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Research article

Transport prices, touristic flow and policy: the case of the high-speed-railway in Andalusia (Spain)

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Abstract: The Spanish high-speed train, known as AVE, has been the commitment in Spain's transport infrastructure for the past 25 years. Along the first twenty years of use, however, the use of this means of transport has presented some figures of utilization well below than anticipated, and very far from other countries'—such as Japan or France—figures. In this work, through descriptive and econometric analysis, we demonstrate how certain political decisions, based on the pricing model mainly, have managed to change the trend and maintain a stable growth process in the number of passengers, favouring tourist flows in a country very dependent on tourism such as Spain.

Keywords: demand; high-speed railway; political economics; pricing policies; transport

JEL Codes: L92, Q5, R11, R4

1. Introduction

The high-speed railway (HSR) in Spain began to run forty-eight years ago connecting Seville with Madrid throughout Córdoba; fifteen years later the corridor Madrid-Malaga was launched. These routes are known as the "Southern Route". Additionally, two more corridors were planned: Seville-Antequera-Malaga and Seville-Malaga-Granada-Almeria which is known as the *Transversal Axis*, as it links many branch lines that run from Seville to Huelva, with two lines derived to the port of Algeciras and the City of

Cadiz. However, they were delayed and postponed afterwards because of budget difficulties due to the economic crisis. Nowadays, Seville—the proper capital of the region—and Málaga—as the principal city in Andalusia in terms of tourism and economy—are connected throughout Cordoba using AVANT trains running on high-speed railways.

From a social and political view, the promotion of the Spanish high-speed railway network, commonly known as AVE, has been continuous. Moreover, its development potential as a boost for the productive output of the region, as well as its relevance as an element of territorial cohesion (Zhao & Liu, 2020), has been widely emphasised. In this sense, the role of tourism as a well-integrated element in the regional economic system (Ferrari et al., 2018; Huang et al., 2021; Ceballos-Santamaría et al., 2021) has been largely promoted too, but Spain focused studies are scarce. Also, its implementation has been publicised as a way for Spanish companies to lead the railway technology in a global dimension. Nevertheless, as Sánchez-Ollero et al. (2014b) noted, *"scientific studies do not accept those premises and point out the existence of dissonances between the high need for funds and the necessity for the project to be useful no previous cost-benefit analysis, the scarce use of this type of train, the insufficient saving in transport times, the unclear impact on the economic development and the territorial cohesion, among other reasons*".

Unfortunately, in recent years in Spain, investments made in public infrastructure have been more motivated by political interests than by technical criteria, the design of the high-speed train network probably being one of its greatest exponents in this regard. Concurrently to railway investments, huge investments were made in high-performance roads and port infrastructures to improve the cruise industry. At the same time, backdoor subsidies to certain transport operations—such as low-cost carriers—have drawn a scenario of public interventionism in an apparently free and competitive market.

The aim of this paper is to analyse whether or not such state intervention has had any effect on the flow of passenger transport, considering the number of passengers, the choice of the destinations and the means of transport. Therefore, the following analysis is focused on transportation from and to Andalusia while connected to Madrid, which is the centre of the current radial transport system in Spain.

This piece of work follows the next structure. Starting with this brief introduction, it follows describing the theoretical framework as it reviews the extant literature. Section 3 summarises the main problems in relation to the need for funds and benefits from Andalusian high-speed railway. Then, in the fourth section, the elements that might have a larger impact on the Andalusian tourism sector are discussed. Finally, Section 5 contains some conclusions derived from this work.

2. Review of the literature

2.1. The high-speed railway infrastructure in Spain

The role of the public infrastructures in the economy has been a topic widely studied by academics since their consideration as a productive factor—or not—have consequences for their study, so that assumption needs to be verified. If they are considered as such, it must also be studied if it is possible to quantify the possible consequences on the economy. For the Spanish context, related studies have shown four issues: 1) in Spain, the impact on a macroeconomic concept of the investments in infrastructures are larger than in nearby countries; 2) however, since the results show a wide range of radically different outcomes, an agreement on the scale of such an impact is not found; 3) at a regional scale, the analysis carried out reveals that exists a direct and positive relationship between the level of

productive private capital in a region with the economics return from the investments on public infrastructures in that region; 4) and the latest studies show that these positive effects are likely to decrease steadily over time.

The investments on high-speed railways have been studied for many researchers for the case of Spain and other countries (Kravchenko et al., 2020). How such investments impact on high-speed trains has been analysed from different standpoints, and so the main topics of the studies and their results are affected. In empirical studies, the most expressed opinion considering the reasons to invest in high-speed railway and not to do it or not doing adequately in other transportation means, and to invest more in some routes than in others, undoubtedly uncovers that benefits and profitability have been put aside while prevailing political decisions. In this same result, multiple authors, who have studied the implementation of the high-speed train in Spain, have come to agree on the inaccuracy and overvaluation of investment returns, as well as the undervaluation of costs (Campos et al., 2009).

Synthetizing selected works classified by their main topic, we highlight the followings: Impact on the economy: (Bo & Ningqiao, 2018; Laird et al., 2005; Romero et al., 2018; Liu & Shi, 2019); economic profitability of specific railways: (De Rus & Román, 2006; Sánchez-Ollero et al., 2014b); effects on the territory and the environment: (Bellet & Alonso, 2016; Gavira-Narváez & Fernández, 2017; Gutiérrez, 2004; Gómez-Naranjo et al., 2020; Kageson, 2010; Li et al., 2019; Martínez, 2018; Yin et al., 2019b; Huang & Wang, 2020); by the effects on social welfare (Bracaglia et al., 2020, Gutiérrez-Gallego et al., 2015; Moyano et al., 2019; Yin, et al., 2019a); those which analysed disability and passengers movement: (Fröidh & Nelldal, 2008; Gómez-Naranjo et al., 2020; Jin et al., 2020; Liu & Shi, 2019; Martín & Nombela, 2008; Martín et al., 2004; Sustar et al., 2020); those other that analyse the effects on competitiveness between means of transport: (Abrate et al., 2016; Bergantino & Madio, 2020; González-Savignat, 2004; Muro-Rodríguez & Pérez-Jiménez, 2016; Román et al., 2014a; Román et al., 2014b).

Particularly important for the goals of our work, the effect on tourism have been analysed in (Albalate et al., 2017; Abrate et al., 2016; Albalate & Fageda, 2016; Campa et al., 2016; Campa et al., 2019; Cordente-Rodríguez et al., 2011; Ferrari et al., 2013a; Gómez-Naranjo et al., 2020; Hernández-Mogollón, 2011; Gao et al., 2019; Guirao & Campa, 2016; Gutiérrez et al., 2019; Gutiérrez et al., 2018; Hortelano et al., 2016; Jin et al., 2020; Li et al., 2019; Li et al., 2019; Liu & Shi, 2019; Moyano et al., 2019; Padilla et al., 2016; Saladié et al., 2018; Sun & Lin, 2018; Vázquez-Varela & Martínez-Navarro, 2016; Yang & Li, 2019; Yin et al., 2019b).

Nevertheless, researchers have not limited their studies to a general economic evaluation neither to an assessment of the profitability of specific corridors. Analysing further aspects related to the development of high-speed railways across certain territories, such as its social, environmental or spatial impacts, is becoming highly relevant to assess the effects of the extant corridors as well as to design the upcoming projects.

For the case of Spain, we highlight several relevant Spanish studies classified by geographical area or line: Spain, as country was analysed by: Albalate et al. (2017), Albalate & Fageda (2016), Campa et al. (2016), Gómez-Naranjo et al. (2020), Guirao & Campa (2016), Gutiérrez-Gallego et al. (2015), Hortelano et al. (2016), Martínez (2018), Moyano et al. (2019) and Romero et al. (2018), and for the province of Alicante (Padilla et al., 2016); the region of Andalusia was analysed by Gavira-Narváez & Fernández (2017) and Sánchez-Ollero et al. (2014b) and the province of Cuenca (Vázquez-Varela & Martínez-Navarro, 2016); the region of Madrid, by Pagliara et al. (2015); the route in Madrid-Barcelona (De Rus & Román, 2006; Martín et al., 2004); the route Madrid-Zaragoza-Barcelona in (Román, 2008); the province of Tarragona or the Costa Daurada was studied in the works of Gutiérrez

et al. (2018), Gutiérrez et al. (2019); and Saladié et al. (2018)the city of Toledo in Muro-Rodríguez & Pérez-Jiménez (2016) and Vázquez-Varela & Martínez-Navarro (2016), and, finally, the city of Zaragoza in Bellet & Alonso (2016).

In consequence, it is quite revealing to break these studies down to draw up an overview of the studied areas in Spain. Such breakdown shows that half of the studies do not refer to a specific corridor or city, but the Spanish context in general. Besides, the great majority of the remaining half analyse the effects of the high-speed railway in a single destination but do not consider a whole corridor even though many of them refer to other cities several times along themselves. It occurs because they gather data that include tourists' point of departure, which necessarily involve corridors that connect the studied destination and the departure point cities. An example of this is Padilla et al. (2016) work, which is mainly focused on the high-speed railway passenger profile of a sun and beach tourist destination such as Alicante. Many trendy tourist segments such as cultural tourism (Ferrari et al., 2013b) are understudied in relation to the high-speed railway flows. However, it also reveals the existence of a stable corridor between Alicante and Madrid to which it refers several times as well as between other points in North Spain.

But, if the extant literature is limited to corridor-focused studies, there are just a couple of works De Rus & Román (2006) and Román (2008) that refer explicitly to them. Consequently, some conclusions might be drawn. In the first place, there is a lack of studies for those corridors or destinations which are not represented in the prior summary as other are underrepresented considering the importance of the regions such as Andalusia (Gavira-Narváez & Fernández, 2017 and Sánchez-Ollero et al., 2014b), what involves a poor understanding of the current situation of the Spanish high-speed railway network. Secondly, for those that are adequately studied, some studies might have missed out on the chance to get a deeper understanding of some corridors that may strongly influence the assessed city (Gutiérrez et al., 2018; Pagliara et al., 2015; Padilla et al., 2016; Saladié et al., 2018). Finally, despite most of the compiled studies revolve around discovering the relation—in the case it might exist—between high-speed railways and tourism development, clear conclusions have not been reached yet, even more considering the different positive (Gutiérrez et al., 2018; Saladié et al., 2018; Vázquez-Varela & Martínez-Navarro, 2016) and negative results (Albalate et al., 2017; Albalate & Fageda, 2016; Guirao & Campa, 2016).

2.2. The return on investment on high-speed railway in Spain

The amount of the investments needed in public transport infrastructures and its devaluation has been analysed for many authors as, for instance, (Givoni & Perl, 2020). The investment in high-speed railway in Spain is noteworthy: over 45,000 million Euros in 25 years, of which 31,414 million were invested in the decade 2008–2018. This investment effort has been financed in part thanks to European funds but, above all, it comes from Spanish state contributions and especially from the indebtedness of ADIF (Railway Infrastructure Administrator, the public company that manages railway infrastructures in Spain) that in 2018 had a liability of 18,000 million Euros. That trend continues by being planned to be invested 2,660 million Euros in 2019. However, compared to 2012 figures, investments in high-speed railways have dramatically decreased since the main corridors have almost been completed. As a result of this investment, at the beginning of 2020 over 3,400 kilometres of functioning high-speed railway tracks and more than 900 kilometres were planned to be built, but COVID-19 pandemic has slow-downed it.

In terms of cost per kilometres built, each line differs substantially. Madrid-Seville line cost about 9 million Euros per built kilometres, while Madrid-Malaga one cost around 13.5 million Euros per built kilometres (Sánchez-Ollero et al., 2014b). The cost of the line Antequera-Granada is about 1700 million Euros for 127.5 kilometres, that represent similar figures to the line Madrid-Malaga. This data coincides with the estimation of (Campos et al., 2009), which establish an approximate cost per kilometres in a range of 8–20 million Euros for the Spanish high-speed railway network.

Also, the high maintenance cost per year for the service to function properly must be considered. Likewise (Campos et al., 2009) approximated an average cost of 47,000 Euros per kilometre of single track for the maintenance of the infrastructure; on the other side, the former Government of Spain in 2002, estimated the yearly cost of maintenance per kilometre per year for "on the surface" and "tunnel" sections, being 139,000 Euros for the first one and the double for the latter.

In Andalusia, the Infrastructure Plan for Transport Sustainability in Andalusia contemplates a total investment for railway infrastructures of 61,710 million Euros from both national and regional funds, and an undefined amount of European funds in the period 2012–2024. Most of this investment is related to the high-speed railway infrastructure. The Southern Routes are fully operational with the recent inauguration in June 2019 of the line Antequera-Granada, which connects the latter to Madrid and Barcelona. The track Murcia-Almeria is under construction co-founded with European funds but the section between Almeria and Granada is still under study.

These figures show a constant in local policy in terms of transport connectivity, but also for the current and past state governments no matter their ideology: the high-speed train is the preferred option to join the territory. Nevertheless, it is appropriate to question if their decisions are being correct. Even though such data are objective and unquestionable, it is worth to gather additional information to estimate other aspects besides benefits, including environmental and financial costs in the creation and maintenance of the infrastructure. That is, if the expected social outcomes are larger than the social costs, then the investment is appropriate but, if reversed, it might be advisable to dedicate public money to other projects (De Rus, 2009).

In this sense, the European Commission(2014) considers lines with less than 9 million voyagers per year as unjustifiable and may only remain open under specific circumstances. De Rus (2009) obtained similar data for lines of 500 kilometres. Following these criteria and considering that the line which leads in total more passengers in Spain, the line Madrid-Barcelona, was utilised in 2018 for 4.2 million passengers, not a single high-speed railway line in Spain might be profitable. Moreover, despite the constant growth in terms of the number of passengers experienced by high-speed railway lines, they are still used by fewer passengers by far than conventional ones in medium-distance routes. Nevertheless, since 2011 such figures are reverted in favour of high-speed railway in long-distance routes, being almost twice in 2018. That may reveal that high-speed railway services are not competitive yet regarding medium distances and actions should be taken to turn these lines into profitable ones.

If a country has low-density railway traffic, and its costs are high and insensitive to the volume of the demand, the average price per traveller depends on the population density of the country. But the high-speed rail route that carries the most passengers per kilometres is the Madrid-Seville one, which counts 14,000 passengers. Comparison with other lines in the world seems impossible: the corridor which connects Cologne and Frankfurt, in Germany, transport over 51,000 travellers a year; in France, the TGV which connects Lyon with Paris transport approximately 60,000 travellers; and, in Japan, the line Tokyo-Osaka transports 235,000 travellers, which carries more passengers than the

whole Spanish high-speed railway network. Considering the above, no economic viability justification exists for the Spanish high-speed trains except for a few cases.

3. Methods

Although the role of the high-speed railway in Spain has been widely studied, when it comes to the data used, two main groups of studies are identified: those that use data from self-managed surveys limited to a city, and those that use governmental data from the National Institute of Statistics, RENFE (the railway operator) and ADIF (the infrastructure manager), which are public organisations.

Therefore, as the scope of this piece of work is to analyse the high-speed railway in Andalusia, which involves treating with more than a single city, governmental data is used. Also, it is noteworthy to mention that such governmental data are scarce and, when publicly available, presented in an aggregated way. In consequence, part of the originality of this study lies in the effort carried out by the authors to gather the regional data presented onwards, as well as suitably analysing such information, considering the difficulties that arise when working in these conditions at that territorial level (Mondéjar-Jiménez et al., 2007).

Moreover, a descriptive analysis is carried out by comparing the information related to the high-speed train with other means of transportation. Also, a widely known economic variable Spanish GDP per capita acts as a control variable to properly assess the figures that appear in this paper to study the evolution of high-speed railway. All the variables are studied for the 2009–2019 period, that is, the last decade and the latest available data, by analysing their variation rates along the period. Then, to check and, if applicable, quantify the associations between such variables, Yule's Coefficient of Association (1) (Yule, 1912) is calculated to measure the association between variables by quantifying the strength and direction of it.

$$Q = \frac{n_{11}n_{22} - n_{12}n_{21}}{n_{11}n_{22} + n_{12}n_{21}} \quad (1)$$

Additionally, to perform a more profound analysis of the association between variables, a multiple linear regression is proposed (2). This regression tries to verify whether the volume of travellers from Madrid to Seville or Malaga (Y_i) depend on a particular set of variables or not. Such variables, which combine tourist and economic ones, are the Spanish GDP per capita (X_1) -control variable also included in Table 1, the HSR long-distance travellers (X_2), the Spanish aeroplane travellers to Seville or Malaga (X_3) and the average stay in hotels in Seville or Malaga (X_4). The regression model used allows for an initial exploratory analysis of the data. However, for a more complete and comprehensive analysis, the longitudinal nature of the data and the time effects must be appropriately taken into account.

$$Y_i = \beta_0 + \beta_1 X_{1_i} + \beta_2 X_{2_i} + \beta_3 X_{3_i} + \beta_4 X_{4_i} + u_i \quad (2)$$

Finally, the concept of "generalised travelling cost" is applied to compare the different means of transport and their evolution in the period 2012–2019 (base year and latest year, respectively). Such concept is the homogenisation of the costs by considering not only the fares but also quantifying access times as displacements, security, and boarding times, following Sánchez-Ollero et al. (2014b) estimations.

4. Results and discussion: an analysis of the means of transport and tourists flows in Andalusia

For the region of Andalusia, tourism is the most important sector. Within the area of high-speed railway, two contrary elements may substantially influence its relevance for tourism. On the one hand, high-speed railway might potentially increase the flows of tourists throughout rising mobility. Conversely, such rise might promote travelling, but it also may reduce the demand of accommodation in some destinations, and it would influence too on visitor spending which is the key of profitability, but it does not seem to be a priori positive either negative.

Table 1. Voyagers on conventional train and high-speed railway in Spain, variation rates[1] and GDP per Capita (2009–2019). Data per thousand travellers.

Period	Total	Conventional Medium Distance	HSR Medium Distance	HSR Long Distance	Conventional Long Distance	GDP per capita (Spain)
2009	55,803	27,054	5,652	11,250	11,847	23,062
	(−1.31)	(−4.88)	(16.73)	(−1.84)	(0.44)	(−4.42)
2010	54,125	26,032	5,900	10,851	11,342	23,038
	(−3.01)	(−3.78)	(4.39)	(−3.55)	(−4.26)	(−0.10)
2011	55,767	26,866	6,070	12,536	10,296	22,761
	(3.03)	(3.20)	(2.88)	(15.53)	(−9.22)	(−1.20)
2012	54,264	25,872	6,044	12,101	10,248	22,048
	(−2.70)	(−3.70)	(−0.43)	(−3.47)	(−0.47)	(−3.13)
2013	56,387	24,264	6,526	14,697	10,900	21,899
	(3.91)	(−6.22)	(7.97)	(21.45)	(6.36)	(−0,68)
2014	59,640	23,713	6,251	17,967	11,709	22,218
	(5.77)	(−2.27)	(−4.21)	(22.25)	(7.42)	(1.46)
2015	61,453	23,946	6,699	19,428	11,381	23219
	(3.04)	(0.98)	(7.17)	(8.13)	(−2.80)	(4.51)
2016	62,449	23,319	7,309	20,352	11,470	23979
	(1.62)	(−2.62)	(9.11)	(4.76)	(0.78)	(3.27)
2017	64,231	23,674	7,653	21,108	11,797	24,969
	(2.85)	(1.52)	(4.71)	(3.71)	(2.85)	(4,13)
2018	66,505	24,215	8,654	21,332	12,304	25,727
	(3.54)	(2.29)	(13.08)	(1.06)	(4.30)	(3.04)
2019	67,771	24,299	8,931	22,370	12,171	26,438
	(1.90)	(0.35)	(3.20)	(4.87)	(−1.08)	(2.76)

Note: [1] Variation rates are in parenthesis. Source: Government of Spain (2020) and National Institute of Statistics (2020).

Generally, when estimating for high-speed railways, the success of the investment is measured by the number of passengers. In this sense, Table 1 shows a clear evolution of the volume of voyagers during the last decade. From it, some figures are worth to be highlighted. Firstly, during the 2008 economic crisis, there is a rise in high-speed railway travellers in the medium distance over the conventional medium-distance trains. Such an increase might seem remarkable only considering variation rates, but some context is required. As such period includes the first years of the high-speed

railway network, a growing tendency is usual. Also, regarding the number of voyagers, the differences between both types of conventional trains are narrowed.

On the other hand, the high-speed railway figures on the long-distance show a sharp rise from 2011 onwards. That corresponds with a range of improvements that RENFE applied, which are explained below. However, even though the conventional long-distance railway suffered the transfer of passengers, it continued steadily growing yearly.

But all those variations should be put into context. Consequently, an economic control variable is included in the prior table. The GDP per capita variations are expected to follow the economic cycle, as observed on its negative growth rates until 2014 when the 2008 crisis is usually considered to end. Then, it steadily grows. Such evolution matches with the conventional long-distance one, but it does not with the other types of railway transportation studied. Therefore, additional information is required to study this phenomenon, that is, a proper analysis of the impact on tourism of the high-speed railway must consider other equally important factors. On the first place, would tourist have gone to a destination in case high-speed railway did not exist? And, if so, how many of them would have gone? Then, does the tourist spending justify such investments? And, thirdly, which is the impact of other new and competitive means of transport, e.g., the low-cost carriers?

Table 2 and Figure 1 show the evolution of tourist arrivals to Andalusia and the fluctuations in the figures of the means of transport during the last decade (2009–2019). This period is selected as it contains the latest available data. Because of the economic crisis, all figures dropped, what is in line with the negative evolution of tourist arrivals to Andalusia between 2008–2010. Then, in 2011 and 2012, the traffic at Andalusian airports increased while passengers on high-speed trains continued decreasing.

Despite the economic crisis, these figures show that other reasons may justify the traveller's behaviour when deciding between the train or the plane as their mean of transport. Then, three important issues on this topic arise. In the first place, in January 2013, RENFE changed its old and fixed tariff system by a brand-new one based on yield management, which radically modified its sales scheme. Secondly, late in 2013, the Spanish economy started to recover from the previous years' recession, even steadily growing until COVID-19 arose. Thirdly, it must be considered the recent evolution of the establishment, development, and retreat of low-cost airlines in Spain, which irregular behaviour is at the base of some statistical deviations which are especially relevant for Seville's airport.

Delving into the first of the questions, and following (Sánchez-Ollero et al., 2014a), four main causes may justify the lack of use of the Spanish high-speed railway lines: 1) RENFE's commercial policy was to sell tickets just two months prior the date of departure, but tourists can buy plane tickets along the whole year. Consequently, travel agencies and tourists could not plan their vacations considering the train in it since transport tickets are usually purchased much in advance to get the lowest prices. 2) RENFE's pricing scheme was obsolete, not using modern online selling methods such as yield management is. 3) RENFE's sales network was isolated and not connected to the Global Distribution Systems so access to international markets was limited and 4) RENFE's train stations were not located inside airports. All these issues averted RENFE to sell transport tickets to a potential market of 82 million international tourists visiting Spain each year. RENFE's performance since February 2013 in points 1 and 3 has been crucial in the shift in focus of the railway demand. Since then, as (Hortelano et al., 2016) show, RENFE has been applying a new price policy, including reduced prices and discounts offers up to 70% and other online promotions. Consequently, since 2012, the average fare a traveller must pay has been reduced by 27.5%, 31.2% in the Andalusian lines considered. Nowadays, the railroad operator uses revenue management techniques, sells tickets through online intermediaries, has opened new long-distance lines and has introduced new tickets that

combine different means of transport (train-plane, train-bus and train-train). It also offers door-to-door luggage servicing, a new loyalty card incorporating free extra services, silent-train-wagons in all the routes, providing WIFI connection in all high-speed railway trains and some charter trains. In consequence of all these changes framed on its new operational plan, medium distance high-speed railway passengers have risen by 43.18% and 76.28% in the long distance in the period 2013–2018 (see Table 1), with a rate of trains occupation by 89.5%. Also, by 2018, up to 60% of all tickets were sold through the internet. Additionally, comparing 2012 and 2018 figures, high-speed rail passengers increased by 32.95% in the route Madrid-Seville and by 34.07% in the Madrid-Malaga one. In this period, the HSR gained over 1.12 million passengers just in these two routes. However, if 2019 data are taken into account, there is still a huge variation, but the pace slows down.

Table 2. Total tourist arrivals to Andalusia and voyagers by means of transportation (2009–2019). Data per thousand travellers and variation rates[1].

Period	Railway		Airplane		Tourist Arrivals (Andalusia)	
	Madrid-Seville	Madrid-Malaga	Malaga	Seville	Residents in Spain[2]	Foreigners
2009	2,391	1,500	11,571	4,038	13,862	8,064
	(−5.77)	(2.60)	(−9.27)	(−7.51)	(−9.99)	(−17.25)
2010	2,213	1,432	12,04	4,222	13,242	8,052
	(−7.43)	(−4.44)	(4.05)	(4.56)	(−4.48)	(−0.14)
2011	2,137	1,433	12,801	4,953	13,277	8,508
	(−3.43)	(0.09)	(6.32)	(17.30)	(0.27)	(5.66)
2012	1,974	1,375	12,561	4,287	13,747	7,846
	(−7.62)	(−4.05)	(−1.87)	(−13.44)	(3.54)	(−7.78)
2013	2,176	1,533	12,905	3,685	14,267	8,257
	(10.21)	(11.49)	(2.73)	(−14.05)	(3.78)	(5.24)
2014	2,322	1,628	13,725	3,882	15,352	8,673
	(6.73)	(6.19)	(6.36)	(5.36)	(7.60)	(5.04)
2015	2,481	1,695	14,385	4,306	16,473	9,556
	(6.84)	(4.08)	(4.81)	(10.92)	(7.30)	(10.17)
2016	2,545	1,744	16,651	4,621	17,445	10,77
	(2.58)	(2.90)	(15.75)	(7.30)	(5.90)	(12.70)
2017	2,620	1,812	18,604	5,105	17,805	11,963
	(2.94)	(3.92)	(11.73)	(10.49)	(2.07)	(11.08)
2018	2,625	1,844	18,966	6,358	18,525	12,125
	(0.18)	(1.75)	(1.95)	(24.53)	(4.04)	(1.35)
2019	2,639	1,957	19,856	7,544	19,826	12,651
	(0.53)	(6.13)	(4.70)	(18.60)	(7.02)	(4.34)

Note: [1]Variation rates are in parenthesis.

[2]These values include the residents in Andalusia who travels through the region.

Source: Government of Andalusia (2020) and Government of Spain (2020).

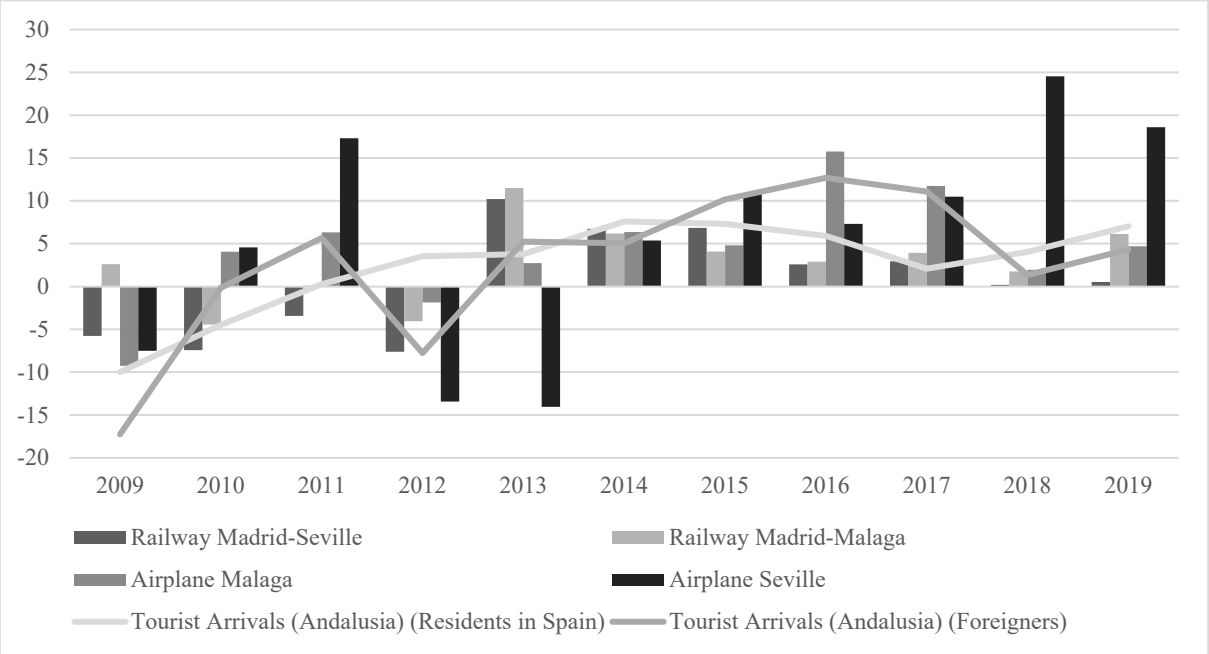

Figure 1. Total tourist arrivals to Andalusia and voyagers by means of transportation (2009–2019). Variation rates.

Regarding the second question, the economic crisis, it seems obvious that passenger transport by whichever means of transport is directly related to economic cycles. The sharp growth of international tourism in Spain—from 57 million travellers in 2012 to almost 84 million passengers in 2019 joins together with the recovery of the individual tourism since 2012, which involved 200 million tourist journeys in 2019, 90% of them within the Spanish territory.

Finally, it is quite revealing the role played by low-cost airlines and public policies lad by some city councils and some Spanish public institutions to capture the traffic generated by these airlines, being San Pablo's airport in Seville—a clear example of public intervention. As shown in Table 2, between 2009 and 2014, variations occurred in travellers' arrivals to Seville's airport figures, but they do not seem to be related to the evolution of the economy. Thus, of the 4.5 million passengers arriving at that airport in 2007, it dropped to just over 4 million in 2009. Then it rose to almost 5 million in 2011 to fall to just over 3.6 million in 2013. And, since then, it steadily grew until reaching a record of 24.5% growth in 2018 and 18.6% in 2019. In only five years, this airport doubled its traffic. This sway in the figures might be justified, in the first place, by the establishment in 2010 of the Ryanair bases at this airport, which led to a spectacular growth of passenger arrivals in 2010 and 2011 during an economic crisis. The second might be sought in the institutional response to the sharp fall in the arrival of passengers suffered in 2012 and 2013: the creation of the working group "Connecting Seville with the world", in which take part in addition to the airport, the City Council of Seville, the Provincial Council, the Regional Government of Andalusia and businessmen of the sector. That working group has promoted a series of measures such as the reduction of airport fees and bonuses for the acquisition of new connections, marketing tasks aimed at supporting the launch of new routes and, above all, the measures adopted to attract more international connections and the breakdown of dependence on the domestic market. According to AENA data, connections abroad represent more than 52% of total users (compared to 31% just five years ago) which is a historical novelty for the Seville airport.

Although there are no official figures, various studies and reports—including a complaint by Air France to the Competition Court of the European Union—indicate that the "*measures taken to attract new connections or the maintenance of existing ones*" is a euphemism that masks direct subsidies to airlines that distort the market and damage competition. Various sources indicate that only under this concept companies such as Ryanair on which the growth of connections and passenger traffic in Seville is based would have received between 80 and 100 million Euros a year of direct subsidy in Spain. It is not an isolated phenomenon: other companies, such as Vueling or Air Nostrum, and other airports, including some with high traffic levels such as Malaga, also perform the same actions, but with a lower percentage incidence in their operations. In all these cases, this intervention ultimately translates into a reduction in the cost of the airfare for the passenger, which affects not only competition between airlines, but also between these and other transportation alternatives, such as railway transport.

In this global context, on the one hand, extensive and generous investments in railway infrastructure are made, and commercial measures are carried out to increase rail traffic. And, on the other hand, actions are taken to encourage tourist arrivals via airports. Then, one wonders how the traveller reacts and what are his decision criteria when choosing between one transport model or another.

Consequently, a couple of analysis are carried out onwards. Firstly, Yule's Coefficient of Association analysis and Pearson's chi-square test are performed to test the association, if applicable, between the studied destinations—Seville and Malaga—and the means of transportation considered aeroplane or high-speed railway (Table 3 and Table 4). Then, a multiple linear regression (Table 5) is proposed to try to verify whether the volume of travellers from Madrid to Seville or Malaga depend on a particular set of variables or not, as explained in the methodology of this paper.

Regarding the association between the destinations and the means of transport, Yule's Coefficient of Association applied to the mentioned variables return the following results (Table 3). It clearly shows two phenomena. On the one hand, it proves the existence of a moderate (Knoke et al. 2002) association between Malaga and air transportation, and Seville and the high-speed railway transportation. On the other hand, it shows a slight decrease in the strength of these associations in the studied period (2009–2019). It involves that the associations found are stable and sound, but they might vary in the long term. Additionally, to further examine such association, Pearson's chi-square (Pearson, 1900) tests are performed to the previous data (Table 4). This non-parametric test is applied, in addition to Yule's Q, as it provides a measure of statistical significance. In both cases, the obtained values are statistically significant, so the association between the variables is confirmed.

Table 3. Association between destinations and means of transport: Yule's Coefficient of Association.

		2009					2019		
		Means of Transport					Means of Transport		
		Plane	HSR	Total			Plane	HSR	Total
Destination	*Malaga*	11,571	1,500	13,071	Destination	*Malaga*	19,813	1,957	21,770
	Seville	4,038	2,391	6,429		*Seville*	7,520	2,639	10,159
	Total	15,609	3891	19,500		*Total*	27,333	4,596	31,929
Yule'S Q		0.64			Yule'S Q		0.56		

Source: Government of Spain (2020).

Table 4. Association between destinations and means of transport: Pearson's $\chi 2$.

		VALUE	DF	ASYMP. SIG. (2-SIDED)
PEARSON'S χ2	2009	1,784.128	1	0.000
	2019	1,622.138	1	0.000

Source: Authors.

Moreover, by using a multiple linear regression applied to both destinations, more information can be extracted to analyse which factors might influence the volume of travellers that use the high-speed railway network to arrive to Malaga and Seville. However, the effects of the COVID-19 pandemic might condition the future use of the proposed regressions. Despite this, they are useful for making decisions. Therefore, once both regressions are built using the variables explained in the methodology of this piece of work, the estimations return the following results (Table 5).

Table 5. Regressions for high-speed railway voyagers per destination[1].

Variables		R^2	Adjusted R^2	F
Madrid-Malaga				
(Constant)	−0.006	0.920	0.855	14.321*
	(0.009)			
Spanish GDP per capita	1.581*			
	(0.328)			
HSR Long-distance	0.223**			
	(0.080)			
Spanish aeroplane travellers to Malaga	−0.247**			
	(0.089)			
Average stay in hotels in Malaga	0.364			
	(0.203)			
Madrid-Sevilla				
(Constant)	−0.052*	0.981	0.966	65.743*
	(0.007)			
Spanish GDP per capita	1.944*			
	(0.181)			
HSR Long-distance	0.435*			
	(0.040)			
Spanish aeroplane travellers to Seville	−0.257*			
	(0.038)			
Average stay in hotels in Seville	0.960**			
	(0.344)			

Note: [1] Significance levels at: *1%, **5% and ***10%. Standard errors are in parentheses.

Source: Authors.

The results obtained in both regressions are clarifying about which factors determine the number of voyagers that travel through the mentioned corridors. Indeed, their R^2 s show that these regressions predict more than 90% of the number of travellers of each route. However, for the case of Malaga, the constant and the average stay in hotels are not significant.

Regarding the variables of the models, the Spanish GDP per capita accounts for the larger part in both models. In the case of Malaga, for each additional percentual point, the number of total voyagers that use the Madrid-Malaga line increases by 1.58%. But, in the case of the Madrid-Seville corridor, it involves an increase of almost two percentual points.

The effect that the rest of the variables have on the total number of passengers that use both lines is much lower. For instance, for each percentual point that the number of Spanish passengers travelling by high-speed long-distance trains increases, the number of travellers using high-speed trains rises by 0.22% in the case of the line Madrid-Málaga and 0.44% in the case of the Madrid-Seville one. That effect is explained because Madrid acts as a transportation hub in the radial Spanish transport network. In consequence, those passengers that travel to Malaga or Seville (as stated in the literature and previously mentioned in this paper, medium-distance corridors) through Madrid, count as long-distance travellers so their variations influence the number of travellers that use the studied corridors. Conversely, the average stay in hotels in Seville almost doubles the effect of the previous variable, accounting for a rise in 0.96% per each percentual point it increases.

Besides, the variations in the number of passengers that arrive at the airport of Malaga or Seville, as expected, negatively affect the volume of high-speed railway voyagers in both destinations. That is, per each percentual point that the traffic of these airports increases, the number of passengers using the high-speed railway is reduced by 0.25% and 0.26% respectively.

Table 6 shows some noteworthy figures to the goals of this work. Madrid, the capital of Spain, is connected to the two largest cities in Andalusia—Seville and Malaga—by high-speed lines. Sánchez-Ollero et al. (2014b) remark on that high-speed railway network influences on domestic tourism, but it does not for foreign tourism, and that reducing travel time is a must for those Andalusian sun and beach destinations as it is an important cost for this type of tourist. That note is connected to the concept of generalised transport costs, that is, transportation cost should be calculated by added waiting times and access times to the different means of transport to the price of the ticket and the travel time. The extant literature on this topic mainly concludes that the railway appears to be more competitive than other means of transport in the medium distances (300 to 600 kilometres). While, in the short distance, the car appears to be better considering the fares supported by other means of transport, and air transportation seems to be the most suitable choice in the long-distance because of time-saving reasons. Currently, high-speed railway routes across Andalusia are operating in the short and medium distance. Hereafter, Table 6 shows the estimated generalised costs for different means of transport and its evolution in recent years.

Table 6. An estimation for Andalusia of the generalised travelling cost[2,6].

Generalised Costs (In Euros)	Airplane		Car[4]		Bus		HSR	
	2012[3]	2019	2012	2019	2012	2019	2012	2019
Cordoba-Madrid	-	-	78,1	85,8 (9.86)	58	45,9 (−20.86)	109,6	87,9 (−19.80)
Seville-Madrid	247	136,4 (−44.78)	106,2	111,1 (4.61)	67,4	60,1 (−10.83)	135	101,6 (−24.74)
Malaga-Madrid	190,8	173,5 (−9.07)	105,9	115,5 (9.07)	73,3	44,8 (−38.88)	142,4	117,3 (−17.63)
Malaga-Seville[5]	-	-	44,8	49,1 (9.60))	37,6	30,6 (−18.62)	81,1	83,2 (2.59)
Cordoba-Seville	-	-	33,9	35 (3.24)	29,2	23,8 (−18.49)	55	51,8 (−5.82)
Cordoba-Malaga	-	-	39	39,5 (1.28)	37,5	23,9 (−36.27)	69,5	61,9 (−10.94)

Note: [2]These generalised travelling costs are based on (Sánchez-Ollero et al., 2014b) updated. The approximated access times including displacements, security, and boarding are as follows: aeroplane, 1 hour and 45 minutes; car, 15 minutes; bus and high-speed railway, 60 minutes. The fares for the analysis were obtained on April 14, 2012, and July 30, 2019, for a one-way ticket. 3 2012 costs have been updated to 2019 values. 4 Based on 1 passenger per car and considering uniquely the cost of fuel; 5These trains run on high-speed tracks but not belong to the high-speed locomotives.

[6]Variation rates are in parenthesis.

Source: Authors based on Sánchez-Ollero et al. (2014b).

Comparing 2012 and 2019, the Madrid-Seville connection by plane has experienced a reduction of real generalised cost by 45%. While, via high-speed railway, it has also experienced a lowering in its prices by 25%. In the case of the Madrid-Málaga connection, the reduction was 9 and 17.6% respectively. That is, the reduction in flight costs from Madrid to Seville has almost doubled the reduction in high-speed railway on that same route. At the same time, the price reduction on flight fares in the Madrid to Malaga corridor has almost been half of the lowering in the costs of the high-speed railway. The generalised costs of the high-speed railway in the rest of the routes experienced a reduction between 5.7 and 19%. The only exception is the route between Seville and Malaga—which uses AVANT trains on AVE rails—that has grown by 2.7%. Moreover, it is remarkable in this analysis the case of the transport by bus, the only means of transport that despite the notable growth of passenger movements in recent post-crisis years—has reduced the number of its users in the period considered (−1.29% in the case of medium distance and −14.72% in long-distance according to INE data). Even it has had to lower their rates in a context of strong cost growth in fuel, suffering a dramatic decrease in its income, which has resulted in a severe crisis in this subsector. However, in terms of generalised transportation costs, it is the most favourable means for the traveller in all considered routes.

The first thing that stands out in Table 6 is the sharp fall in generalised costs that have occurred in the air corridors between the capital of Spain and the two Andalusian cities, and in the bus and high-speed railway in all the routes considered. The estimation made for car journeys based exclusively

on the evolution of petrol prices and the total absence of commercial variables is the only one that grows within the period considered.

In a combined analysis of the means of transport, it can be affirmed that, as it has already been indicated in the literature in section 2, in general, the train could be more competitive in the medium-distance (approximately 300 to 600 kilometres). But, in the short-distance (less than 300 kilometres) it competes with the car (for reasons of fare) and, in the long-distance, it cannot compete with the aeroplane (mainly for the saving in time). Precisely, Sánchez-Ollero et al. (2014b), using data from 2012, concluded that for the "case of high-speed lines that circulate in Andalusia, their generalised costs were higher than both public and private road transport on all routes". While regarding the competition of the aeroplane "the AVE has an advantage on the Madrid-Seville route, but it is more expensive than the aeroplane on the Madrid-Málaga route, mainly due to the operability in this last airport of several low-cost companies". According to our data, the routes that connect the cities of inland Andalusia fight in strong competition with the bus and the car, respectively. In the short distance, the bus is more competitive than the high-speed railway in the public-transport market while the car is more competitive than high-speed train in terms of usefulness in the private-transport market. The route that connects Andalusia with Madrid, which could be considered as intermediate distance, has the same behaviour if we compare the bus with the high-speed railway; however, in this route, the indicator between 2012 and 2019 has evolved reducing a lot the difference in costs between the private car and the train, due to the disparate evolution of the fares of the train (down) and the prices of the gasoline (upward). The results for the Madrid-Seville and Madrid-Malaga lines are disparate. In 2012 the outcome was favourable to road transport, but the evolution of fares has made high-speed railway in 2019 more favourable for the passenger than the use of private cars on the Madrid-Seville line while, on the Madrid-Malaga line, a similar situation to that indicated for Madrid-Córdoba happens.

5. Summary and conclusions

The analysis of the data and the scientific literature carried out in the present work have come to highlight the importance of political decisions in the evolution of the flows of travellers, in terms of creation or maintenance of transport infrastructure. And its more or less direct influence on the rates of the means of transport. Thus, taking as a case analysis the two high-speed train lines that connect Madrid with Andalusia and comparing them with other alternative means of passenger transport, evidence arises on how direct and indirect actions of public authorities have led to a specific transport offer and a price scheme. As a result, it has deeply altered the logic of the generalised costs of transport and, therewith, the movement of travellers to and from Andalusia.

The change in the rate model adopted by RENFE (Government of Spain) since February 2013, imposed to some extent by the European Commission, has led to a substantial alteration in the transport cost ratio, resulting in a rate reduction. As observed through the analysis performed in this paper, such political decisions affect in a more profound way than other variables expected to be crucial as the Spanish PIB per capita or the destination itself. In this sense, it must be highlighted that the regression model used allows for an initial exploratory analysis of the data but, for a more complete and comprehensive analysis, the longitudinal nature of the data and the time effects must be appropriately taken into account.

However, the intervention of local authorities both in Seville mainly and in Malaga subsidizing the implementation of low-cost carriers has partially offset this alteration. The result has been that, in

the context of increasing fuel prices, the greatest harmed has been bus transport, an industry that is suffering a severe crisis in Spain as a whole. Meanwhile, travellers have been the greatest benefited since their transport costs have been reduced, which has undoubtedly favoured tourism and bases the strong tourist growth experienced in Spain between 2014 and 2019.

Lastly, the COVID-19 pandemic affects the transportation industry and it will continue doing so by dramatically reducing the number of national voyagers, and almost preventing international tourists from travelling through Spain using high-speed trains. However, RENFE has taken measures to attract tourists while this situation continues such as allowing full refund for cancellations in the 15 minutes before the departure of the train, additionally to the sanitary measures. That fact might have attracted travellers from other means of transportation, but further study is needed in this regard once official data are publicly available.

As a limitation to our work, we must highlight that the Government of Spain is implementing the deregulation of all means of transport in the country, including the high-speed railway. Recently opened a tendering process to allocate the exploitation of a wide set of high-speed railway lines, including the most profitable ones. It is probably that from 2021 new companies compete with RENFE in the internal market. Therefore, part of our evaluation could become obsolete soon. However, as COVID-19 is battering the tourism industry, the effects of the deregulation might be delayed.

This new frame of competition, the changes that are coming with it, and the post-COVID-19 pandemic scenario will be future research for this team.

Conflict of interest

All authors declare no conflicts of interest in this paper.

References

Abrate G, Vigñlia G, Sánchez-García J, et al. (2016) Price competition within and between airlines and high-speed trains: the case of the Milan-Rome route. *Tourism Econ* 22: 311–323. DOI: 10.0.20.247/te.2016.0549

Albalate D, Campos J, Jiménez JL (2017) Tourism and high speed rail in Spain: Does the AVE increase local visitors? *Ann Tourism Res* 65: 71–82. DOI: 10.1016/j.annals.2017.05.004

Albalate D, Fageda X (2016) High speed rail and tourism: Empirical evidence from Spain. *Transp Res Part A Policy Pract* 85: 174–185. DOI: 10.1016/j.tra.2016.01.009

Bellet C, Alonso P (2016) Incomplete urban projects: Urban voids in post-high speed train Zaragoza. *Boletin de La Asociacion de Geografos Espanoles* 70. DOI: 10.21138/bage.2172

Bergantino AS, Madio L (2020) Intermodal competition and substitution. HSR versus air transport: Understanding the socio-economic determinants of modal choice. *Res Transp Econ* 79: 100823. DOI: 10.1016/j.retrec.2020.100823

Bo Z, Ningqiao L (2018) The impact of high-speed trains on regional tourism economies: Empirical evidence from China. *Tourism Econ* 24: 187–203. DOI: 10.1177/1354816617749346

Bracaglia V, D'Alfonso T, Nastasi A, et al. (2020) High-speed rail networks, capacity investments and social welfare. *Transp Res Part A Policy Pract* 132: 308–323. DOI: 10.1016/j.tra.2019.11.011

Campa JL, López-Lambas ME, Guirao B (2016) High speed rail effects on tourism: Spanish empirical evidence derived from China's modelling experience. *J Transp Geogr* 57: 44–54. DOI: 10.0.3.248/j.jtrangeo.2016.09.012

Campa JL, Pagliara F, López-Lambas ME, et al. (2019) Impact of high-speed rail on cultural tourism development: The experience of the Spanish museums and monuments. *Sustainability* 11: 5845. DOI: 10.3390/su11205845

Campos J, De Rus G, De Angoiti IB (2009) El transporte ferroviario de alta velocidad (No. 3). Documentos de Trabajo Fundación BBVA. Available from: Available from www.fbbva.es.

Ceballos-Santamaría G, Mondéjar-Jiménez J, Sánchez-Cubo F, et al. (2021) Motivations in heritage destinations of the cultural tourist: the case of Malaga (Spain). *Natl Account Rev* 3: 86–94. DOI: 10.3934/NAR.2021004

Cordente-Rodríguez M, Esteban-Tayala Á, Mondéjar-Jiménez JA (2011) Alta Velocidad en Castilla-La Mancha. Efecto dinamizador turístico, In: Hernández-Mogollón JM, *Ferrocarril, turismo y sostenibilidad, Congreso Internacional Truismo y Medio Ambiente*, Cáceres: Septem Ediciones, 21–41.

De Rus G (2009) La medición de Ia rentabilidad social de las infraestructuras de transporte. *Invest Reg* 14: 187–210.

De Rus G, Román C (2006) Análisis económico de la línea de alta velocidad Madrid-Barcelona. Revista de Economía Aplicada Número. Available from: https://www.redalyc.org/pdf/969/96917230002.pdf.

European Commission (2014) *Guide to Cost-benefit Analysis of Investment Projects: Economic appraisal tool for Cohesion Policy 2014–2020*, Publications Office of the European Union. DOI: 10.2776/97516

Ferrari G, Mondéjar-Jiménez J, Secondi L (2018) Tourists' Expenditure in Tuscany and its impact on the regional economic system. *J Clean Prod* 171: 1437–1446. DOI: https://doi.org/10.1016/j.jclepro.2017.10.121

Ferrari G, Montero-Lorenzo A, Mondéjar-Jiménez JM, et al. (2013a) *Investigaciones, métodos y análisis del turismo*, Oviedo: Septem Ediciones.

Ferrari G, Mondéjar-Jiménez J, Mondéjar-Jiménez JA, et al. (2013b) *Principales tendencias de investigación en turismo*, Oviedo: Septem Ediciones.

Fröidh O, Nelldal BL (2008) Regional high-speed trains on the Svealand line: Evaluation of effects, In: *Railway Development: Impacts on Urban Dynamics*, 295–314. DOI: 10.1007/978-3-7908-1972-4_14

Gao Y, Su W, Wang K (2019) Does high-speed rail boost tourism growth? New evidence from China. *Tourism Manage* 72: 220–231. DOI: 10.0.3.248/j.tourman.2018.12.003

Gavira-Narváez A, Fernández V (2017) Evolución y panorama actual de la red ferroviaria en Andalucía. *Cuadernos Geográficos* 56: 283–305. Available from http://revistaseug.ugr.es/index.php/cuadgeo/article/view/4866

Givoni M, Perl A (2020) Rethinking Transport Infrastructure Planning to Extend Its Value over Time. *J Plann Educ Res* 40: 82–91. DOI: 10.1177/0739456X17741196

Gómez Naranjo JM, Castanho RA, Fernández JC, et al. (2020) Assessment of high-speed rail service coverage in municipalities of peninsular spain. *Infrastructures* 5: 11. DOI: 10.3390/infrastructures5020011

González-Savignat M (2004) Will the high-speed train compete against the private vehicle? *Transp Rev* 24: 293–316. DOI: 10.1080/0144164032000083103

Government of Andalusia (2020) Sistema de Información Multiterritorial de Andalucía. Available from: https://www.juntadeandalucia.es/institutodeestadisticaycartografia/sima/index2.htm.

Government of Spain (2020) Ministerio de Transporte, Movilidad y Agenda Urbana. Available from: https://www.mitma.es/.

Guirao B, Campa JL (2016) Cross Effects between High Speed Rail Lines and Tourism: Looking for Empirical Evidence Using the Spanish Case Study, In: *Transportation Research Procedia,* 14: 392–401. DOI: 10.1016/j.trpro.2016.05.091

Gutiérrez-Gallego JA, Naranjo-Gómez JM, Jaraíz-Cabanillas FJ, et al. (2015) Estimation of social cohesion in the Spanish municipalities after the implantation of the high speed railway. *Boletin de La Asociacion de Geografos Espanoles* 69. DOI: 10.21138/bage.1892

Gutiérrez A, Miravet D, Saladié Ó, et al. (2019) Transport mode choice by tourists transferring from a peripheral high-speed rail station to their destinations: Empirical evidence from Costa Daurada. *Sustainability* 11: 3200. DOI: 10.3390/su11113200

Gutiérrez A, Saladié Ò, Clavé SA (2018) High-speed rail and tourism destination choice: The role and significance of the Camp de Tarragona station for passengers visiting the Costa Daurada. *Boletin de La Asociacion de Geografos Espanoles* 76: 479–503. DOI: 10.21138/bage.2531

Gutiérrez J (2004) El tren de alta velocidad y sus efectos espaciales. *Invest Reg J Reg Res* 5: 199–224.

Hernández-Mogollón JM (2011) *Ferrocarril, turismo y sostenibilidad. Congreso Internacional Truismo y Medio Ambiente*, Cáceres: Septem Ediciones.

Hortelano AO, Guzman AF, Preston J, et al. (2016) Price elasticity of demand on the high-speed rail lines of Spain: Impact of the new pricing scheme. *Transp Res Record* 2597: 90–98. DOI: 10.3141/2597-12

Huang Y, Wang Y (2020) How does high-speed railway affect green innovation efficiency? A perspective of innovation factor mobility. *J Clean Prod* 265: 121623. DOI: 10.1016/j.jclepro.2020.121623

Huang Y, Guo Q, Xiao M (2021) The unbalanced development and trends of China's regional tourism. *Natl Account Rev* 3: 69–85. DOI: 10.3934/NAR.2021003

Jin S, Yang J, Wang E, et al. (2020) The influence of high-speed rail on ice–snow tourism in northeastern China. *Tourism Manage* 78: 104070. DOI: 10.1016/j.tourman.2019.104070

Kageson P (2010) Environmental aspects of inter-city passenger transport. 429–457. Available from: https://trid.trb.org/view/926606.

Knoke D, Bohrnstedt GW, Mee AP (2002) *Statistics for social data analysis*, 4 Eds, Itasca: FE Peacock Publishers.

Kravchenko O, Bohomolova N, Karpenko O, et al. (2020) Scenario-based financial planning: the case of Ukranian railways. *Natl Account Rev* 2: 217–248. DOI: 10.3934/NAR.2020013

Laird JJ, Nellthorp J, Mackie PJ (2005) Network effects and total economic impact in transport appraisal. *Transport Policy* 12: 537–544. DOI: 10.1016/j.tranpol.2005.07.003

Li LSZ, Yang FX, Cui C (2019) High-speed rail and tourism in China: An urban agglomeration perspective. *Int J Tourism Res* 21: 45–60. DOI: 10.1002/jtr.2240

Liu Y, Shi J (2019) How inter-city high-speed rail influences tourism arrivals: evidence from social media check-in data. *Curr Issues Tourism* 22: 1025–1042. DOI: 10.1080/13683500.2017.1349080

Martín JC, Gutiérrez J, Román C (2004) Data Envelopment Analysis (DEA) index to measure the accessibility impacts of new infrastructure investments: The case of the high-speed train corridor Madrid-Barcelona-French border. *Reg Stud* 38: 697–712. DOI: 10.1080/0034340042000240987

Martín JC, Nombela G (2008) Impacto de los nuevos trenes ave sobre la movilidad. *Revista de Economia Aplicada* 16: 5–23.

Martín JC, Román C, García-Palomares JC, et al. (2014) Spatial analysis of the competitiveness of the high-speed train and air transport: The role of access to terminals in the Madrid-Barcelona corridor. *Transp Res Part A Policy Pract* 69: 392–408.

Martínez CM (2018) The territorial political model as an explanatory factor of the accelerated development of the high-speed railway in Spain: A review and a methodological approach. *Boletin de La Asociacion de Geografos Espanoles* 77: 111–147. DOI: 10.21138/bage.2536

Mondéjar-Jiménez J, Vargas-Vargas M, Mondéjar-Jiménez JA, et al. (2007) Extracción de señal y predicción en series turísticas. *Cuadernos de turismo* 20: 153–170.

Moyano A, Rivas A, Coronado JM (2019) Business and tourism high-speed rail same-day trips: factors influencing the efficiency of high-speed rail links for Spanish cities. *Eur Plann Stud* 27: 533–554. DOI: 10.1080/09654313.2018.1562657

Muro-Rodríguez AI, Pérez-Jiménez I (2016) La intermodalidad aéreo-ferroviaria del turismo en la ciudad de Toledo 1. *Revista Invest Turísticas* 12: 121–141. DOI: 10.14198/INTURI2016.12.06

National Institute of Statistics (2020) Contabilidad regional de España. Available from: https://www.ine.es/index.htm.

Padilla AO, Rodríguez DB, Aracil PF, et al. (2016) High Speed Rail Passenger Profile in Sun and Beach Tourism Destinations: The Case of Alicante (Spain). *Open Transp J* 10: 97–107. DOI: 10.2174/1874447801610010097

Pagliara F, La Pietra A, Gomez J, et al. (2015) High speed rail and the tourism market: Evidence from the madrid case study. *Transp Policy* 37: 187–194. DOI: 10.1016/j.tranpol.2014.10.015

Pearson K (1900) X. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *London Edinburgh Dublin Philos Mag J Sci* 50: 157–175. DOI: 10.1080/14786440009463897

Román C (2008) *Competencia intermodal en el corredor Madrid-Zaragoza-Barcelona ante la introducción del tren de alta velocidad* (No. 11–08). *Economía de las Infraestructuras CÁTEDRA Fedea-Abertis*. Available from: www.fedea.es.

Román C, Martín JC (2014a) Integration of HSR and air transport: Understanding passengers' preferences. *Transp Res Part E Logistics Transp Rev* 71: 129–141.

Román C, Martín JC, Espino R, et al. (2014b) Valuation of travel time savings for intercity travel: The Madrid-Barcelona corridor. *Transp Policy* 36: 105–117.

Romero J, Brandis D, Delgado-Viñas C, et al. (2018) Approach to the Geography of waste of economic resources in Spain: Balance of the last two decades. *Boletin de La Asociacion de Geografos Espanoles* 77: 1–51. DOI: 10.21138/bage.2533

Saladié Ò, Gutiérrez A, Clavé SA (2018) Influencia de la alta velocidad ferroviaria en la elección del destino turístico según el origen de los viajeros. El caso de la Costa Dorada en Cataluña. *Documents d'Anàlisi Geogràfica* 64: 339–364. DOI: 10.5565/rev/dag.390

Sánchez-Ollero JL, García-Pozo A, Del Cubo Arroyo EI (2014a) Tourism development and high-speed raiways in Andalusia, In: F. J. Sáez-Martínez, J. L. Sánchez-Ollero, A. García-Pozo, & E. Pérez-Calderón (Eds.), *Managing the Environment*, 1Ed., Oxford: Chartridge Books Oxford, 55–65.

Sánchez-Ollero JL, García-Pozo A, Marchante-Mera A (2014b) The impact of the high speed train in the development of Andalusia: An approach. *Boletin de la Asociacion de Geografos Espanoles* 64: 341–356.

Sun YY, Lin ZW (2018) Move fast, travel slow: the influence of high-speed rail on tourism in Taiwan. *J Sust Tourism* 26: 433–450. DOI: 10.0.4.56/09669582.2017.1359279

Sustar H, Mladenović MN, Givoni M (2020) The landscape of envisioning and speculative design methods for sustainable mobility futures. *Sustainability* 12: 2447. DOI: 10.3390/su12062447

Vázquez-Varela C, Martínez-Navarro JM (2016) High-speed railway and tourism: Is there an impact on intermediate cities? Evidence from two case studies in Castilla-La Mancha (Spain). *J Urban Reg Anal* 8: 133–158. Available from https://www.ceeol.com/search/article-detail?id=726103

Yang Z, Li T (2019) Does high-speed rail boost urban tourism economy in China? *Curr Issues Tourism* 23: 1973–1989. DOI: 10.1080/13683500.2019.1696756

Yin, P, Lin Z, Prideaux B (2019a) The impact of high-speed railway on tourism spatial structures between two adjoining metropolitan cities in China: Beijing and Tianjin. *J Transp Geogr* 80: 102495. DOI: 10.1016/j.jtrangeo.2019.102495

Yin P, Pagliara F, Wilson A (2019b) How does high-speed rail affect tourism? A case study of the Capital region of China. *Sustainability* 11: 472. DOI: 10.3390/su11020472

Yule GU (1912) On the Methods of Measuring Association Between Two Attributes. *J Royal Stat Soc* 75: 579–652.

Zhao Y, Liu B (2020) The evolution and new trends of China's tourism industry. *Natl Account Rev* 2: 337–353. DOI: 10.3934/NAR.2020020

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