WTP for the integration between the HSR and air transport at Madrid Barajas airport[1].

Juan Carlos Martín[♦]
Institute of Tourism and Sustainable Development Economics (TiDES), University of Las Palmas de Gran Canaria. jcmartin@daea.ulpgc.es

Concepción Román
Institute of Tourism and Sustainable Development Economics (TiDES), University of Las Palmas de Gran Canaria. croman@daea.ulpgc.es

Abstract:

In this paper we analyze the most valued service quality attributes in order to develop intermodal products consisting in the integrations of the high-speed rail (HSR) and the air transport. In this sense, different solutions could be implemented ranging from the very basic integration, in which passengers need to take an important active role, to the most sophisticated systems which include ticket and handling integration.

We conducted a discrete choice experiment facing travellers, on routes linking Gran Canaria with different cities in mainland Spain through a connection at Madrid-Barajas Airport, to the choice between the current option and the integrated alternative involving the HSR in the second stage of the trip. To understand passenger preferences for the integrated transport alternative we estimated flexible choice models, the specification of which allowed us to analyze the existence of systematic and random taste heterogeneity as well as the correlation panel effects. We obtain some different willingness to pay for service quality attributes of these intermodal products and find some peculiarities that depend on the type of trip. Results of the analysis can be used to infer important policy conclusions that balance some existing misconceptions about the real possibilities of the Air-HSR integrated alternative. We show that the schedule coordination between both modes, as well as other measures facilitating their integration is paramount in order to promote intermodality at Madrid-Barajas airport.

Keywords: Transport networks; intermodal transport; modal integration, HSR services Stated Preference (SP), Willingness to pay.

1 Introduction

Air and rail passenger transportation have always had a special love-hate relationship that reveals itself acutely when something goes wrong. Initially, at the beginning of twentieth century, the railways dominated the passenger transport demand for long distance trips, but during the last sixty years the airline industry has undergone an expansion unrivalled by any other form of transport and the situation was reverted. The rate of technological change in air transport resulted in falling costs and fares which

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[♦]Corresponding author

stimulated a very rapid growth in demand. However with the appearance of high-speed-trains, railways are again back in the scene. The competition war between air and high-speed railways is being fought in several areas and from different perspectives, some of which make the playing field anything but level. City centre to city centre or airport to airport, the nightmares of airport security and more relaxed measures in train stations, and finally public money invested in railways infrastructure against full cost recovery for the airlines.

However, since recently we assisted to a virtual change in this previous hatred that existed between those high-speed rail (HSR) companies and the airlines. Love is in the air, or rather on the tracks, when some Thalys trains run in cooperation with an Air France flight between Brussels and Paris Charles De Gaulle airport, or when several of Germany's ICE trains carry a determined number of seats from Lufthansa passengers with their respective code-share agreement. It is evident that cooperation instead of competition changes the hatred for love, but when trains take passengers away from certain flights instead of feeding the airline network, love is evanescent.

The construction of a new HSR rail station at Madrid Barajas Airport was announced by the Spanish Ministry of Development in 2006. This infrastructure will significantly improve the intermodal alternative between HSR and air transport and it is named AEROAVE in its Spanish acronym. Today, passengers who are travelling to/from Barajas on a high-speed train from/to other provinces in the Iberian Peninsula have to change transport modes in Madrid Atocha station, where they can choose private car (taxi), underground, bus or conventional train. The Metro (underground) Line 8, connecting the city centre with Barajas Airport - Terminal 4 station, was opened in May 2007 and the initial 1999 station was named as Terminal 1, 2 and 3. Since 2010 it is possible to take a suburban train which links Madrid Barajas Terminal 4 with Chamartin and Atocha high-speed train stations. It can be said that up to now, the intermodal station regarding railways and air transport at Madrid Barajas only serves as the final last mile trip – Madrid is the origin or destination, or as an additional leg that connects the airport with Atocha and Chamartin HSR stations.

However, in the near future it would be possible to develop a feeder role of the railways in the air transport industry beyond its actual function as access providers to airport terminals. Thus, it would be possible to commercialize direct connections from/to the airport to/from HSR national intercity network. The cases of Charles de Gaulle, Schipol and Frankfurt had a demonstrative effect in the Spanish governments to develop this transport policy strategy.

The aim of this paper is to analyse the key drivers in order to promote intermodal connectivity between Air and High-Speed Rail (HSR) transport networks in Madrid Barajas airport. Many air transport trips in Spain usually involve two flight legs and a transfer at Madrid Barajas airport. The new alternative, object of analysis here, would replace a leg of this trip by HSR and the transfer would involve not only changing planes but also transport modes. Such integration has to provide an overall better service quality to be seen as the best alternative on some routes, that is when the integrated alternative will cause that passengers would be better off transferring in Madrid Barajas to the HSR. In this case, both transport modes can be considered as complements instead of substitutes.

It is well known that intermodality can only be considered as a valid alternative when its generalized price is inferior to the other existing alternatives. In this paper, we analyse the satisfaction of travellers on this new alternative with respect to some basic attributes, like ticket integration, ground-handling integration, price, transfer time and travel time. The empirical analysis is based on individual subjective responses to a stated preference experiment conducted at Gran Canaria airport for those passengers who were connecting at Madrid Barajas airport on some route to a province in the Iberian Peninsula. We obtain the willingness to pay for making the alternative more attractive and we will shed some light of some existing misconceptions about the real possibilities of the Air-HSR integration. We show that the schedule coordination between both modes, as well as other measures that facilitates the integration of both modes is paramount in order to promote intermodality at Madrid Barajas airport. Our findings may prove to be useful for planners, policy makers, air transport and HST operators who aim for complementarity or cooperation between both transport modes.

2 Intermodal HSR-air transport agreements

Definitions of high-speed trains are usually based on what speed passengers can achieve in their trips. Thus, experts seem to agree within a range between 200 and 300 kph. Givoni (2006) concludes that a HSR service should be defined as "high capacity and frequency railway services achieving an average speed of over 200kph"(p.1), Nash (2008) suggests that a common definition is "rail systems which are designed for a maximum speed in excess of 200kph" (p.1), while the European Union EC Directive 96/58/EC define High-Speed rail as a set of 3 elements with precise criteria: (1) the infrastructure has to be built specially for high speed travel or those specially upgraded for high speed travel; (2) the rolling stock must run at a speed of at least 250 km/h on lines specially built for high speed, and at a speed of 200 km/h on existing lines which have been specially upgraded; and (3) the rolling stock must be designed along its infrastructure for a complete compatibility, safety and quality of service.

Traditionally, air and rail have been considered as competitors and the relationship between HSR companies and airlines has been dominated by a high rivalry. Even the literature on these two modes has mainly focused on the analysis of factors driving the competition between them (González-Savignat, 2004; de Rus and Roman, 2006; Román and Martín, 2010; Román et al., 2010). The range in which these two high-speed transport modes can compete has been widely studied and, although the findings differ across the transport literature, some agreement is reached. Before the advent of HSR, trains were unable to compete with flights properly on trips covering distances over 400 km. Nowadays, air passenger transportation and HSR compete strongly on a range between 400-600 km., usually the latter being the main transport mode. Other studies have mentioned the interval 750 – 800 km as the maximum distance that allows the HSR to act as a competitor to air (IATA, 2003). On journey time, the tipping point has been found to be around 2.5 or 3 hours for a HSR journey (especially for the case of business trips), which would be equivalent to a 1 hour flight; apart from the in-vehicle time, other parts of total journey time (such as access, waiting and egress time) have to be taken into account given their relevant weight due to the nature of air journeys.

Intermodal agreements between airlines and rail operators are beginning to be more popular in the transportation arena. These agreements have been promoted by the benefits accrued by different stakeholders: airlines, rail companies, intermodal airports, consumers and policy makers. In the EU, there exists a not very contested credo that supports politically these agreements because some environmental externalities can be reduced transferring passengers from air transport to HSTs or to alleviate congestion problems at some European hubs that operate under important capacity constraints.

It is also true that in spite of such advent, air-rail products are still at their infancy positioned as “niche products” which are offered by only a few operators subject to bilateral arrangements. Multilateral cooperation between air and rail operators is made difficult not only by the fact that these two modes have been competing and still compete in some of the routes that now can be an object of desirable cooperation, but also because both modes present different business models which are not easy to integrate and make compatible.

Saying this, it is also necessary to cautiously advice that integration needs a real intermodal platform – HSR station available inside the airport terminal, in order to develop attractive air-rail products with adequate ticket integration, handling integration, etc. These air-rail product characteristics support and increase the number of intermodal passengers, but they are not a necessary condition as some passengers prefer to substitute planes by HST whenever this possibility exists within the airport terminal. Passenger travel by trains and airplanes in a complementary way, even without intermodal stations or sophisticated air-rail integrated schemes.

Air-rail intermodality in Europe has been analysed extensively in different studies that have involved the participation of important stakeholders, mainly policy makers, airports, airlines and railways operators (CEC, 1995; EC, 1998; IARO, 1998; CEC, 2001; IATA, 2003; EC, 2004). The reports vary amply in extension and coverage but in all the cases, they provide interesting results about the degree of cooperation between both transport modes, the intricacy delimitation between competition and cooperation, the effects of the frequency of the services of HSR in airport terminals, the efficiency of the HSR-airport terminal design on the essential elements that need to be considered in order to provide seamless journeys to passengers, such as interchange conditions and integration of tickets and handling.

The academic literature has mainly treated the hatred relationship between HST and air transport (Givoni and Banister, 2006). However there are a number of exceptions that can be cited (Givoni, 2005, 2007; Givoni and Banister, 2006, 2007; Givoni and Rietveld, 2008, Zanin et al., 2012). Chiambaretto and Decker (2012) argued that there are three factors which can be associated with the expansion of intermodal agreements in Europe: (1) the ‘rebirth’ of the rail industry; (2) the difficult trading environment for airlines; (3) and the development of airports which can accommodate intermodal forms of transportation. The idea of such development is to what extent HSR can be used as additional spokes within the air hub-and-spoke network, making a win-win situation for the main stakeholders involved-airlines, rail operators, airports and taxpayers. For example, airlines could be better off changing some slots from domestic routes to more profitable international routes and HSR could be benefited from additional traffic of more satisfied passengers.

3 The data

To understand passengers' preferences for an Air-HSR integrated mode of transport, using the intermodal facilities of Madrid-Barajas Airport, we focused on routes linking the Island of Gran Canaria with different cities in mainland Spain, through a connection at Madrid-Barajas Airport. For this purpose we conducted a stated choice (SC) experiment facing travellers to the choice between the current alternative (Air-Air) and the Air-HSR option. Apart from the usual and normally included attributes in every mode choice model, say *travel cost* and *travel time*, our experiment also included variables that are relevant in modal integration: *connecting time*, *fare integration* and *baggage integration*. As one of the most claimed advantages of the HSR versus air transport is the better accessibility of train stations, the *access time to destination* was also included in the experiment.

The primary purpose of the choice experiment was to determine the independent effect of the attributes upon the observed choices made by the sample respondents that undertook the experiment (Rose and Bliemer, 2009). To gain realism and accuracy in the outcomes of the experiment, the attribute levels were customized to respondent's current experience. Thus, alternatives presented in the choice sets were different for each respondent and were defined by pivoting attribute level values around the reference alternative (the current option), considering plausible percentage deviations (Rose *et al.*, 2008). All the information needed to define the reference alternative was obtained from a set of preliminary questions included in the questionnaire. Table 1 presents the value of the attribute levels used in the discrete choice experiment.

An efficient SC design, based on the D-error minimization criteria, was created with the N-gene software (ChoiceMetrics, 2009). As it was neither possible to build a specific design for each respondent (the ideal situation) nor to know beforehand the final model specification, we decided to generate a design considering the attribute level values corresponding to a representative trip for the general structure of the multinomial logit model (MNL). Parameter priors were chosen in order to be consistent with WTP figures obtained in other studies in similar contexts. Although we are aware that this strategy could result in a sub-optimal design, the gain in realism would offset this problem by reducing the hypothetical bias (Bradley, 1988). Also, an increasing in the sample size would contribute positively to the quality of the estimation results. The nine different choice situations generated for the SC experiment as well as the parameter priors are presented in Table 2.

The survey was conducted between November 2010 and January 2011 and the fieldwork was organized into four waves of interviews, in accordance to the procedure used to locate respondents: check-in and boarding area at Gran Canaria Airport; different departments of the civil administration in the city; and different departments of the University of Las Palmas de Gran Canaria. For the first two groups, the reference trip was the current trip; and the last trip made within the last 12 months for the rest of the interviewees. Given the nature of the SC experiment, a face-to-face computer aided personal interview (CAPI) was developed with the aid of the Sawtooth Software package.

Table 1. Attributes and levels

ATTRIBUTES	LEVEL	TRANSPORT MODE: Air-Air	TRANSPORT MODE: Air-HSR
Travel cost	0	P -20%	P-50%
	1	P	P-25%
	2	P+20%	P
Travel time (in-vehicle)	0	T_v-20%	T_v'-20%
	1	T_v	T_v'-10%
	2	T_v+20%	T_v'
Connecting time[2]	0	T_c	T_c -50%
	1		T_c -25%
	2		T_c +25%
Access time to destination	0	T_a-20%	T_a-40%
	1	T_a	T_a-25%
	2	T_a+20%	T_a-10%
Fare integration	0	Full fare integration-One single ticket. (The airline assumes all the costs incurred in case of delay)	**2 independent tickets** (The airline **does not assume any risk** in case of delay)
	1		**2 independent tickets** + one **travel insurance** to compensate passengers if they have to buy a new HSR ticket in case of delay, without paying **an extra cost**.
	2		**One single ticket**. The two companies assume all the costs incurred in case of delay
Baggage integration	0	Full fare integration-The baggage is checked-in in origin and picked-up at the final destination	The baggage **is picked-up at Terminal T4** and carried by the passenger to the HSR Terminal (200 m. walking distance)
	1		The baggage is picked-up at a **Special Airport Terminal** within a walking distance of 20 m. from the HSR Terminal

P=Air ticket price

T_v=Air in-vehicle travel time (the two legs)

T_v'=Air+HSR in-vehicle travel time (the two legs)

T_c=Connecting time at the airport

T_a=Access time to destination

[2] Hsu (2010) shows through a simulation numerical mode that connecting time is mainly affected by the capacities and headways of the connecting and feeder services.

Table 2. Choice situations

<table>
<tr><th colspan="2" rowspan="2">ATTRIBUTES</th><th colspan="10">CHOICE SETS</th></tr>
<tr><th>Priors</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th></tr>
<tr><td rowspan="6">Air-Air</td><td>Travel cost</td><td>-0.01</td><td>P</td><td>P -20%</td><td>P</td><td>P</td><td>P +20%</td><td>P +20%</td><td>P -20%</td><td>P +20%</td><td>P -20%</td></tr>
<tr><td>Travel time (in-vehicle)</td><td>-0.0025</td><td>T_v</td><td>T_v +20%</td><td>T_v -20%</td><td>T_v -20%</td><td>T_v +20%</td><td>T_v +20%</td><td>T_v</td><td>T_v</td><td>T_v -20%</td></tr>
<tr><td>Connecting time</td><td>-0.0034</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td><td>T_c</td></tr>
<tr><td>Access time to destination</td><td>-0.0034</td><td>T_a +20%</td><td>T_a +20%</td><td>T_a -20%</td><td>T_a +20%</td><td>T_a</td><td>T_a</td><td>T_a -20%</td><td>T_a</td><td>T_a -20%</td></tr>
<tr><td>Fare integration</td><td>0.03|0.11</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Baggage integration</td><td>0.09</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td rowspan="6">Air-HSR</td><td>Travel cost</td><td>-0.01</td><td>P</td><td>P -25%</td><td>P</td><td>P -25%</td><td>P -50%</td><td>P -50%</td><td>P</td><td>P -50%</td><td>P -25%</td></tr>
<tr><td>Travel time (in-vehicle)</td><td>-0.0025</td><td>T_v’-20%</td><td>T_v’-20%</td><td>T_v’</td><td>T_v’</td><td>T_v’-10%</td><td>T_v’-20%</td><td>T_v’-10%</td><td>T_v’-10%</td><td>T_v’</td></tr>
<tr><td>Connecting time</td><td>-0.0034</td><td>T_c +25%</td><td>T_c -50%</td><td>T_c +25%</td><td>T_c -50%</td><td>T_c +25%</td><td>T_c -25%</td><td>T_c -50%</td><td>T_c -25%</td><td>T_c -25%</td></tr>
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After a thorough work of data depuration, a total of 875 valid questionnaires were collected, resulting in 7875 observations for model estimation. The main characteristics describing our sample can be summarised as follows: (1) 42 years old male residents in Canary Islands travelling to Galicia, Andalucía and Levante; (2) travelling between one and three times per year; (3) staying out for more than five nights and the trip purpose is leisure and work; (4) accessing to the airport by private vehicle and connecting time at Barajas Airport is usually higher than 60 minutes; (5) using private vehicle and taxi to go to the final destination that is located in the city centre; (6) time to destination is usually higher than 30 minutes; (7) paying themselves for the travel expenses and belonging to the Iberia frequent flier program *Iberia Plus*; (8) travelling in economy or tourist class and most of the individuals read, listen music, sleep or work during the trip; (9) travelling with companions, making a check-in of one piece of baggage; (10) having an education level of secondary school or higher; (11) paying in average 100 euros per ticket, belonging to a three-person household, where two of them work and having two cars; (12) working 40 hours per week and with a net family income higher than 3000 euros per month.

The box-plot graph in Figure 1 depicts the degree of importance of design attributes considering a five-point Likert scale, where 5 represent very important and 1 represents not important at all. Although all attributes have been considered of importance, travel cost and travel time are among the most relevant when the individual expresses his travel preferences. Figure 2 analyzes the degree of importance of other attributes that has been commonly reported in the literature as competitive advantages of the HSR over the air transport. When the two options are available (i.e., in the second leg of the trip), safety, punctuality, service frequency and comfort are the most positively rated.

Figure 1. Importance of design attributes

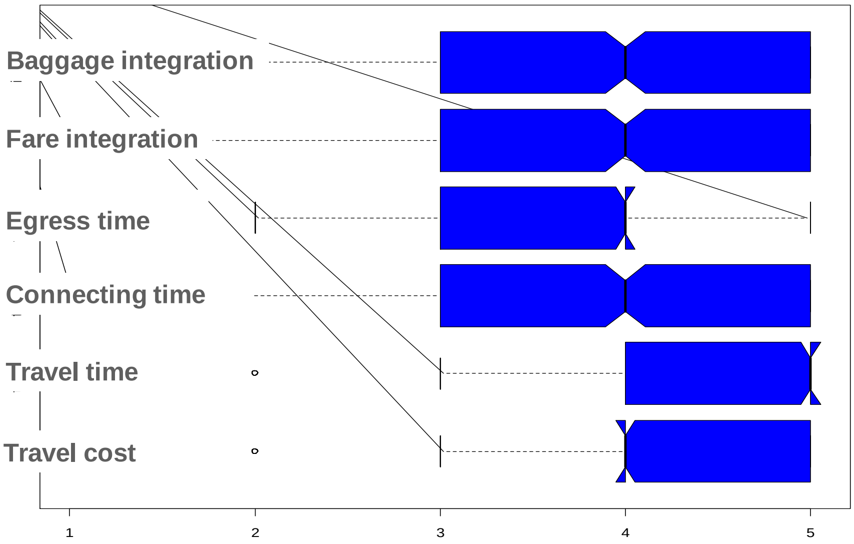
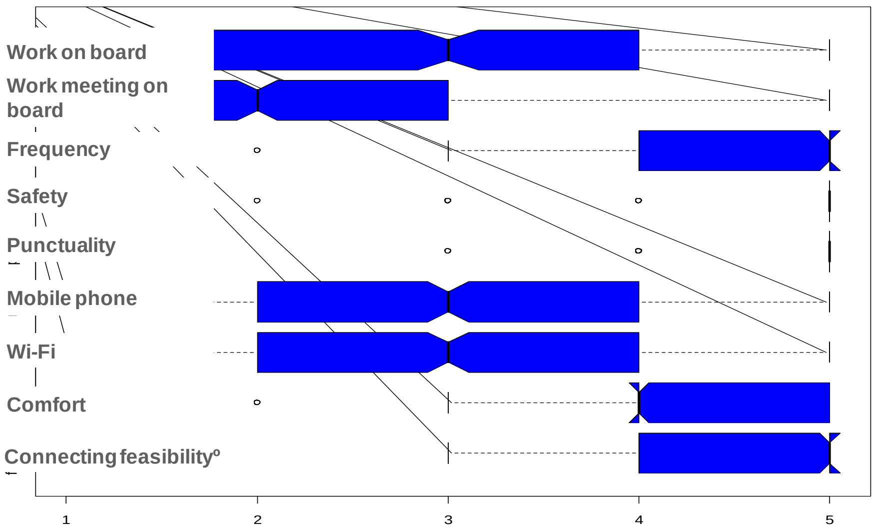


Figure 2. Importance of other attributes



4 Model and results

Under the assumption of random utility maximization (MacFadden, 1974), different discrete choice models were estimated using the SC data set, with the purpose of understanding travellers preferences for an integrated Air-HSR transport mode.

Our modelling approach was primarily focused on the analysis of factors that determine modal choice when integrated transport alternatives compete with traditional modes. On another hand, the study of systematic and random taste variation, as well as the panel effects, inherent to every SC data set, were also analyzed. To meet these objectives, we estimated progressively more flexible models whose specification included random parameters and the interaction of design attributes and socioeconomic variables (see Train, 2009 for a detailed reference on discrete choice models). All models were calibrated with the software package Biogeme 2.2 (Bierlaire, 2009) considering different procedures to generate random draws, depending on the model specification.

Estimation results for different Multinomial Logit (MNL) and Mixed Logit (ML) models are presented in Table 3. The first model MNL1 consisted in a simple linear specification of the attributes included in the discrete choice experiment described in Table 1: *travel cost* (C), *in-vehicle travel time* (Tv), *access time to destination* (Ta), *connecting time* (Tc), the dummy corresponding to the level one of *baggage integration* (BI) and the two dummies corresponding to levels one and two of *fare integration* (FI1 and FI2, respectively). All parameter estimates presented consistent signs and are significant at the 95% confidence level with the only exception of *baggage integration* that presented a very low value for the t-test. In order to understand the effect of this attribute, a new model MNL2 was estimated, considering instead the interaction of *baggage integration* and the variable *baggage* (B), being equal to one for those individuals who checked in at least one piece of baggage and zero otherwise. Although in this case the significance for this variable was increased, the effect of this variable is still not significant, at a reasonable confidence level. Thus, another model MNL3 adding the interaction of a third variable, namely *leisure* (L), that is equal to one if the trip purpose is leisure, was considered. In our case, results demonstrate that the effect of *baggage integration* resulted only significant for individuals who checked in some baggage and travelled for leisure purposes. This result is consistent with the composition of our sample, as 90.5% of the individuals travelling for leisure purposes checked in at least one piece of baggage; and therefore could positively value the availability of integrated baggage services. In contrast, the effect of this attribute could not be analyzed for work trips, since in a significant percentage of these trips (46.5%), travellers did not use the baggage handling services.

Model MNL4 also includes the interaction of the variable *work* (W), that is equal to one if the trip purpose is work and zero otherwise, with *connecting time* and *in-vehicle travel time*. In this case, all parameter estimates were significant at the 95% confidence level and presented the expected sign. The specification of these interactions allowed us to conclude that both, connecting and in-vehicle travel time, are more negatively perceived for those individuals travelling for work purposes.

Different ML models were estimated in order to analyze panel correlation effects as well as the existence of random taste heterogeneity. The first one, ML1 consisted in a fixed parameter specification that included an error component normally distributed with zero mean as a way to account for the potential correlation among choices of the same respondent. The high level of significance obtained for the estimated standard deviation (*Sigma*) of the error component allowed us to confirm the hypothesis of panel correlation. ML2 and ML3 correspond to a random parameter specification for the *travel cost, access time to destination* and *baggage integration*baggage*leisure* parameters. During the modelling process, other parameters were allowed to be random, but as their standard deviations were too small they were estimated as fixed in the final specification. In the case of ML2 model, the Normal distribution for all random parameters was considered. Even though this model provided consistent estimates, in terms of the parameter signs and their significance level, the size of the population parameters of the Normal distribution produced a relatively high probability of obtaining an inconsistent sign in certain coefficients. Thus, according to this model, the probability of obtaining a positive marginal utility for the access time to destination was 0.28. A similar result was obtained for the parameter of *baggage integration*baggage*leisure*, yielding a 0.38 probability of being negative. As this may cause certain problems in the phase of model application, e.g., in the simulation of the WTP distribution, the ML3 model was estimated considering log-Normal distributions for the random parameters, forcing the corresponding marginal utilities to present consistent signs. Although with this model the *access time to destination* reduces considerably its significance level, we decided to leave it in the final specification, as it is a relevant attribute.

Regarding coefficients magnitude, in general, their interpretation appears consistent. Travel and connecting time produce more disutility for work trips; and in contrast with other studies, in-vehicle travel is more negatively perceived than connecting time and access time to destination. The high proportion of in-vehicle travel time with respect to total travel time for these trips (approximately 59%) could be a possible explanation of this result. As an example, this figure differs substantially from the 30% that represents in-plane travel time over total travel time in the Madrid-Barcelona corridor (Román et al, 2010). As for the qualitative variables, model results indicate that fare integration is perceived as more important than baggage integration, being the latter significant only for individuals that check in their luggage and travel for leisure purposes. In all models, the estimated alternative specific constant for the Air-Air option had a positive sign. This result evidences the existence of inconveniencies associated to mode interchange, other than those considered in the utility specification, which are not compensated by the comparative advantages of the HSR in terms of comfort, safety and reliability. Finally, concerning the overall fit, the model with the highest log-likelihood is ML2, but if we take into consideration the consistency of the marginal utilities, ML3 provides a better performance.

4.1 Willingness to pay for modal integration

Willingness to pay for the attributes that define the modal integration can be obtained from the estimation of discrete choice models as the ratio between the marginal utility of the attribute and the marginal utility of travel cost, which in turn is defined as minus the marginal utility of income (Jara-Díaz, 2000). In the case of qualitative variables, the WTP can also be obtained as the ratio between the increment in utility produced by an improvement in the attribute and the marginal utility of income.

When a fixed-parameters specification for the utility is used, a point estimate for the WTP, represented by a fixed value, is obtained. By contrast, when random parameters are considered, the corresponding WTP measure is a random variable as well, and simulation techniques will be usually required in order to know their probability density function.

Table 3. Estimation results

Attributes			MNL1	MNL2	MNL3	MNL4	ML1	ML2	ML3
			Estimate (t-test)						
ASC Air-Air (ASC)	θ_{ASC}		0.702 (10.42)	0.707 (11.19)	0.727 (12.06)	0.725 (11.97)	1.1 (10.55)	1.44 (12.00)	1.31 (10.95)
Travel cost (C)	θ_{C}	Mean	-0.0222 (-27.69)	-0.0222 (-28.00)	-0.0221 (-28.18)	-0.0222 (-28.22)	-0.0341 (-29.56)	-0.0472 (-22.60)	1.42 (29.07)
		Stand. Dev.	- -	- -	- -	- -	- -	0.0294 (11.71)	0.817 (8.87)
Baggage integration (BI)	θ_{BI}		0.0186 (0.28)	- -	- -	- -	- -	- -	- -
Fare integration level 1 (FI1)	θ_{FI1}		0.406 (5.33)	0.41 (5.55)	0.425 (5.88)	0.422 (5.83)	0.538 (6.04)	0.696 (6.44)	0.875 (7.34)
Fare integration level 2 (FI2)	θ_{FI2}		0.507 (6.27)	0.515 (6.81)	0.553 (7.72)	0.551 (7.68)	0.783 (8.24)	0.728 (6.75)	0.827 (7.70)
Access time to destination (Ta)	θ_{Ta}	Mean	-0.395 (-2.65)	-0.378 (-2.64)	-0.285 (-2.05)	-0.288 (-2.08)	-0.391 (-1.78)	-0.843 (-3.54)	-1.42 (-1.27)
		Stand. Dev.	- -	- -	- -	- -	- -	1.48 (4.40)	0.77 (0.81)
Connecting time (Tc)	θ_{Tc}		-0.43 (-10.68)	-0.431 (-10.7)	-0.436 (-10.81)	-0.386 (-8.12)	-0.581 (-9.49)	-0.614 (-8.89)	-0.632 (-8.92)
Travel time in-vehicle (Tv)	θ_{Tv}		-0.625 (-20.65)	-0.627 (-21.22)	-0.635 (-21.85)	-0.593 (-17.72)	-0.796 (-16.63)	-0.843 (-15.89)	-0.914 (-15.32)
Baggage integration (BI) * Baggage (B)	θ_{BI*B}		- -	0.0405 (0.63)	- -	- -	- -	- -	- -
Baggage integration (BI) * Baggage (B) * Leisure (L)	θ_{BI*B*L}	Mean	- -	- -	0.213 (2.93)	0.192 (2.58)	0.21 (1.92)	0.141 (1.18)	-3.21 (-1.94)
		Stand. Dev.	- -	- -	- -	- -	- -	0.467 (1.81)	1.82 (1.99)
Connecting time (Tc) * Work (W)	θ_{Tc*W}		- -	- -	- -	-0.157 (-1.97)	-0.256 (-2.41)	-0.258 (-2.21)	-0.205 (-1.71)
Travel time in-vehicle (Tv) * Work (W)	θ_{Tv*W}		- -	- -	- -	-0.12 (-2.47)	-0.316 (-4.29)	-0.372 (-4.73)	-0.347 (-4.19)
Sigma	σ		- -	- -	- -	- -	1.92 (23.62)	2.27 (21.48)	2.1 (21.26)
***l**(0)**			-5458.53	-5458.53	-5458.53	-5458.53	-5458.53	-5458.53	-5458.53
***l**(θ)**			-4260.87	-4260.71	-4256.62	-4252.71	-3691.14	-3587.69	-3650.51
Observations			7875	7875	7875	7875	7875	7875	7875

Willingness to pay values corresponding to MNL4 and all ML models are presented in Table 4. For ML2 and ML3 the mean and the median of the simulated WTP distribution are presented. The highest WTP is found for saving in-vehicle travel time, with figures ranging from 27.09 to 33.60 €/hour when the trip purpose is work and between 19.70 and 26.71 €/hour when the trip purpose is other, depending on the model. In general, we observe that the value of in-vehicle travel time is higher than the value of connecting time, and the later higher than the value of access time to destination. With regard to qualitative attributes, individuals also exhibit a significant WTP for fare integration. It is interesting to note that, for certain models, the two levels of this variable are perceived as similar. In contrast, individuals in our sample did not consider worth the availability of an integrated service of baggage handling. In fact, and in order to be realistic, the highest level of this variable was defined according to the future plans of investment at Madrid-Barajas Airport, where a full baggage integration system was not projected in a near future[3].

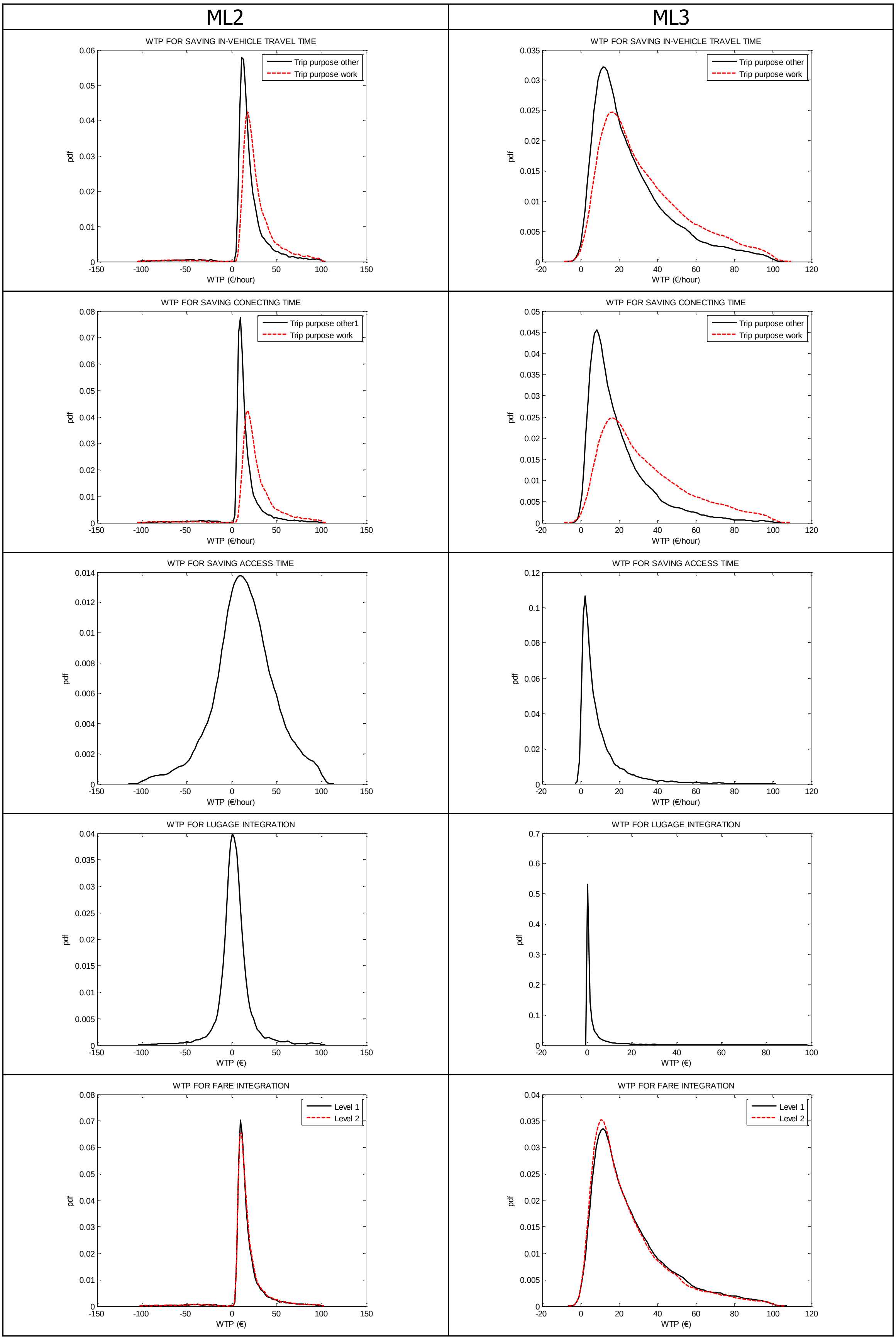
Figure 3 depicts the probability density function of the WTP measures for models ML2 and ML3 after considering 10.000 random draws of the Normal and log-Normal distributions for the corresponding parameters. Looking at these distributions for the model ML2 we observe that, in the case of access time and baggage integration, there is a significant probability of obtaining a negative WTP. However, this problem is not present in the ML3, when log-Normal distributions are considered, which makes this model much more suitable for policy analysis.

Table 4. Willingness to pay values

Attribute	**Willingness to pay**					
	MNL4	**ML1**	**ML2**		**ML3**	
			Mean	Median	Mean	Median
Baggage integration (€)						
- The traveller checks baggage and the trip purpose is leisure (€)	8.65	6.16	3.33	2.64	4.54	0.94
Fare integration level 1 (€)	19.01	15.78	16.53	13.54	26.27	20.22
Fare integration level 2 (€)	24.82	22.96	17.27	14.15	25.19	19.25
In-Vehicle travel time (€/hour)						
- Trip purpose is other (€/hour)	26.71	23.34	19.70	16.33	27.13	21.05
- Trip purpose is work (€/hour)	32.12	32.61	27.09	23.28	33.60	27.60
Access time to destination (€/hour)	12.97	11.47	14.37	13.90	10.07	5.68
Connecting time (€/hour)						
- Trip purpose is other (€/hour)	17.39	17.04	14.61	11.96	20.12	14.93
- Trip purpose is work (€/hour)	24.46	24.55	20.33	16.88	25.42	19.47

[3] This result is consistent with Chiambaretto and Decker (2012) who show that passengers at the Paris-CDG train station reject the baggage integration. They conclude that this can be interpreted in different forms, but the most plausible one is that baggage integration definitively supposes a benefit-risk trade-off (Shaw, 2011).

Figure 3. Distribution of the WTP figures. ML2 and ML3



5 Conclusions

Intermodality between HSR and air transport is gaining its momentum worldwide as a way to rationalize more efficiently both transport modes. Thus, a better knowledge of the importance of the key drivers in order to promote this new alternative is necessary. In this paper the analysis is based in a (SC) experiment facing travellers to the choice between the current alternative (Air-Air) and the Air-HSR alternative.

Our results show that there is certainly some disutility associated not only to the connection in Madrid Barajas airport but also to the change of transport modes. For this reason it is highly relevant to have good estimates for the different service attributes that help policy makers and transport managers to develop attractive intermodal alternatives. This compensation has to be provided in terms of connecting, total in-vehicle and access time, instead of baggage integration. Fare integration is also very valued. Our results show that passengers value in a similar way the complete fare integration or the soft-integration in which an insurance company reduces the uncertainty of the monetary losses for potential delays.

We also find a different pattern regarding the preferences between mandatory and leisure trips. In this respect, baggage integration is only significant for leisure travel and when at least one piece of luggage is checked-in. The disutility associated to travel time is lower for leisure than for mandatory trips. The new intermodal alternative is positively valued in terms of both, punctuality and safety associated to the HSR.

However, a cost benefit analysis needs to be done with the basis of this demand analysis of intermodal transport services contemplating the costs of these projects with different service levels before implementing a suboptimal alternative. To reach the highest potential it should be necessary to create a real intermodal terminal that passengers are willing to pay.

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