High Speed Rail vs. Air Competition in Spain

High-speed railway lines (HSR) in Spain have gradually increased during the last twenty years. At the beginning of 2010, four HSR lines were operating on routes where air transport used to be the dominant mode of transportation, connecting Madrid with other mainland cities in short-haul routes. In this article, we examine the air carriers’ reaction to these HSR entries into the market by using data at the route level from two perspectives: firstly, we test whether the high-speed rail links have changed the frequency that airlines offer; and secondly, we analyze how the market share of airlines in the total market (air plus rail) have changed.

by: Juan Luis Jiménez and Ofelia Betancor

Introduction

Before the introduction of high-speed railways (HSR), aircraft and railways were considered as independent modes of transportation that could not compete given their different features (Ivaldi and Vibes, 2005). The empirical literature finds that the introduction of HSR has a significant effect on consumers and, therefore, on air carriers. This fact is more relevant in routes with a distance shorter than 800 kilometers or with a travel time by train of less than 3 hours (IATA, 2003). In addition to speed, it is the fact that most cities’ railway stations are located in downtown areas, which gives HSR the travel time advantage over aircraft (Givoni and Banister, 2007).

There are some examples from around the world about the effects of HSR on the air sector. Paris-Lyon was one of the first routes where a high-speed rail operated and in which airlines reduced their participation almost 50 percent. In Spain, on the route Madrid-Seville (HSR entry in 1992), railway increased its share from 16% to 51% (Park and Ha, 2006).

There is a considerable among of literature analyzing the influence of the market structure on competitive variables, mainly prices and frequencies for the case of the air transport sector. Results in all of these studies are similar: the level of concentration on the route or at the airport positively affects consumer prices.

Another research branch is related to the rise of low-cost air carriers. Those studies point out how such air companies discipline competition, leading to price reductions after their entry or even making incumbent air carriers change their behavior into a low-cost carrier entry threat, as described in Goolsbee and Syverson (2008).

Concerning the HSR appearance as a competitive mode for air transport, the number of references is lower. Three works that summarize the general evolution of such modes are Campos and Gagnepain (2009), Gourvish (2010) and Albalate and Bel (2010).

Nevertheless, there is less literature related to competition as exerted by HSR on airlines than in the case of intra-modal competition for air transport. This paper aims to shed some light in this regard by using a database on the route level for the Spanish market. We evaluate whether high-speed rail has significantly changed the frequency, the number of passengers and the market share of airlines. We carry out this analysis for air carriers as a whole and also concerning the strategic behavior of the former Spanish flag air carrier Iberia in each route.

Database

We use data on the route level for air carriers’ frequencies and market shares in the Spanish markets for nine routes with origin in Madrid and for the period of January 1999 through De-
Results of Estimations

The Airlines’ Reaction: the Effects on Flight Frequencies

We test whether the introduction of HSR services has had a significant effect on flights frequency (a relevant air carriers’ competitive variable that affects their slot policy). To do that, we will try to explain the number of monthly operations of direct commercial flights between Madrid and destination $i$ in the period $t$ by using the following exogenous variables: the number of air passenger carried in those operations (instrumented by tourism per capita, GDP per capita, among others); the number of railway passengers between Madrid and destination $i$, in period $t$ (average monthly data in this case); share of air carrier Iberia in the air market; distance between two airports; a binary variable that takes value 1 after the entrance of the HSR in route $i$ and 0 in other case, and some temporal, fixed-effects and seasonal dummies. Nevertheless, the result of such an analysis can be applied to the whole set of routes studied, though a different analysis for each route may be needed. For this reason, we also substitute the HSR introduction dummy variable with three other ones. These are constructed by multiplying $D_{it}^{HSR}$ by the specific airport dummy.

Using a Two-Stage Least Square estimator (2SLS-IV) with instrumental variables, we reach several conclusions. Firstly, on the routes in which Iberia has a higher market share in the air transport market, the total number of operations decreases, as pointed in the works by Schipper et al. (2002), Carlsson (2004) or Bilotkach et al. (2010), too. Secondly, distance negatively affects the frequency of monthly flights. Thirdly, the parameter of the HSR dummy is negative and is statistically significant when explaining the total number of operations. On average, the number of air transport operations decreases by 17% in response to the introduction of HSR, though this result differs depending on the route and the airlines considered.

In general, Iberia reduced its operations in Barcelona by 11% and by 34% in Zaragoza. The other airlines reduced theirs by 31% in Málaga and almost disappeared on the Madrid-Zaragoza route. These results are more robust than those described in Park and Ha (2006) or in other descriptive works, as other routes are operated by air transport and train services, though only in four of them, the HSR is in operation, or at least in the period under analysis. For the remaining five routes, there are plans for future operation of HSR services as well.

Table 1 shows some information on the main variables per route, distinguishing, in the case of routes with HSR, the period before and after the introduction of HSR services. The variables reported in this table are the focus of our econometric analysis as presented below. Of particular importance are the number of total passengers (air plus rail), the number of flights and the market share of air transport as compared to the railway mode. In such routes (Barcelona, Málaga and Zaragoza), air transport monthly operations and passengers carried have decreased after the introduction of HSR services. In turn, passengers transported by railway (monthly average) increased substantially. In fact, the trains’ market share more than tripled for the route Madrid-Barcelona, doubled for the route Madrid-Málaga, and almost monopolized the passengers’ volume in the case of Madrid-Zaragoza.

Finally, it is worth noting Iberia’s behavior concerning the starting of HSR services. The change in its air transport market share is not so clear. In fact, except for Barcelona, it maintained or even increased its share. For routes without HSR services, as expected, the air transport mode is more relevant, especially for routes connecting Madrid with cities in the North of Spain. As we will see below, the Madrid-Barcelona route in particular is competitive, and one where HSR has clearly won the race with air carriers for the market.

Table 1: Average monthly data by route. Source: Own elaboration. Standard deviation among brackets.

<table>
<thead>
<tr>
<th>Route from Madrid to...</th>
<th>Air Passengers</th>
<th>Number of flights</th>
<th>Train passengers (Renfe)</th>
<th>Distance</th>
<th>Iberia’s passenger share (air market)</th>
<th>Air transport’s passenger share (air plus rail market)</th>
<th>Date entrance HSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona (before HSR)</td>
<td>345228 (59719)</td>
<td>3255 (483)</td>
<td>51468</td>
<td>483</td>
<td>66.7</td>
<td>86.9</td>
<td>December 2007</td>
</tr>
<tr>
<td>Barcelona (after HSR)</td>
<td>269217 (57966)</td>
<td>2806 (535)</td>
<td>200070</td>
<td>493</td>
<td>56.9</td>
<td>63.8</td>
<td>February 2008</td>
</tr>
<tr>
<td>Málaga (before HSR)</td>
<td>105971 (20769)</td>
<td>971 (132)</td>
<td>46406</td>
<td>430</td>
<td>60.5</td>
<td>69.1</td>
<td>-</td>
</tr>
<tr>
<td>Málaga (after HSR)</td>
<td>79771 (20574)</td>
<td>708 (176)</td>
<td>120404</td>
<td>66.6</td>
<td>39.6</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Zaragoza (before HSR)</td>
<td>7935 (1308)</td>
<td>232 (30)</td>
<td>45333</td>
<td>251</td>
<td>96.0</td>
<td>14.9</td>
<td>-</td>
</tr>
<tr>
<td>Zaragoza (after HSR)</td>
<td>1986 (1070)</td>
<td>85 (37)</td>
<td>96099</td>
<td>95.9</td>
<td>2.2</td>
<td>-</td>
<td>December 2003</td>
</tr>
<tr>
<td>Seville (HSR for all sample period)</td>
<td>39601 (6541)</td>
<td>401 (65)</td>
<td>189166</td>
<td>91.4</td>
<td>17.4</td>
<td>-</td>
<td>April 1992</td>
</tr>
</tbody>
</table>

Table 1: Average monthly data by route. Source: Own elaboration. Standard deviation among brackets.
arrived to the following main conclusion: the introduction of Square estimator (2SLS-IV) with instrumental variables, weism, distance, fixed effects, etc.) and with a Two-Stage Least
By controlling the factors that might affect airlines' decision
correlation analysis, an instrument variable is used to
controlled through econometric means, allowing the delimitation of the specific effects of HSR.

The Total Passenger and Market Shares
We now focus on how passengers (by routes and market shares by mode change) after the introduction of HSR. In this case, we explain the total passengers (train plus air) carried in route
i at year t, the Air Transport Share in terms of passengers of the total transport market (air plus railways) and the Iberia’s Share in terms of passengers. The empirical strategy, description of variables and period of time considered was similar to that applied to get estimates for the effect on frequencies, but for the fact that variables were on a yearly basis.

Our results show that the introduction of HSR in the Spanish markets has produced an important impact on demand. In fact, it has increased between 41 to 86 per cent, depending on the routes, however, we are not able to identify what part of it has been deviated from the road market and what part is purely new generated demand. On the other hand, the air transport total market share has also been significantly affected. After the introduction of HSR, the air transport share in terms of passengers is between 14 to 33 percentage points lower. Finally, Iberia’s share in the air markets also reduced with the introduction of HSR, and it is for the Madrid-Barcelona route that such a decrease is more important.

Summary and Conclusions
HSR not only affects the environment, mobility or the process of territorial integration, but also other competitive transport modes, especially air transport. The first objective of our work was to delimitate the air carriers’ reaction to the introduction of HSR in terms of frequencies offered. With that aim, we conducted an empirical analysis by using monthly data on air transport operations in nine Spanish routes with origin Madrid from January 1999 through December 2009.

By controlling the factors that might affect airlines’ decision when offering a given operations frequency (number of passenger, level of concentration at the air route, income, tourism, distance, fixed effects, etc.) and with a Two-Stage Least Square estimator (2SLS-IV) with instrumental variables, we arrived to the following main conclusion: the introduction of HSR in Spain, a political decision exogenous to the route’s features, has reduced on average the number of air transport operations by 17 %, though this result differs depending on the route and the airlines considered.

As a second objective, we aimed to check whether or not the introduction of HSR has favored market size in terms of passengers, and to what extent it has altered the shares of airlines in the total market (air plus railways) and Iberia’s passengers share in the air transport market. For this part of our work, the main conclusions are: On the one hand, the introduction of HSR in the Spanish markets has allowed the demand to increase substantially, between 41 to 86 per cent, depending on the routes. The most important effect is registered for the Madrid-Barcelona route, however, we are not able to identify what part of it has been come from the road market and what part is purely new generated demand. On the other hand, and in spite of such an increase, the weight of air transport in the total market has been reduced. Finally, the Iberia’s share in the air markets also reduced with the operation of the HSR.

End Notes
i This article summarizes a more detailed analysis developed in the paper entitled “When trains go faster than planes: the strategic reaction of airlines in Spain”. We would like to thank Javier Campos, Pilar Socorro and Xavier Fageda for their helpful comments and suggestions. We are also grateful to Iberia and Renfe for provision of data, and to Agustín Alonso for assistance with the database. The main research was undertaken within the project AEROAVE funded by the Spanish Ministry of Science and Innovation, research grant E 20/08. The responsibility for possible errors is solely ours.

ii Some examples are the works by Borenstein (1989), [0]Evans and Kessides (1993), or Fageda (2006), for data at the route level; and the articles by Brander and Zhang (1990), Oum et al. (1993) or Fisher and Kamerschen (2003), for aggregated data.

iii For the United States air transport market, the works by Dresner et al. (1996) or Morrison (2001) may be consulted. For the European case, we can mention the works by Alderighi et al. (2004) or Gaggero and Piga (2010). For the Spanish market, Fageda et al. (2010) show how the incumbent traditional airline (Iberia) reacts to low cost carrier's competition in two ways. Firstly, by creating low costs sister companies, and secondly, trying to reduce costs at its main brand.

iv For detailed results please contact the authors. In a two-stage least squares (2SLS) regression analysis, an instrument variable is used to create a new variable that explains in turn the behaviour of another.

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