) + +10(Metro\_Main) + (City\_pop) + \\ &(Mega) + 10(T) + (CR\_1) + 0.5(LR\_1) + 0.5(E\_LR\_Len\_I) + +0.5(HRT\_1) + 0.5(E\_HR\_Len\_I) + (Met\_Pop\_1) + \\ &10(Metro\_Ma\_1) + (City\_pop\_1) + +(Mega\_1) + 10(T\_1) + (C\_Length) + (G\_GDP\_Scal) + (TTI\_Ind) \end{aligned} \quad (1)$$

One of the deficiencies detected in the original model when applied to the Spanish case, was that corridors below 160 km. were ignored. This fact was important in case of the existence AVANT services (high frequency and low prices) in which commuter traffic can arise. The Spanish HSR experience shows that cities located within a 160 km radius of the centre of a major metropolitan area should be included in the database and appear in the ranking result. There are also a number of tourist cities in this situation (Toledo, Salamanca, Burgos or Segovia) and in order to consider them, corridors with lengths of below 160 km have been introduced in the model database, and their distance variable has been given the value of 0.0.

Table 4 shows the main results of the model after applying these changes to the original equation: the top 50 HSR city pairs in Spain according to the results obtained using a tourism variable and considering pairs O-D separated by less than 160 km. If we compare these results with current HSR network traffic (see Table 1), the tourism variable has clearly corrected some previous deficiencies, although the three top pairs remain the same: Madrid-Barcelona, Barcelona-Valencia, Madrid-Valencia. The fourth pair has changed. When the tourism variable is considered, Madrid-Bilbao is replaced by Madrid-Seville, as Seville has a higher tourism score than Barcelona in the UrbanTUR ranking. Madrid-Zaragoza goes from 6th to 11th position in the ranking, while Madrid-Málaga remains the same (9th position), and traffic validates this fact (Madrid-Malaga has higher HSR traffic than Madrid-Zaragoza). Other cities are clearly disadvantaged by the UrbanTUR study (like Vitoria or Murcia): pairs such as Madrid-Murcia, Barcelona-Murcia or Madrid-Vitoria are relegated from the top HSR ranking. Other cities like Toledo are included on the list for the first time, and traffic figures validate this inclusion. Madrid-Cordoba also improves its position in the ranking list, as do other cities like Santander and Burgos. As can be seen, this model explains the relationship between HSR and tourism more effectively: tourism is a positive HSR demand factor and should be taken into account. One of the determining factors for using this approach and extrapolating this methodology to other countries is the availability of a database on the tourism competitiveness of cities; even the Spanish UrbanTUR has its limitations, and only 20 Spanish cities are included in the study. This database does not allow the model to establish any differences between the cities outside this top ranking (like Segovia, Cuenca or Gerona), which are also attractive to tourists.

Table 4. Top 50 HSR city pairs (Rank 1) in Spain according to the results obtained using a tourism variable and considering O-D pairs separated by less than 160 km. Rank 0 results from applying the original model of Hagler and Todorovich (2009) without considering tourism variables.

Rank 1	Rank 0	City pair	RI	Rank 1	Rank 0	City Pair	RI
1	1	Madrid - Barcelona	106,31	26	99	Barcelona-Toledo	81,12
2	2	Barcelona- Valencia	97,21	27	NC	Madrid- Toledo	80,30
3	3	Madrid -Valencia	96,59	28	92	León – Barcelona	80,18
4	5	Madrid- Seville	92,95	29	23	Valencia – Bilbao	79,63
5	4	Madrid - Bilbao	91,32	30	20	Zaragoza - Valencia	79,47
6	7	Barcelona- Bilbao	90,73	31	54	Valencia - San Sebastián	78,59
7	17	Barcelona- San Sebastián	90,12	32	40	Valencia – Málaga	78,33
8	10	Barcelona- Zaragoza	89,91	33	44	Valencia - Alicante/Alacant	76,49
9	9	Madrid-Málaga	89,79	34	211	Oviedo - Madrid	75,97
10	16	Madrid- San Sebastián	89,79	35	50	Sevilla - Málaga	75,91
11	6	Madrid- Zaragoza	89,79	36	85	Valencia - Granada	75,31
12	11	Madrid- Gijón	88,07	37	84	Valencia - Salamanca	75,30
13	14	Barcelona - Alicante/Alacant	87,69	38	75	Gijón - Valencia	75,26
14	13	Madrid - Alicante/Alacant	87,28	39	89	Valencia - Córdoba	74,43
15	28	Madrid - Coruña, A	86,41	40	83	Valencia - Santander	74,06
16	18	Madrid- Santander	86,06	41	67	Valencia - Burgos	74,02
17	29	Madrid- Salamanca	85,94	42	51	Zaragoza - Bilbao	73,70
18	30	Madrid - Granada	85,85	43	113	Valencia - Toledo	72,49
19	34	Madrid - Córdoba	85,14	44	105	Sevilla - Granada	72,23
20	37	Barcelona- Santander	84,87	45	104	Zaragoza -San Sebastián	72,17
21	24	Madrid - Burgos	84,52	46	90	Sevilla - Alicante/Alacant	72,09
22	38	Burgos - Barcelona	83,92	47	110	Sevilla - Salamanca	72,00
23	74	Salamanca - Barcelona	83,91	48	72	Gijón - Bilbao	71,97
24	43	Madrid - León	82,43	49	NC	San Sebastián - Bilbao	71,70
25	27	Valencia- Seville	81,14	50	114	Gijón - Sevilla	71,55

Returning to the specific case of Toledo, the authors wish to highlight some other considerations. The high traffic in Toledo is due mainly to a mix of commuting and tourism, but the commuting variable is not considered by the current model equation. Over 60% of the demand between Madrid and Toledo is from commuters and not tourists, and there are also other important HSR commuter links with high traffic such as Madrid-Valladolid or Madrid-Ciudad Real. As a line of future research, the authors consider it necessary to introduce a commuting variable in the model (for cities less than 200 km from major metropolitan areas). This variable will help separate two types of travel demand in the model: tourism and commuting. However, the improvements to the model are evident; it has been empirically demonstrated that tourism conditions HSR demand, and that the implications for tourism should be studied in detail and at the local level. In the next section, we will check "the opposite effect", whether tourism demand at destinations is directly affected by the arrival of a HSR line.

3. Effects of HSR on tourism: Spanish case study

According to the previous econometric modelling experience of Chen and Haynes (2012), we have worked on the model structure defined by Equation 1 (Eq. 1) applied to Spanish provincial level, where $Y_{i,t}$ represents the three dependent variables, and $X_{i,t}$ represents the independent variables. The selection and definition of variables have been conditioned by the Spanish data base and their time period availability. Three tourism demand variables have been selected as independent variables: the number of travelers with Spanish residency staying for at least one overnight in a hotel establishment (*TRAV_ESP*), number of travelers with foreign residency who stay for at least one overnight in a hotel establishment (*TRAV_FOR*), and finally the average number of days that travelers stay at the hotel establishment (*OVERNIGHT*).

Equation 2

$$Y_{i,t} = \beta_{0,t} + \beta_{1,t} \times X_{1,t} + \beta_{2,t} \times X_{2,t} + \beta_{3,t} \times X_{3,t} + ... + \beta_{n,t} \times X_{n,t} + U_{i,t} \quad (2)$$

The error Ui,t is the sum of the unobserved province-specific effects and the white noise error term. This model has been also applied in differences (in addition to the conventional model). Where the correlation coefficient is higher than 0,75, the existence of spurious relations is assumed and the results of the model on difference should be considered. Finally, F-test has been applied to verify the general significance of the models. Given that tourism is highly dependent on the destination's characteristics the analysis is selected at provincial level, on 13 provinces connected to the HSR network between 2003 and 2010. The main reason for this choice has been the availability of data, drawn from the Spanish "Encuesta de ocupación hotelera" (Hotel Occupany Survey, see www.ine.es) for the period 1999-2012.

On Figure 2 below, the situation of the selected provinces and the HSR lines is displayed. According to the Spanish IET (Institute for Tourist Studies), the main origin countries for foreign travelers are the European ones, with United Kingdom, Germany and France providing more than one half of the total; the main destinations are the Canary and the Balearic Islands (32,5% of the trips), followed by Cataluña (25,1%) and Andalucía (13,2%). We can observe that "sun and beach" are the most demanded destinations. Domestic travelers represent 53% of the whole trips, being their main destinations Andalucía, Cataluña and Castilla y León (representing 18.2%, 15.0% and 11.6% of the travels). The main origin regions are Comunidad de Madrid, Cataluña and Andalucía, (with 17.9%, 16.1% and 16.0% of the trips respectively).

The dependent variables are chosen to cover the main facts that explain the affluence of travelers, according to the revised literature: the willingness of the travellers to start a new trip, the profile of the trip and the characterization of the destination. In relation to the first one (generation variables), we have considered: the mean per capita income of spanish population measured in current euros (PIB_CAP_ESP), difference between European and Spanish average per capita income (DIF_PIB_CAP) and stand for the accumulative CPI inflation in Spain (IPC_ACUM). In relation to the profile of the trip, as we tried to analyze HSR impacts on tourism, two dummy variables have been selected: AVE_1 and AVE_2 take the value 1 since the year with HSR avaliable on destination and zero otherwise. Two variables are used when there are sucesives conections to HSR lines in 2 different years. Finally, associated to destination profile, four variables have been considered. As most of the destinies ar sun and beach ones, weather should influence travel patterns, specially the short duration ones, in wich HSR is most relevant. PRECIP is the yearly rainfall mesured in mm at destination and has been included as variable in the model. POLITICS evaluates the change of attractiveness of the Spanish destinations due to political happenings, such as the arab spring, that has impacted some of the Mediterranean touristical competitor countries. This is a dummy variable that takes value 1since the year it emerged, in 2011, and 0 in the rest of the cases. EVENTO dummy variable that takes a value 1 the year when a relevant event that may affect the number of visitors on destination has taken place. Three events have been considered: ExpoZaragoza 2008 for Zaragoza, Las Edades del hombre(Ages of Man Exhibition) for Segovia and the America's Cup for Valencia. AIR_MD and AIR BCN are dummy variables that control simultaneous infrastructure policies and private initiatives within the transportation sector that can influence tourism outcomes and misleading the effects of the HSR openings. The enlargements of the two main hub airports, in Madrid (2004) and Barcelona (2006) have been also considered.

In all the cases, models are significant according to the F-tests, except for the province of Cuenca for foreign travelers and overnight stays variables. Given that for this province national travelers are 89% of the total, the loss of these outputs should not be relevant. The estimations results are summarized as follows:

For domestic travelers, the only provinces where there seems to be a relation between HSR and the number of tourist are Guadalajara (p-value equal to 10,7%) and Cuenca, being Guadalajara in the opposite of the expected sign. These are small cities with few previous travelers (both are low populated and have a low ratio tourist/population) what make small variations in the number of visitors show up to be relevant. The case of Tarragona shows that it is the second HSR link with Barcelona that has drawn existing travelers. Of all these three provinces, only Cuenca has increased in number of visitors. The sign of the AVE_1 coefficient is also negative for most of the provinces offering cultural tourism. This could indicate that HSR provides the possibility to visit the destination and return to the departure cities in 1 day trips, the overnights are likely reduced. Sun and beach destinations do not suffer any impact due to their connection with Madrid, probably due to their longer stays and the higher distances to reach them, what makes HSR less attractive compared with private cars or airplanes. No general conclusions from the location of the HSR station at destination can be drawn, but it must be remarked that having both Tarragona and Guadalajara their stations placed far from the main touristic spots, while Cuenca station is in the city centre, the positive sign of the AVE_1 coefficient of Cuenca and the negative of Tarragona and Guadalajara might confirm the existing researches suggesting that peripheral station discourage travelers from using HSR.

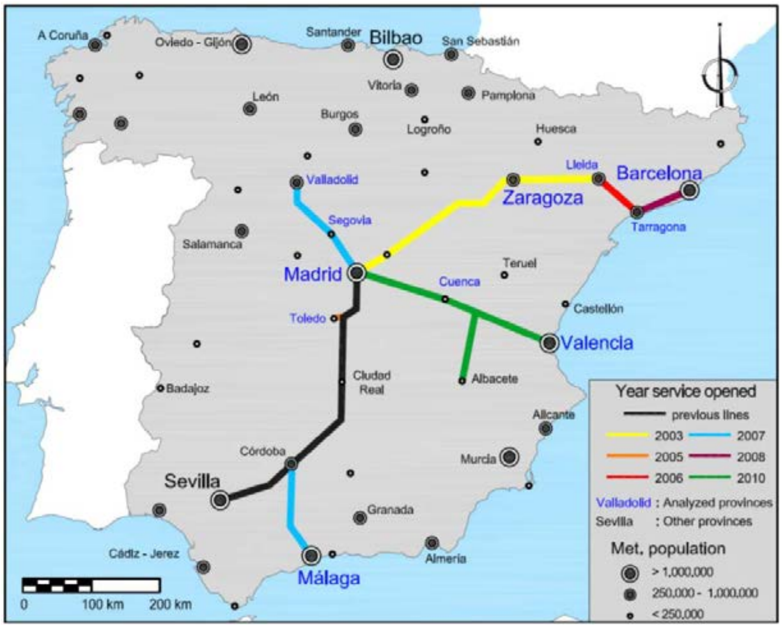

Fig. 1. HSR lines and the provinces analyzed.

For foreign travelers, there is no evidence of the influence of the new HSR connections on the number of travelers received in any of the provinces. This finding is explained by the fact that their preferred destinations are coastal ones (the share of domestic tourists is higher than 70% on all the cases except for Tarragona, Barcelona, Valencia, Malaga and Madrid), and far from their countries of origin. Therefore, the presence of HSR does not provide any advantage in terms of time or money saving in comparison with the airplane.

There is no evidence of the influence of the new HSR connections on the overnight stays on any province. Other noteworthy findings from this research are as follows: For national tourists, the income power does affect to the number of travelers, but only for small cities (Segovia, Guadalajara and Cuenca). These provinces with the least average overnight are the most likely to receive weekend tourists, and are highly affected by the economy of the travelers. Surprisingly, there is a positive impact in some provinces due to the construction of the T4 terminal at the Madrid-Barajas airport. This may indicate that the possibility of new cheap air trips through this airport may have caused an increase in the number of visitors to other Spanish provinces. For foreign tourists, a strong relation for many destinations is observed between their income level and the number of travelers received, which is quite revealing for the cases of Madrid and Barcelona.

The sign is negative, what might indicate that our country is as a destination chosen when other more expensive are ruled out. The political conflicts in other Mediterranean countries have also affected positively the number of visitors in Madrid and Barcelona (where the percentage of foreign tourist is higher).

The inauguration of the T4 terminal in Madrid has negatively affected by the number of overstays in Tarragona and Valencia, although it has caused an increase in domestic visitors. This may indicate that more travels have been generated, and the average duration has been reduced consequently.

INDEP. VARIABLE: TRAV_ES. INCREMENTAL MODELS

	Madrid	Segovia	Valladolid	Guadalajara	Toledo	**Zarazoza**	**Lleida**	Tarragona	Barcelona	Cuenca	**Albacete**	Valencia	Málaga
						c	c				c		
F-TEST													
PIB_CAP_ESP	3,10E-02	3,59E+01	1,45E+00	2,82E+01	1,74E+01	-1,90E+01	-4,19E+00	-5,90E+01	-5,62E+01	4,76E+01	4,16E+01	7,40E+01	5,18E+01
	(95,4%)	(7,8%)	(19,8%)	(9,7%)	(28,4%)	(68,3%)	(89,7%)	(22,0%)	(45,4%)	(1,9%)	(3,6%)	(77,0%)	(81,7%)
IPC_ACUM	6,97E+05	-3,35E+05	2,79E-02	2,19E+06	1,19E+07	-1,22E+07	3,71E+06	-1,11E+08	1,24E+07	-5,84E+05	1,13E+07	-1,14E+08	-9,32E+07
	(95,1%)	(63,8%)	(97,9%)	(85,2%)	(38,4%)	(84,8%)	(92,7%)	(5,4%)	(86,3%)	(95,7%)	(24,4%)	(42,1%)	(56,6%)
PRECIP	-6,94E+02	6,97E+01	4,37E-01	3,29E+01	-8,35E-01	2,15E+02	-3,68E+02	-2,00E+02	4,73E+02	-1,18E+02	-6,82E+01	1,67E+01	-1,49E+02
	(88,6%)	(46,1%)	(67,7%)	(44,3%)	(99,0%)	(37,6%)	(59,4%)	(19,2%)	(8,3%)	(9,5%)	(11,1%)	(97,2%)	(72,4%)
AVE_1	-1,58E+02	-1,41E+04	-8,87E-01	-3,62E+04	4,09E+04	-2,23E+04	8,83E+04	-4,25E+04	9,98E+04	9,51E+04	9,08E+04	1,30E+05	-1,06E+04
	(86,7%)	(64,5%)	(40,9%)	(10,7%)	(16,0%)	(83,3%)	(56,8%)	(54,3%)	(42,0%)	(1,9%)	(1,8%)	(65,8%)	(95,9%)
AVE_2						-1,16E+05	1,37E+05	-1,44E+05					
						(39,0%)	(47,0%)	(6,7%)					
EVENTO		-9,11E+03				2,40E+05						1,30E+05	
		(72,2%)				(5,7%)						(43,8%)	
POLITICS	9,66E+03	3,32E+04	6,24E-01	2,39E+04	-1,98E+04	-1,96E+04	1,11E+04	-5,14E+04	-2,59E+05	-5,51E+03	-5,59E+03	-6,39E+03	-1,33E+05
	(98,7%)	(34,4%)	(55,6%)	(33,8%)	(52,9%)	(79,2%)	(86,6%)	(40,8%)	(7,4%)	(82,0%)	(78,9%)	(97,5%)	(78,4%)
AIR_MD	7,09E+05	7,61E+03	5,77E-01	3,23E+04	0,00E+00	3,31E+04	4,48E+04	1,32E+05	4,22E+05	1,87E+04	3,08E+03	2,93E+05	3,36E+05
	(15,7%)	(86,1%)	(58,5%)	(7,5%)	(94,2%)	(65,3%)	(39,7%)	(7,4%)	(1,7%)	(29,3%)	(83,4%)	(11,5%)	(18,1%)
AIR_BCN						4,04E+04	1,16E+04	7,31E+04	2,26E+05	3,16E+04	7,29E+03	4,47E+04	-1,11E+04
						(63,5%)	(91,3%)	(30,8%)	(11,4%)	(14,3%)	(62,2%)	(85,2%)	(95,8%)

For each province, two values are given. The first is the coeficient and the one in parenthesis, the p-value.
The value "*" in the F-test row indicate that the model is not significative at 1% significance level
The models in bold letters are the ones in which the correlation coefficient less than 0,75, meaning that no expureous relations variables are found

INDEP. VARIABLE: TRAV_FOR. INCREMENTAL MODELS

	Madrid	**Segovia**	Valladolid	Guadalajara	Toledo	Zarazoza	**Lleida**	Tarragona	Barcelona	**Cuenca**	**Albacete**	Valencia	Málaga
F-TEST													
DIF_PIB_CAP	-8,67E+02	-1,36E+01	-1,70E+01	6,12E+00	-1,21E+01	-3,28E+01	-8,91E+00	-3,08E+00	-1,19E+03	-2,01E+01	-3,98E+00	1,14E+03	-1,09E+02
	(9,5%)	(41,2%)	(26,8%)	(51,8%)	(44,9%)	(7,4%)	(66,0%)	(98,5%)	(3,9%)	(4,7%)	(58,2%)	(21,3%)	(79,8%)
IPC_ACUM	-6,17E+06	-3,21E+05	3,96E+04	-1,59E+06	8,38E+06	2,63E+07	6,76E+06	3,70E+07	4,05E+08	1,02E+07	2,89E+05	-4,29E+08	3,79E+07
	(45,5%)	(39,7%)	(56,0%)	(63,7%)	(24,4%)	(3,6%)	(55,0%)	(62,1%)	(3,0%)	(3,9%)	(91,9%)	(24,9%)	(83,1%)
PRECIP	2,20E+03	1,68E+01	-8,53E+00	1,30E+01	4,58E+01	5,75E+01	6,82E+01	3,10E+02	-2,89E+01	1,02E+01	7,26E+00	8,96E+02	-1,65E+02
	(45,8%)	(65,6%)	(71,0%)	(30,9%)	(19,1%)	(13,0%)	(72,9%)	(28,6%)	(96,5%)	(50,2%)	(37,1%)	(19,0%)	(66,2%)
AVE_1	-1,71E+02	9,39E+02	6,12E+03	-2,45E+03	5,17E+03	1,62E+04	-2,62E+04	-1,39E+05	2,37E+05	-1,29E+04	2,03E+03	1,05E+06	3,70E+04
	(84,3%)	(93,8%)	(58,5%)	(72,6%)	(67,0%)	(27,0%)	(54,1%)	(26,8%)	(32,0%)	(15,2%)	(75,3%)	(20,5%)	(89,8%)
AVE_2						-1,50E+04	-2,31E+04	-2,18E+04					
						(39,6%)	(65,0%)	(85,7%)					
EVENTO		-7,18E+03				5,24E+04						-9,42E+04	
		(49,5%)				(1,4%)						(43,0%)	
POLITICS	8,74E+05	2,53E+04	1,24E+04	-7,64E+02	3,67E+04	1,62E+04	4,25E+03	6,43E+04	1,22E+06	1,21E+04	4,01E+03	-5,50E+05	1,84E+05
	(8,3%)	(12,3%)	(37,2%)	(90,8%)	(2,5%)	(24,8%)	(85,6%)	(67,0%)	(1,8%)	(14,8%)	(50,5%)	(20,8%)	(64,9%)
AIR_MD	4,02E+05	9,57E+03	2,04E+03	5,51E+03	0,00E+00	1,63E+04	1,08E+03	2,06E+05	5,87E+05	-3,43E+03	2,60E+03	4,03E+05	3,74E+05
	(31,6%)	(55,6%)	(86,6%)	(32,6%)	(79,3%)	(15,9%)	(93,6%)	(13,1%)	(8,7%)	(46,6%)	(43,8%)	(9,9%)	(22,8%)
AIR_BCN						8,37E+03	1,62E+04	9,38E+04	2,63E+04	1,58E+03	1,83E+03	5,00E+05	-1,67E+05
						(46,3%)	(59,8%)	(50,1%)	(92,3%)	(73,1%)	(55,2%)	(22,5%)	(57,5%)

For each province, two values are given. The first is the coeficient and the one in parenthesis, the p-value.
The value "*" in the F-test row indicate that the model is not significative at 1% significance level
The models in bold letters are the ones in which the correlation coefficient less than 0,75, meaning that no expureous relations variables are found

INDEP. VARIABLE: OVERNIGHT. INCREMENTAL MODELS

	Madrid	Segovia	Valladolid	Guadalajara	Toledo	**Zarazoza**	Lleida	Tarragona	Barcelona	**Cuenca**	**Albacete**	**Valencia**	Málaga
F-TEST										*			
DIF_PIB_CAP	-2,77E-05	-1,44E-04	-1,88E-05	8,78E-08	-1,01E-04	2,86E-05	1,04E-04	-1,39E-04	4,42E-06	-6,28E-05	-2,83E-04	-5,37E-04	2,42E-04
	(78,5%)	(23,4%)	(87,1%)	(99,9%)	(13,8%)	(69,3%)	(49,5%)	(38,2%)	(99,2%)	(15,6%)	(49,7%)	(26,0%)	(42,7%)
PIB_CAP_ESP	-2,46E-08	2,27E-05	4,11E-05	-5,72E-05	4,03E-05	5,74E-05	1,97E-05	1,15E-04	7,78E-05	9,19E-05	9,23E-05	1,59E-04	-1,25E-04
	(80,2%)	(58,1%)	(50,1%)	(33,9%)	(20,0%)	(14,8%)	(75,6%)	(21,1%)	(55,6%)	(0,4%)	(58,5%)	(16,3%)	(56,7%)
IPC_ACUM	-5,07E-01	-3,05E+00	9,94E-01	-5,31E+01	9,59E+00	6,39E+01	-2,41E+01	1,72E+02	1,52E+02	3,40E+01	7,03E+01	3,04E+02	-4,17E+01
	(80,7%)	(26,3%)	(14,9%)	(24,6%)	(75,4%)	(24,3%)	(77,5%)	(12,0%)	(30,7%)	(6,3%)	(55,8%)	(16,3%)	(80,3%)
PRECIP	-6,86E-04	-1,64E-04	2,68E-05	-2,52E-04	9,15E-05	3,57E-04	-2,50E-04	2,73E-04	2,80E-04	1,92E-05	9,77E-05	-3,94E-04	-3,95E-05
	(44,2%)	(58,0%)	(88,6%)	(22,7%)	(50,1%)	(4,2%)	(83,6%)	(28,0%)	(62,6%)	(71,1%)	(76,2%)	(30,0%)	(92,4%)
AVE_1	-1,42E-04	6,75E-02	-1,02E-01	5,59E-02	-1,49E-02	1,14E-02	5,50E-02	-2,05E-03	-8,96E-02	-1,61E-02	-1,51E-01	-3,25E-01	8,22E-02
	(49,3%)	(46,5%)	(25,8%)	(54,3%)	(76,3%)	(85,5%)	(80,2%)	(98,6%)	(56,3%)	(75,9%)	(77,6%)	(42,8%)	(68,7%)
AVE_2						-6,90E-03	-2,91E-02	1,44E-01					
						(91,9%)	(92,3%)	(22,3%)					
EVENTO		-4,54E-04				9,50E-02						1,34E-02	
		(99,5%)				(10,9%)						(83,9%)	
POLITICS	-1,22E-02	4,49E-02	-5,57E-02	-3,75E-01	5,56E-02	-3,84E-02	-1,19E-01	2,29E-01	1,96E-01	3,46E-03	2,20E-01	2,60E-01	-2,44E-01
	(91,5%)	(65,0%)	(64,5%)	(0,6%)	(38,4%)	(59,5%)	(52,8%)	(17,3%)	(59,0%)	(89,3%)	(36,9%)	(26,9%)	(60,9%)
AIR_MD	4,64E-02	3,30E-02	-9,73E-02	2,85E-02	0,00E+00	-5,06E-02	-6,58E-02	-6,43E-01	9,02E-02	-4,81E-02	-1,44E-01	-4,17E-01	-3,68E-01
	(58,3%)	(78,7%)	(34,4%)	(62,1%)	(9454,0%)	(26,5%)	(36,6%)	(0,6%)	(71,0%)	(3,5%)	(29,1%)	(2,2%)	(14,8%)
AIR_BCN							1,42E-02	-3,80E-01	-1,68E-03	-3,38E-03	-1,11E-01	-3,50E-01	-2,57E-02
							(93,7%)	(3,5%)	(99,4%)	(82,1%)	(38,1%)	(15,2%)	(90,0%)

For each province, two values are given. The first is the coeficient and the one in parenthesis, the p-value.
The value "*" in the F-test row indicate that the model is not significative at 1% significance level
The models in bold letters are the ones in which the correlation coefficient less than 0,75, meaning that no expureous relations variables are found

Fig. 2. Results from the model in differences.

4. Conclusions

For a long time, researchers have argued about the influence of the HSR systems on the development of the tourism sector. Existing literature on the cross effects between HSR and tourism is scarce, with heterogeneous methodologies and does not show a common pattern suitable for all the countries. Apart from the economic geography models and the choice destination approach, the econometric models have rarely been applied until now to analyse the impact of HSR on tourism. While the positive impact of tourism on HSR demand has been demonstrated in Spain, the opposite effect is controversial. This paper provides for the first time empirical evidence from a wide range of results on whether the Spanish a statistical significant influence on its tourism industry, by applying an econometric model on 13 different Spanish provinces. The results reveal that there is not a direct positive impact for the destinations analyzed. Nevertheless, it must be highlighted that the only tourist indicators used are linked to the stay at hotels. Due to the lack of other national data, like the number of visitors staying in apartments or in second residences, which have not been taken into account by the model, results should be interpreted with caution. Their consideration as well as to deepen in the understanding of the existing impacts should be subject to further research with a new and ad-hoc data base elaboration. Revenues from restaurants, museums and tourism- related commerce (like business tourism indicators) should also be taken into account.

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