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THREATS AND OPPORTUNITIES FOR HIGH SPEED RAIL TRANSPORT IN COMPETITION WITH THE LOW-COST AIR OPERATORS

Dipl. Eng. Carles Casas Esplugas
PhD. Dipl. Eng. Paulo Fonseca Teixeira
Prof. Dr. Eng. Andrés López-Pita
Dipl. Eng. Adrina Bachiller Saña

CENIT (Center for Innovation in Transport)
Barcelona, Spain

ABSTRACT

The apparition of Low Cost air Carriers (LCC) in Europe over the last decade has been a direct effect of the liberalisation of European Skies. However, its rapid growth wasn't anticipated for most of the traditional European transport operators.

Although traditional air carriers (or Full Cost Airlines, FCC) have been seen as the main receptors of the impact of this change, the expansion of LCC from their traditional market in and from the United Kingdom and Ireland to the continental Europe threats the rail marketshare in high speed services.

High speed rail in Europe has proved to be a powerful competitor against the plane for travel times up to 3 and a half hour (i. e. distances up to 750 km). One of the main weapons of high speed rail against the air competitors has been the fares policy which was much lower than the average air rates. This situation has been changed by the LCC offering average fares even lower than the rail ones. One clear example of this new situation is the Paris – Köln relation, served by Thalys high-speed rail services and the LCC "Germanwings" offering better times and lower fares.

This paper analyses this concurrence scenario, at present and in the future. A Logit model for the modal air/rail distribution has been calibrated showing the capacity of LCC to compete with high speed rail just with a Low-fare policy. It also shows the variable elasticity of average travellers on the fare rate depending on travel time.

The need of high speed rail to act in order to keep its marketshare is showed together with the inevitable impact of the LCC in its market. Also it is showed its capacity to compete in fares, offering lower fares with high restrictions (as LCC do), and in time, offering best door-to-door times and a far more "quality" travel time. These may be its more effective counter-measures in order to not only maintain but increase its marketshare offering a competitive and sustainable alternative to air transport.

THE APPARITION OF LOW COST AIR CARRIERS IN EUROPE

The apparition of Low Cost air carriers in Europe has been a direct effect of the liberalisation process of the European air transport. Nevertheless, it has not been an immediate effect of this liberalisation. In a firs stage the companies that entered the liberalised European skies followed a more classical approach of the air transport mainly offering elite or high class services. This was the case of Debonair & Fairlines.

But, although not an immediate effect, once the Low Cost Companies made their entry in the European market, their growth has been such that in a few years the whole short-haul air market has been changed.

Effects of the liberalisation of European Skies

The industry of airlines in Europe had been traditionally characterized by national companies or "flag" companies working as unique operator in their corresponding internal markets and depending on political agreements for the international flights. These agreements between countries established the routes, frequencies and fares to be applied.

This lack of competition had an end, at least for intra european flights, with the liberalisation process of the european skies. This process took place during the nineties by means of different initiatives of the European Union. These legislative initiatives had deep effects on the air transport sector.

The air transport sector had a big dispersion before the liberalisation but different companies have evolved fast to concentration and alliances between companies while reorganizing their services in hubs. It must be said that European market has some particularities like the quality of rail services, the public founding of some regional lines and the density of population which make it in some aspects very different of the US market. The biggest consequence of the liberalisation wa on the number of services and fares s the creation of a big size market with more than 370 million of population and the possibility of joint negotiations with third countries.

Passengers have taken benefit of the liberalisation process. A direct consequence of this process was a boost in frequencies and a multiplication of available destinations (directs through regional companies and with scales through hubs and alliances). The growth in passengers between 1989 and 1993 was mainly produced in the reduced fare segment, due to promotion and loyalty programs of air companies. Nevertheless, as has been said, liberalisation was, in a first stage, not followed by a reduction in fares with the exception of some of the most economic ones. It was not until the irruption of low cost companies when fares were really reduced, by the new companies but also by the existing ones when re-adjusting they commercial offer.

The airline sector has been deeply affected by the liberalisation process. Among all the changes induced by this regulation changes, three aspects can be highlighted:

- Progressive privatizations of national air companies and the search of partners and alliances. This last aspect is due to the big fragmentation of the european market as can be stated by the fact that in 1998 British Airways, the biggest European company at the moment, had an 8% of the intraeuropean traffic. At the same time, american companies United Airlines, American Airlines and Delta Airlines had a 16% of the american domestic market each.

- Growth of regional companies, in several cases with bases in secondary hubs and allies of the big airlines

- The apparition of low cost air companies

Expansion and effects of low cost air carriers

As the Association of European Airlines (AEA) states, sins 2002 the growth of the so-called low cost companies has boosted in Europe (fig 1). The “Low Cost phenomena” beagan earlier, in the mid-1990s when it comprised only Ryanair and Virgin Express, shortly joined by Easy Jet. Since that time, the number of players has increased. It is rather difficult, as is admitted by the AEA, to establish a common definition for these new air operators, as although all these carriers share some characteristics, all ar substantially different from each other.

Regardless of the difficulty of establishing a common definition, the main effect of the apparition of these new players in the european market has been an increase of destinations served and a general increase of the availability of low fares for the destinations served. Thus, the reaction of traditional companies has induced an overall decrease of air fares.

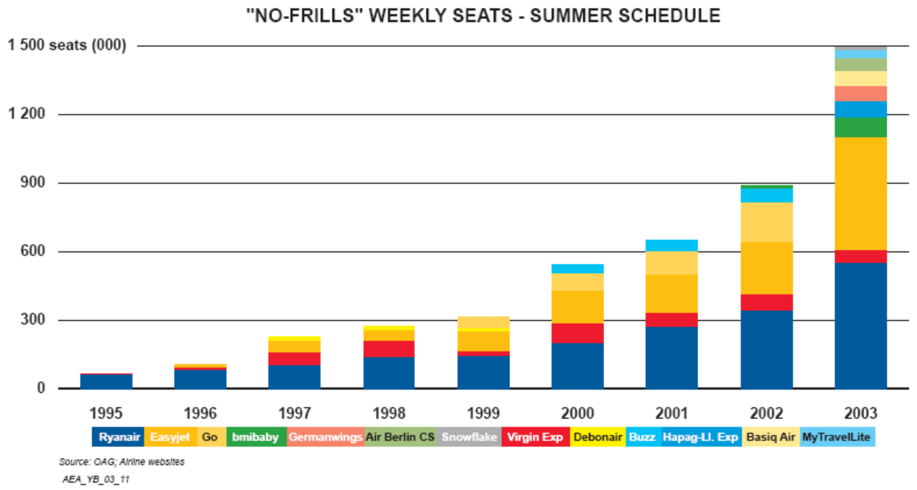


Fig 1, The growth of Low cost services. Source: AEA (2003)

The apparition of low cost companies has answered some specific demands of the market and, also, has contributed to increase the mobility of European citizens. Studies made by consultants Mercer (2002), Morgan Stanley (2002), McKinsey&Company (2003), and the analysis of some airlines such as Air France (2002) agree that Low Cost companies have margin to grow and that, in short, they will last in the European market.

Prognosis made by the mentioned studies establish that low cost companies will expand until 2010, where they would achieve a market share of a 25%. From that moment, a deceleration in its growth is foreseen mainly due to the increase of competence among low cost air companies themselves.

COMPETITION BETWEEN AIR AND RAIL

The apparition of High Speed Rail in Europe

The apparition of High Speed Rail (HSR) services in Europe with the inauguration of the Paris-Sud-Est line in 1981 was a break point for Air-Rail marketshare. Before the arrival of high speed services, railways were constantly losing marketsare in benefit of roads (mostly for freight traffic) and air.

HSR was seen as the technological jump that could allow a modernization of the rail mode of transport and replace into the transport market with possibilities to compete with success in medium and long distance trips. This technological jump had already begun in the other modes with the introduction of modern jets for air transport services in the seventies and with the expansion of the highway network in Europe (from 16.000 km at the end of the seventies to 46.000 at the end of the nineties).

The important growth of road and air traffics has driven to important congestion and saturation problems of the European transport system. Within this framework, railways have emerged as a suitable and sustainable alternative in order to satisfy transport demand. The support of rail mode has therefore become one of the main axes European transport policies

Rail competitive advantages and disadvantages

Undoubtedly, the fare level was one of the key factors for rail success for the first high speed rail services in France but the virtues of high speed rail offer go much further. One of the aspects that influence de most the modal election is the frequency of services and High Speed Rail has, in most relations, doubled the previous offer. Nowadays, the main relations connected by High Speed Rail are served by more than 20 trains per day and direction.

The quality of a transport service offer is constituted by an ensemble of parameters being time and cost the ones widely recognized as more determinant. But these are not the only factors that influence modal election. The factors that influence modal election are not absolute parameters but highly dependant on the traveller and the reason of the trip. Fig 2 shows the result of the study carried on by the Deutsche Magnet Bahn in 1993 evaluating the traveller demands corresponding to different travel reasons. This study highlighted that for business trips, main factors in modal election are travel time, frequency and comfort while for leisure trips fare level is a main election factor.

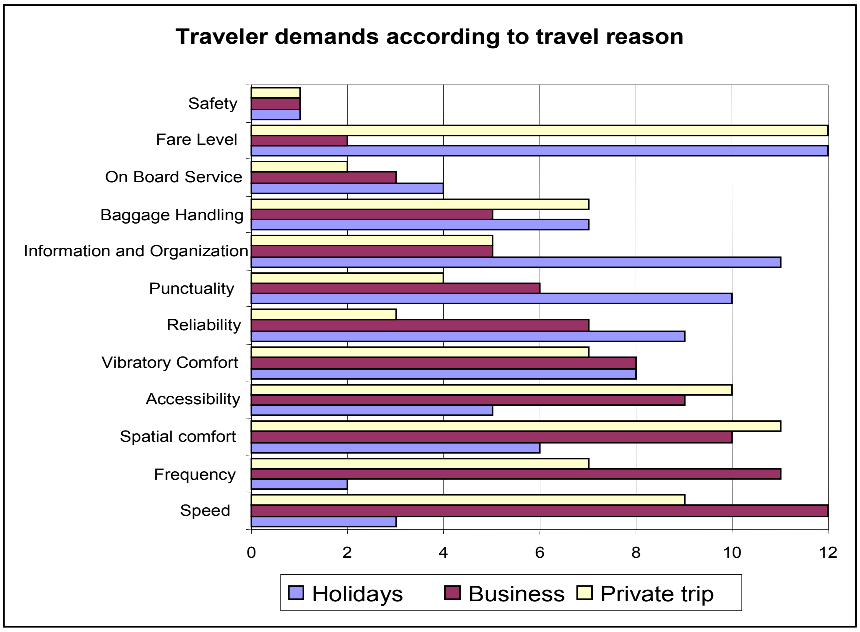


Fig 2. Traveler Demands according to travel reason.
Source: A.López Pita from data of DBAG (1993)

Among the advantages of railways sevices, it can be highlighted the following aspects that influence the modal election:

- **Safety:** Railways are the safest of the transport modes

- **Network effect:** In most of the European countries, High speed trains can also run the classic rail network. This allows extending the effects of high speed beyond the section of real high speed transit. At the same time allows planning a step-by-step construction of high speed infrastructure

- **Punctuality:** In opposition with the Air Transport, rail offers high punctuality of its high speed services. This characteristic has allowed the operators to acquire “quality agreements with the passenger. These agreements include, as with the AVE Madrid-Sevilla services, total reimbursement of the ticket for more than 3 minutes.

- **Comfort:** Besides of more useful time, railway offers more space between seats. In railways, this distance is between 95 and 115 cm. while for short and medium haul air services the distance between seats is around 75-80 cm.

- **City centre to city centre services**: The use of the existing rail network allows to offer services that link city centres which tend to be much close to or better connected with the final destination of the traveller than airports

- **Environmental aspects:** Rail transport is a considerable improvement compared to road and air transport with regard to the environmental aspects and acoustic contamination. The following table shows the advantages of railways in terms of gas emissions.

Table 01: Energy consumption and gas emission per transport mode

Parameter	Transport mode		
	Railways	Plane	Road
Energy consumption* (epl/passeng/km)	0,0258	0,0783	0,0591
Carbon Dioxide (kg/viajero/km)	0,0445	0,1860	0,1400
NO (g/pas/km)	0,0376	0,6460	0,1730
SO_2(g/pas/km)	0,0359	0,0968	0,0815

* epl = equivalent petroleum litre.
Source: López Pita (2002) a with data from DBAG

Among the disadvantages can be highlighted:

- **Investment Costs:** The construction of new infrastructures for High Speed Railways has high costs (Koln-Frankfurt 25M€/km, Valence-Marseille 14M€/km, Madrid-Lleida 10M€/km, London-Folkestone 30 M€/km, Roma-Nápoli 16 M€/km). Besides of infrastructure costs, the rolling stock suited for rolling at high speeds have high investment costs.

- **Weak flexibility:** Due to the cost of building a high speed line, their construction mus be justified by a high traffic demand able to make profitable the investment while keeping fares in a reasonable level. But the dependency on the infrastructure as the long time between the decision of building a new line and its inauguration make it difficult to adapt the offer to sudden changes in demand.

Rail success

High Speed Rail success in competition with air transport in Europe was proved since its beginning in the Paris-Lyon route. As it can be seen in the fig.3 rail mode absorbed all the growth of traffic between Paris and Lyon wile air transport was driven to lower levels than at the beginning of the seventies. On the other hand, the Paris-Marseille route continued to gain passengers for air transport due to a lack of competitiveness of the rail mode. The success of rail mode is well presented in fig. 4 which shows the modal split Air-Rail for relations served by High Speed Rail. Rail gets more than 50% of marketshare for rail travel times of up to 3 hours.

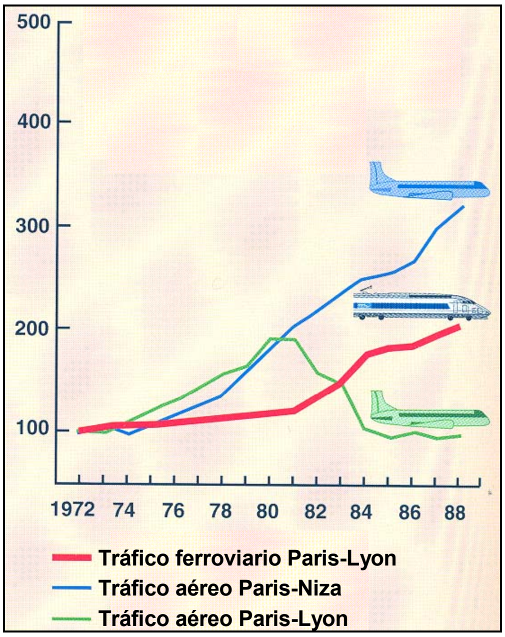


Fig 3 Evolution of modal split in the SE axis. Source: Soulié & Tricoire (2002)

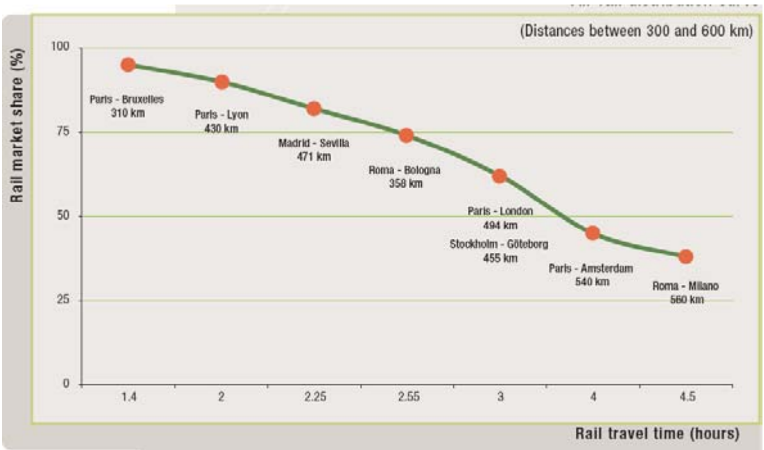


Fig 4. Air-Rail Distribution Courbe. Source: UIC

The big success of the new rail offer made other countries build new infrastructures for high speed trains with high investments in this mode of transport. These investments are expanding the high speed lines (3216 km in june 2003) tending to constitute, in the near future, an European high speed rail network (fig 5).

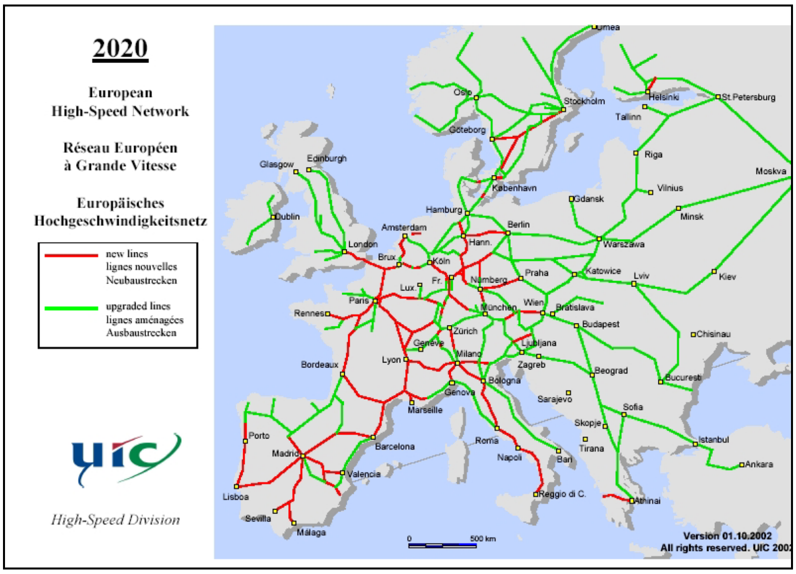


Fig 5. Planned High Speed Rail Network for 2020. Source: UIC

From competition to complementarity

Despite the apparition of the high-speed, passengers air traffic in Europe didn't stop growing so congestion and saturation problems in the European airspace were increasing. This saturation caused an important lose of quality in air service, by the lack of punctuality, and at the same time, important economic losses.

In front of this scene, the idea of complementarity between high-speed railway and airplane started to take shape in the late 80's and early 90's. It actually originated in Europe in France. The French government decided at that time to build the high-performance, Interconnection line that would link up the high-speed LGV South East, LGV Atlantic and LGV North lines in the Paris suburbs, and which would also serve Charles-de-Gaulle airport. This first high-speed station entered commercial service in November 1994. Almost simultaneously, a few months earlier, in fact, the LGV station at Lyon-Satolas airport was opened now called Saint-Exupéry.

To synthesize, A. López Pita (2001) resumed in three the main fields of cooperation between railway and airplane:

- Railway links to the airports
- Intra-European middle and long distance journeys
- Transport chain

Essentially, the final objective of the initiatives of cooperation between railway and airplane is for each mode being used where it is more efficient and having interactions among the other modes that are globally profitable for the operators and the society.

In this line must be placed recent services established in collaboration by the air company Lufthansa and German railways so the passengers flying from Frankfurt can check-in in railway stations of Stuttgart and Cologne travelling to Frankfurt in ICE high-speed trains. Similar initiatives are been developed in France, and the arrival of new high-speed lines to airports will increase the possibilities of intermodal journeys.

Another innovative concept starting to develop is the "System of airports", that seeks coordinating airports linked by high-speed railway services, as will be in shortly the case of Frankfurt-Cologne.

LCC EFFECTS IN RAIL MARKETSHARE

The success of High Speed Rail transport was a combined result of the competitive performance of rail in travel time, the quality of the rail service (punctuality, city centre to city centre, etc.) and lower fares than air transport. In Fact, Sands (1993) defined High Speed Train as “twice as fast as the auto, half as expensive as air”. This definition is clearly no longer applicable with Low Cost Companies as players in the same market.

Within this context of success and big investments in the rail network, Low Cost airlines are a completely new player that, due to their low fares, can affect not only the other airlines but also the success of High Speed rail.

The influence of low cost airlines is not only a theoretical issue. Germanwings started low cost air services between Paris and Köln offering tickets as low as 29€ one way (2003). This produced a reaction in Thalys rail services that introduced a new ticket no reimbursable at a price of 59€ (when the cheapest one used to be of 78€)

Previous considerations and aims of the model

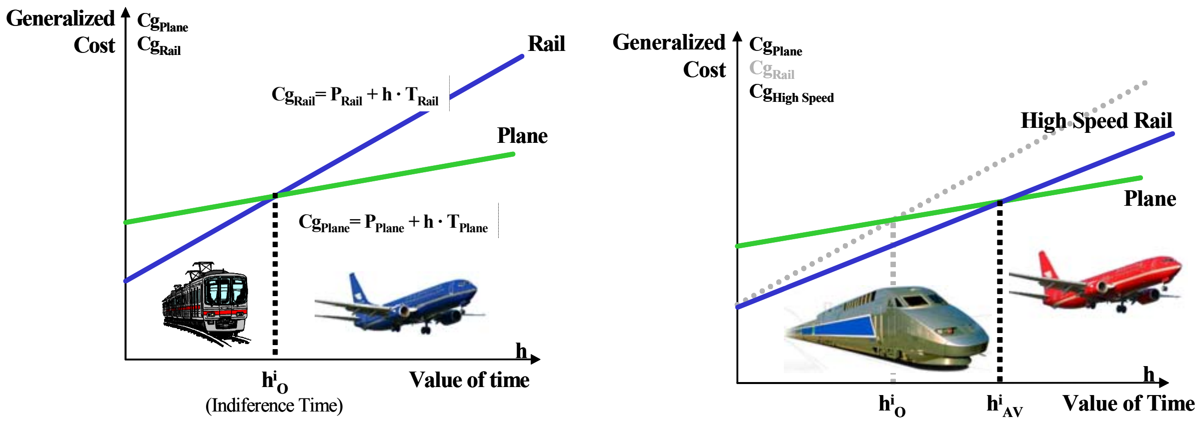
Air-rail competition has been traditionally modelled to evaluate the profitability of new investments in rail infrastructures but assuming, in general, lower fares for rail than air. The objective of the model was to evaluate the influence (probably a loss of marketshare) of rail services serving the same destinations.

With this aim, a bimodal model (HSR-air) has been developed and calibrated with the available data. The effect of the irruption of a low cost carrier has been simulated by a reduction of air fares.

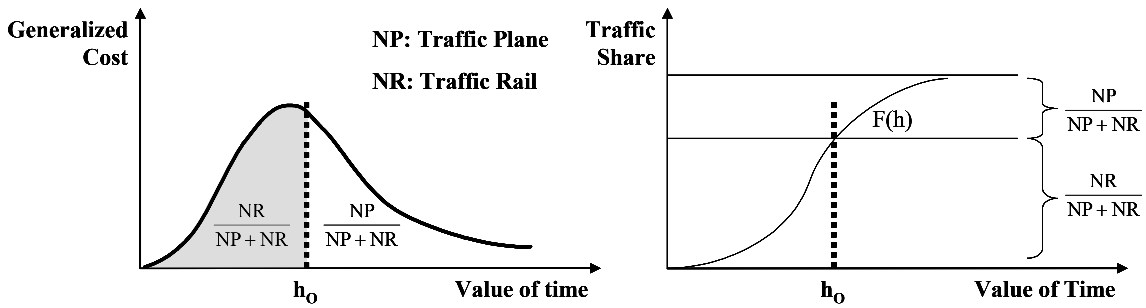
The aim of the model was not to analyse in depth the characteristics of the demand on the different modes or which were the factors that could influence modal changes. This would require much more detailed data collecting and modelling. The objective was to evaluate the sensibility of rail transport marketshare to a decrease of air fares in the same corridor.

Modelling technique

One traditional method of forecasting the share of traffic between rail and air is the one used by the SNCF. It is based on what might be termed a “price-time” model (BRB, 1988; Jincheng, 1996). The procerures assumes that a traveller chooses rail or air according to which has the lowest generalised cost. The latter is composed as the fare plus the journey time weighted by the value of time (figs 6 and 7). A distribution of values of time is used to obtain each modes marketshare (figs 8 and 9).



Figs. 6 and 7 determination of Indifference time



Figs. 8 and 9 Determination of traffic share from the indifference time

But this kind of model is not able to evaluate the entry of a Low Cost carrier into the market as it assumes lower fares for rail mode. A Low Cost air company would offer (for flight times of 1 hour or more) lower time and lower fares, thus a lower generalized cost for all values of time (fig 10). This would result in a 100% of marketshare for low cost, which is not the case.

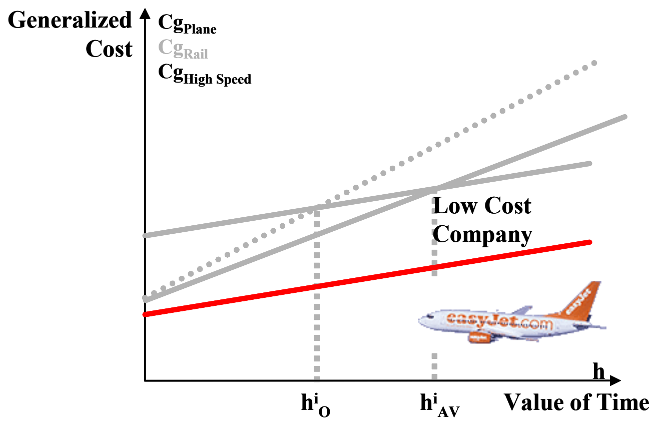


Fig 10. Example of malfunction of the price-time model to represent the effect of a Low Cost airline entry

The modelling technique choosen to evaluate the modal split has been a bimodal logit model. The theory of this family of models is the aleatory utility technique (Domencich & McFaden 1975; Williams 1977). In its essence, it states that an individual chooses one mode guided by an utility function with two factors: a deterministic one (measurable part) V and an random one which reflects the particularities of each individual together with the measurement or observation errors.

Utility of the alternative i for the passenger A:

$$U_i(\theta_i,A) = V_i(\theta_i,A)+\xi_i(\theta_i,A) \quad i = 1,.....,m \quad \textbf{(1)}$$

If it is established that the random factor (ξ) follows a distribution of Gumbell type then the model is a Logit one. If it is assumed a Normal distribution, then the model would be a Probit one. The Logit condition assumes independency of irrelevant alternatives. If modal choice is restricted to two unique alternatives (in this case Air and High Speed Rail) this condition can be assumed. The logit model theory states that High Speed Rail marketshare can be expressed as

$$p_{ij}^{HS} = \frac{e^{V_{ij}^{HS}}}{e^{V_{ij}^{HS}} + e^{V_{ij}^{Air}}} = \left[1 + e^{\left(V_{ij}^{Air} - V_{ij}^{HS}\right)}\right]^{-1} \quad \textbf{(2)}$$

where Vij is the utility of each mode for the relation between i and j. In general, this function is a linear combination of variables.

Due to the lack of data available to calibrate the model, it has been chosen a simplified utility function only using generalised costs as variables:

$$V_{ij}^{(k)} = \gamma \cdot \left(GC_{ij}^{(k)}\right) \quad \textbf{(3)}$$

The parameter to be calibrated is γ and will have negative sign as utility decreases with costs.

For the Generalized Cost it has been used the expression (4)

$$GC = F + vot \cdot \sum_h w_h t_h \quad \textbf{(4)}$$

Where: ***F***: is the average fare
vot: is the value of time
Wh y ***th*** weights and times of each step of the trip

Implementation of the model

There was not much data available for the modelization at the moment of the study so some of the parameters were estimated in order to evaluate the foreseeable impact of a low cost entrance as competitor to high speed rail. The relations selected for the calibration are city pairs with already high speed rail services and direct air services.

In order to obtain the generalized cost it is necessary to obtain the total trip time, the value of time and the average fare for each relation and each mode. To simplify the model, some global parameters have been assumed at this stage.

To obtain the weighted time, the trip was divided in five stages; access to the terminal, check-in, Main trip, Check out and Ride to destination. The time of each one of the stages was weighted according to the perception of the traveller of the time spent in each of the stages (table 2):

	Weights				
	TIMES				
	Acces	Check-in	Main Trip	Check-out	Riding
Standar	1,25	1,5	1	1,5	1,25

Table 2, Time Weights

The same times for access, check-in, check out and riding were applied to each relation in order to obtain the weighted time. The value of time applied was of 37 €/hour as proposed by Hammadou & Jayet (2002) as the average value of time for air transport in France in 2002. At this stage of the model, average values of access time, waiting time, check-in time, check-out time and riding to destination time were used.

The determination of the average fares for each relation is a difficult issue as there is a big variability of fare levels, even more with the day-by-day variation of the low cost air carriers. To establish a representative average fare, four fare levels were kept, full price for business and tourist class and economy price for tourist and economy class. The average fare was obtained weighting each fare level for an estimated percentage of passengers travelling in this class which are different for rail and air:

Plane fares distribution			
Standard		Economy	
business	tourist	business	tourist
0,05	0,5	0,05	0,4

Train fares distribution			
Standard		Economy	
business	tourist	business	tourist
0,15	0,4	0,15	0,3

Table 3. Fare distribution

The resulting data for the selected relations is:

	High Speed Train			Plane		
Corridor	Weighted time (wt)	Kept Fare	GC^{HS}	Weighted time (wt)	Kept Fare	GC^{Air}
Paris-Brussels	163,75	61,675	162,65	266,25	182,15	346,34
Paris-lyon	198,75	56,3188	178,88	266,25	95,2	259,39
Madrid-Sevilla	228,75	68,215	209,28	251,25	104,425	259,36
Paris-Londres	258,75	105,375	264,94	271,25	111,187	278,46
Paris-Amsterdam	328,75	91,875	294,60	271,25	104,717	271,99
Roma-Milano	363,75	49,0758	273,39	261,25	74,747	235,85
Paris-Nice (2002)	413,75	96,52	351,67	281,25	135,7	309,14
Paris-Marseille	258,75	83,045	242,61	271,25	81,05	248,32
Paris-Toulouse	393,75	74,2225	317,04	271,25	108,75	276,02

Table 4. Data for the calibration

The calibration of the expression (2) once applied (3) and (4) and the data of Table 4 gives the result shown in table 5:

γ	-0,019
R^2	0,8998

Table 5. Calibration results

The expression of the utility can thus be written as:

$$V_{ij}^{(k)} = -(0{,}019)\cdot CG_{ij}^{(k)} \quad \textbf{(5)}$$

And rail marketshare as:

$$p_{ij}^{HS} = \left[1 + e^{-0{,}019\cdot\left(GC_{ij}^{Air} - GC_{ij}^{HS}\right)}\right]^{-1}$$

Although the “R^2” is not very high, it is close to 0,9, therefore an acceptable adjustment at this stage, even more considering the few points available for calibration, the simplicity of the utility function and the assumptions made when calculating Generalized Costs. Figure 11 and table 6 show the model adjustment to the real values of utility and marketshare.

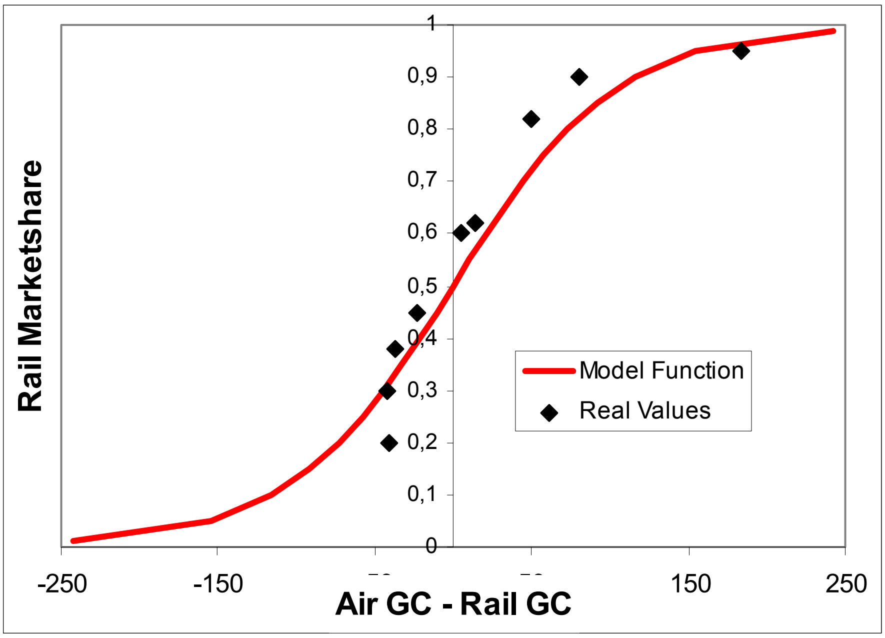


Fig 11. Adjuts of the model to the real data

	HS Rail Marketshare	
	Model	Real
Paris-Brussels	97%	95%
Paris-lyon	82%	90%
Madrid-Sevilla	72%	82%
Paris-Londres	56%	62%
Paris-Amsterdam	39%	45%
Roma-Milano	32%	38%
Paris-Nice (2002)	30%	30%
Paris-Marseille	52%	60%
Paris-Toulouse	31%	20%

Table 6. Differences between real marketshare and model marketshare

Validation of the model

Due to the lack of data, not much validation of the model has been done. It has been applied to the Roma – Bologna and Köln – Paris corridors which have not been used for the calibration and to the Paris-Amsterdam corridor with an hypothetic reduction of trip time due to a high speed rail service (new trip time: 183 minutes).

	High Speed Train			Plane		
Corridor	Weighted time (wt)	Kept Fare	GC^{HS}	Weighted time (wt)	Kept Fare	GC^{Air}
Paris amsterdam	261,75	91,875	162,65	271,25	104,717	271,987333
Paris Cologne	313,75	77,35625	178,88	266,25	134,9	234,1875
Roma-Bolonia	238,75	39,1159	209,28	256,25	84,1	242,120833

Table 7: Data to feed the model

The application of the model gives a very good value for the Roma – Bolonia corridor, in fact, it coincides with the real modal split. On the other hand, a big difference between predicted and real marketshare appears for the Paris – Cologne corridor. This can be explained by a lack of air offer between Paris and Cologne at the moment (only 2 Low Cost-operated planes per day).

CORRIDOR	Model	Real
Paris-Köln	33% HS	77% HS
Roma-Bolonia	74,3% HS	74% HS

Table 8: Results of the application of the model to selected corridors

The reduction of time in the Paris Amsterdam relation gives an hypothetic marketshare for HS rail of 58,8% which is consistent with the data available of relations with the same travel time and distance (Paris – London 62%) but it can not be verified.

Application of the model

Even if the expression obtained has its handicaps, as will be stated in the next chapter, and thus it can not be considered fully validated expression, the consistency of the data allows to apply it in order to obtain hints on how a reduction of fares (simulating the entrance of a Low Cost air company into the corridor) could influence Air – Rail modal split.

To reproduce this effect, successive reductions of air fares (by 10%) have been applied to each corridor keeping all the other parameters unchanged. These results are represented in fig 12 which represents the predicted marketshare of rail for each of the selected relations.

The result of the application of the model are slighty “S” shaped curves which show that different corridors have different sensitivities to a decrease in air fares. Corridors with a lower travel time are less sensitive to an air fares decrease. The corridors with low travel time (Paris – Brussels, Paris – Lyon and Madrid – Sevilla) have a strong market position that would be kept even in the case of considerable reduction of air fares. For Paris-Lyon and Paris-Brussels, High Speed Rail would remain as dominant mode for air fares reductions over the 60%.

On the other hand, the situation of some of the relations is much sensitive as they are situated in a zone of higher slope of the curve. This is the case of Paris – London and Paris – Amsterdam relations.

Finally, the results also show that there is a sort of “residual” marketshare for rail services that makes that once marketshare drops under 20%, it becomes much less sensitive to air fares variation. It can also be noted that a part of the marketshare would be kept by rail even with a 100% of air fares reduction, due to the big difference in travel times between the two modes that would make desirable to pay for the train even in the case of free air tickets.

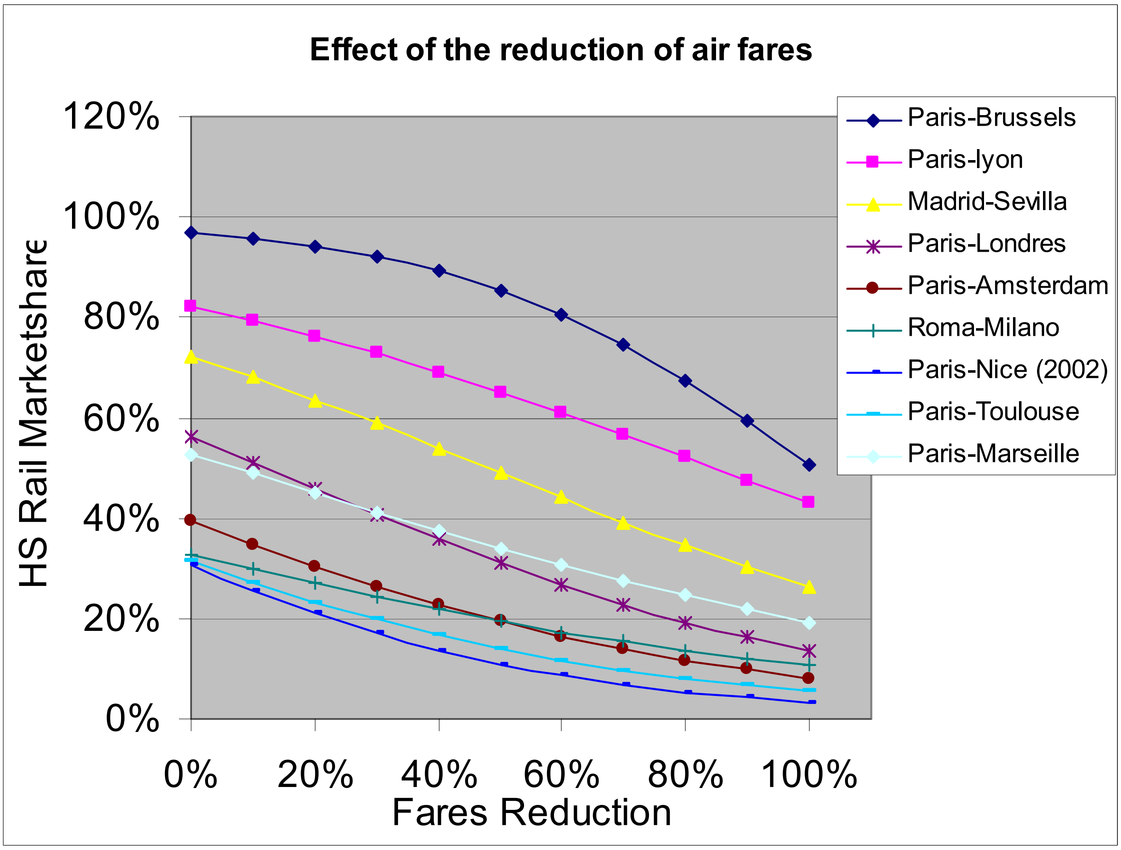


Fig 12 Rail marketshare predicted by the model corresponding to a reduction in Air Fares.

The results could indicate a vulnerability of relations with high travel times. In order to confirm this perception, Fig. 13 represents the predicted Rail marketshare – Rail travel time for air fares reduction of 20%, 30%, 40% and 50%. In the same graph is reproduced the current marketshare (as shown in fig in fig 4) and the predicted marketshare without reduction in air fares.

The graph confirms a high vulnerability zone for High Speed Rail for travel times beyond 2h30' where changes in air fares induce big losses of rail markeshare. On the other hand, High Speed Rail keeps a very strong position for travel times of 2 hours and less. When rail travel time is below 2 hours, rail marketshare is kept over the 60% even for reductions in air fares of the 50%

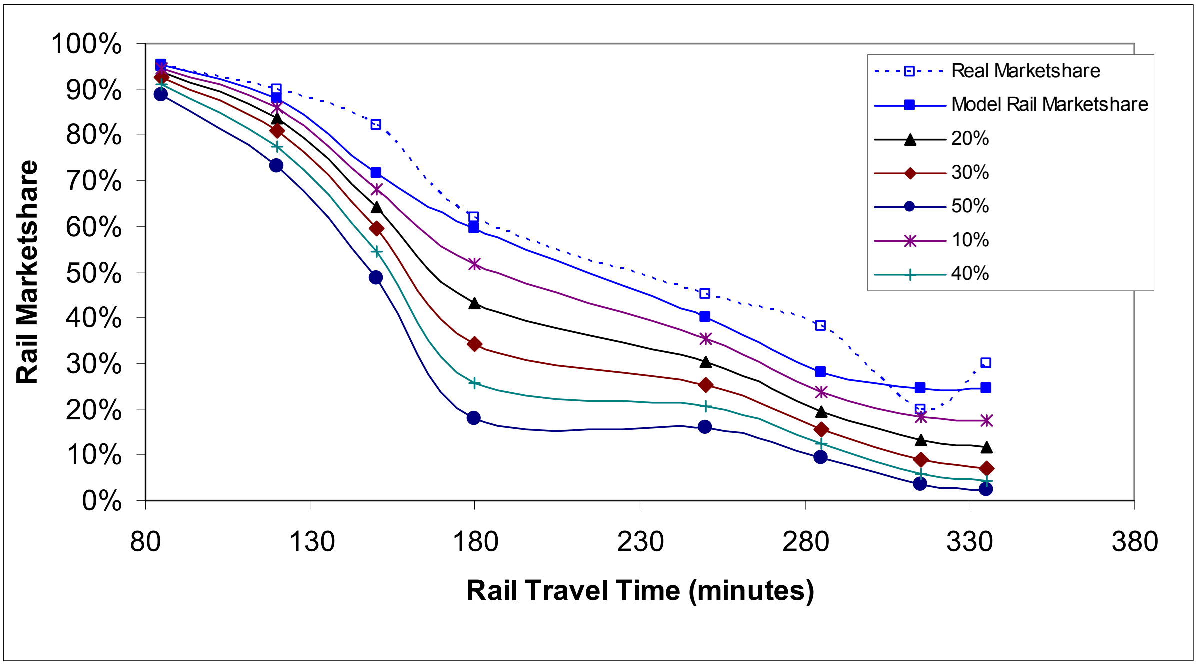


Fig 13 Rail Marketshare – Rail travel time curves predicted by the model for different air fares decreases.

CONCLUSIONS

The model presented in this paper is a first approach to a wider work that is being carried out in order to analyze the overall potential effect of Low Cost Airlines in the development of an European High Speed network. Therefore, this model presents handicaps that should be solved in further stages.

Regardless of this consideration, some conclusions concerning the modelling technique used and the results obtained can be pointed out.

Considerations on the model

The logit model shows a good behaviour when representing modal split between the two modes. The behaviour of the modal split agrees with the available data and intuitive considerations in terms of:

- Rail markeshare corresponding to a drop in travel times

- Stability of rail marketshare in clearly favourable relations against decreases in air fares

- Drop of rail marketshares in relations where rail position is weak.

The definition of the model considers that for the case of identical utilities of air and rail alternatives, market would be split at 50% for each mode. This hypothesis can be untrue in the case of existing “captive” travellers, case that has not been considered.

Several aspects have been excluded in the evaluation of the utility of each mode in order to simplify the model at this stage of development. This simplification has entailed that aspects that could be relevant to a detailed characterization of the modal split are not included in the model like comfort, frequency of services, etc. Future work should include considerations on these aspects altogether with other concepts like useful time at destination.

The lack of data available has forced to reduce the detail of the calibration of the model discarding specificities of each city pair introducing average access, check-in, check-out, waiting and riding to destination times. In the same direction, the cost of access to the air or rail terminals has not been included and it could be, in some cases, a relevant part of the overall travel cost.

The same reason has not allowed a proper calibration-validation of the model and the weights used to calculate weighted times and average fares. Further research in these aspects should be carried out in order to define solid generalized cost.

The model behaviour has also lighted up some aspects that further research should consider. The capacity of transport is not considered in the model, regardless of the real offer of each mode. In this sense, the marketshares provided by the models should be considered as “potential” marketshares of each mode instead of real ones.

It has also been noted a high sensitivity of marketshare on rail and air fares. This puts into relief the importance of a fine adjustment of these values in order not to obtain distorted results.

As a final consideration of the logit model, it has proved to be a valuable technique with potential to reproduce real market behaviour but it needs further development in order to allow a detailed analysis of the different factors influencing modal split.

At this stage of development, the model can be useful to determine general tendencies in modal split behaviour face to alterations in the transport offer of rail and air modes.

Final considerations

High Speed Rail has proved to be a big competitor of air for short and medium distances (corresponding to short haul flights). This success has been based in an better transport offer in terms of time, frequency, comfort and quality but also in terms of fares.

The irruption of low cost air carriers into the market forces has forced an overall reduction in air costs for the last years due to the competition between air carriers. As an airline competitor in some intra-european relations high speed rail is also affected by the entrance of these new players.

The modelling has shown that rail is able to keep a dominant, position in terms of modal split against air, even with considerable reduction of air fares for relations up to 2h30’ of travel time. It has also shown that, on the other hand, relations beyond this value are highly sensitive to a decrease in air fares.

Rail quality offer is far from being based only in fares and travel time. Rail has a margin to compete with air that has not been exploited. As the reaction of Thalys services demonstrate, rail can compete at lower fares keeping most of its quality factors as city centre to city centre services, spatial comfort, frequency and punctuality. It can, then, compete with success with low cost airlines as it has been doing the last years with traditional air carriers. Besides of this, the extension of new fare levels (for example with cheap non reimbursable tickets) to all the High Speed Rail services can induce an overall growth of High Speed Rail marketshare in Europe.

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