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Competitive position of high-speed rail in Western Europe

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Abstract

The last 20 years have shown a drastic change in the railway sector by new European regulations and market liberalization. Large investments are made for the development of a new trans-European high-speed network in order to facilitate growth in mobility and to limit air travel for distances less than 500 km. In 2010, the European market for international rail passenger traffic was liberalised. The objective of this study is to explore what strategies train operators may develop to run competitive high-speed cross-border services in response to the market opening in Europe.

To identify the chances for operators to successfully run high-speed services on international routes, the case for the London-Paris route is studied in detail. For this purpose, simulations are carried out using a calibrated game theory model for competition on city-to-city routes in an oligopolistic market. The effect of higher infrastructure charges, higher service quality and the entrance of a new high-speed rail operator on the London-Paris route is analysed. Data is gathered from the actual operational and business performance on the route under study.

The findings show that Eurostar has a dominant market share of about 70% (2012) on the London-Paris market compared to airlines and private car. This share is sensitive to changes in infrastructure charges. Introduction of new Velaro trainsets with more seat capacity will make Eurostar's market position even more dominant. A new high-speed rail entrant would completely change the competitive landscape. If the new entrant is capable of reducing its marginal costs, it will capture more than half of Eurostar's market share.

The findings will benefit high-speed operators acting in the liberalizing European railway market to build successful strategies. The results also give input to policy makers to even better support market opening by removing entry barriers.

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Keywords: high-speed rail; liberalization; competition

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1. Policy Context

The introduction of High-Speed Rail technology in Europe since the ‘80’s and changes in the European railway policy create new forces in the railway market that influence intra-modal competition between airlines, car and train operators. The European transport policy is aimed at revitalising railway traffic in order to increase the competitive strength of the region and to bridge social and cultural differences. Its focus is on the development of a new trans-European high-speed network in order to facilitate growth in mobility, and to limit air travel for distances less than 500 km (Doomernik, 2015). The legislative framework for liberalising the railway sector is almost ready and is currently being implemented in the European Member States.

In their White Paper, the European Union set itself the goal of creating “new dynamics in railway transport in order to be able to compete better with other modes of transport” (European Commission 2011). In order to achieve an integrated rail space in the entire Union, the European Commission adopted a number of guidelines and directives that were contained in three Railway Packages. The focus of the Third Package was mainly on the certification of the train drivers and the opening up the market for cross-border passenger services by 1 January 2010. The Third Railway Package enables railway operators to have non-discriminatory access to the European rail network in order to offer services across national borders.

The latest White Paper “Roadmap to a single European Transport Area – Towards a competitive and resource efficient transport system” is taking on the challenge of “seeking a deep transformation of the transport system, promoting independence from oil, the creation of modern infrastructure and multimodal mobility assisted by smart management and information systems.” (EC 2011, p. 8). An efficient and low-carbon transport system is needed to guarantee the “well-being of people and the competiveness of businesses in Europe.” (EC 2011, p. 32). “The creation of a single European Railway Area is essential to this purpose.” (EC, 2011, p. 31)

The EC has defined 10 goals for a competitive and resource-efficient transport system. Specifically for high-speed rail traffic the goals 4 and 6 are of paramount importance (EC 2011, p. 34):

“(4) By 2050, complete a European high-speed rail network. Triple the length of the existing high-speed rail network by 2030 and maintain a dense railway network in all Member States. By 2050, the majority of medium-distance passenger transport should go by rail.

(6) By 2050, connect all core network airports to the rail network, preferably high-speed; ensure that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system.”

Although large investments were made in the European High Speed Rail network in the last decades and much effort is done in liberalising the railway market, it is unclear whether the goals of the EU White Paper on Transport will be achieved and whether the European Rail Policy will have the desired outcome.

The goal of our research is to clarify the inter- and intra-modal competition in the Western European cross-border high-speed railway market and to analyse the market effect of rail policies and strategic behaviour of high-speed rail operators. To this purpose, we describe what the European high-speed transport market looks like, present the model that is used for the market evaluation and show the results for a specific case: London-Paris.

The paper is structured as follows. Section 2 gives a review of the development of the high-speed rail market in Western Europe. In section 3, the econometric competition model and the methodology are presented for calibration and simulation to evaluate the market share of high-speed rail operators. Section 4 presents the London-Paris link as a specific case studied in detail with the associated model and input data. Section 5 presents the calculated market equilibrium for the London-Paris transport market and the simulation results for three different scenario’s. Finally, section 6 presents the conclusion from the study and discusses the results.

2. The West European High-speed market

London Heathrow (LHR), Paris Charles de Gaulle (CDG), Frankfurt Airport (FRA) and Amsterdam (AMS) are the four largest airports in Europe and feature in the world's top 15 regarding number of passengers per year. In 2014, LHR handled 73 mln. passengers, CDG 62 mln., FRA 58 mln. and AMS 53 mln. . Besides, London has four other airports, of which Gatwick with over 35 mln. passengers per year is the largest. Paris Orly (ORY), Paris' second airport handles about 28 mln. passengers per year. All these airports are well-connected with frequent flights and within a distance of 300 and 700 km (see figure 1) where strong competition might be expected from high-speed rail services.

As the market for international cross-border rail services is liberalised since 2010, new opportunities arise for international high-speed rail operators. To prevent competition on international routes from new entrants, national incumbent railways have built joint ventures (Thalys, Eurostar) to strengthen their position. Entry barriers for new entrants are numerous (e.g. competition from incumbent railways, compliance with European rail directives and regulations, required certified rolling stock and staff, network access etc.) and there are only few railway operators that have the resources and capabilities to provide these services. Incumbent operators profit from economies of scale and stronger buying power compared to new entrants. New players attempt to develop services on high speed rail routes, but with little success so far. Strong positions and market power of incumbent railways hinder new entrants to be successful. Besides intra-modal competition, high-speed rail faces competition from airlines, private cars and busses. Although road transport needs to be considered, for high-speed traffic the customers' choice is mainly between plane and high-speed train.

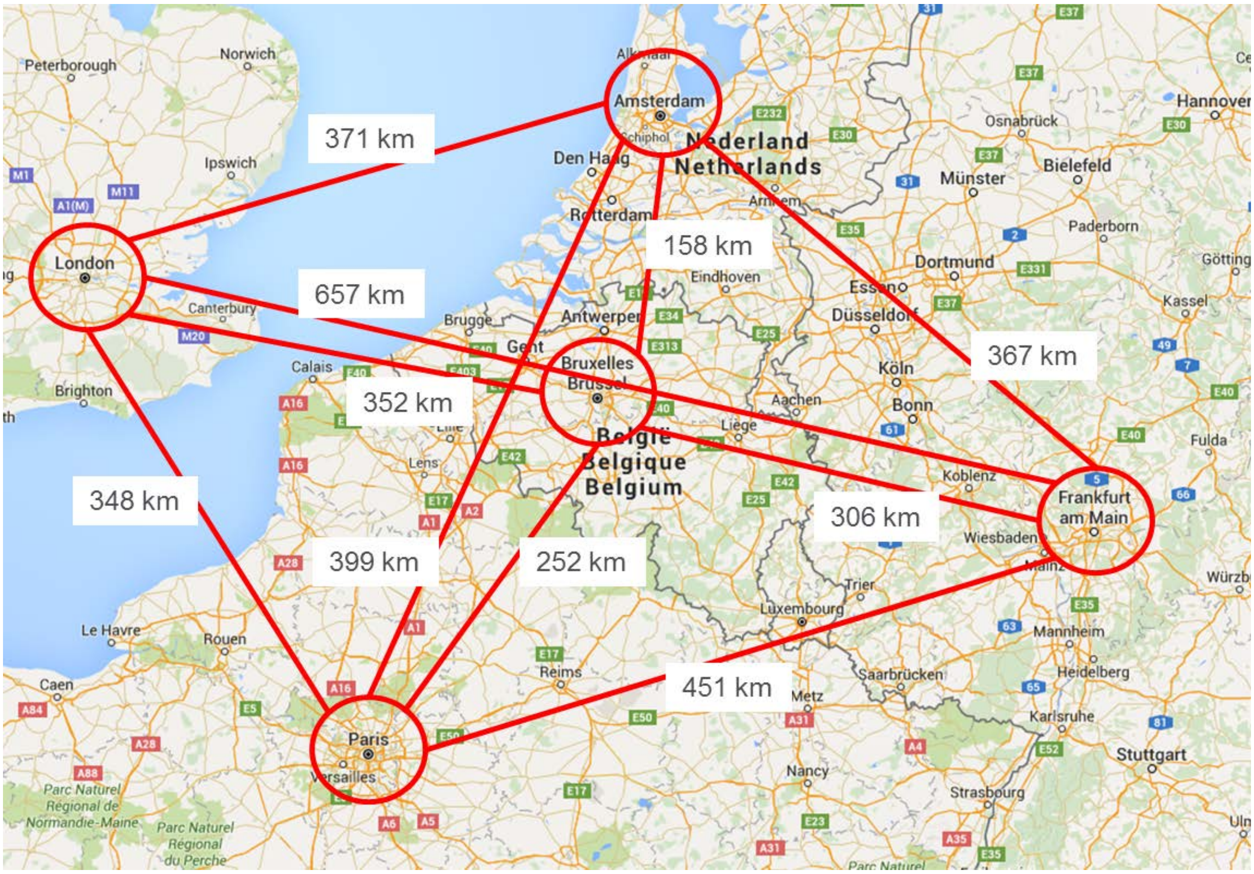


Figure 1: Connecting the largest airports in Europe (Great Circle Distances calculated on http://www.gcmap.com/)

The network in Western Europe for high-speed rail services is presented in figure 2. Currently, cross-border high-speed train services in Western Europe are provided by Thalys between Paris, Brussels, Köln and Amsterdam, DB international for the route between Köln, Liège and Brussels and Eurostar for the connections between Paris, Brussels and London. Thalys is a joint venture of SNCF (62%), NMBS/SNCB (28%) and DB (10%). SNCF has a share of 55% in Eurostar together with London & Continental Railways (40%) and NMBS/SNCB (5%). The cancellation of the ordered Fyra high-speed trains for the Brussels to Amsterdam route by SNCB/NMBS and NS mid 2013 left the HSL Zuid high-speed line from Amsterdam to Antwerp underused (Abott, 2013b). This gave Thalys the opportunity to run more services on this route and Eurostar to plan for a service from London to Amsterdam via Brussels. So far this service has not been established yet. Air France and Veolia have established a partnership, possibly with a view to competing with Thalys services, whilst DB are believed to be considering competing with Eurostar services (Preston 2009). DB has ordered 16 Velaro-D high speed trains for providing services from London to Frankfurt. As approvals are running late, it is expected that DB will not be introducing a service competing with Eurostar through the Channel Tunnel until 2018 the earliest (Abott, 2013a). Apart from the already established high-speed rail operators (Thalys, Eurostar, DB), no new entrants are observed, but the Italian national operator Trenitalia is holding preliminary discussions with suppliers and regulatory bodies regarding the possible launch of an open access high speed service between Paris and Brussels†

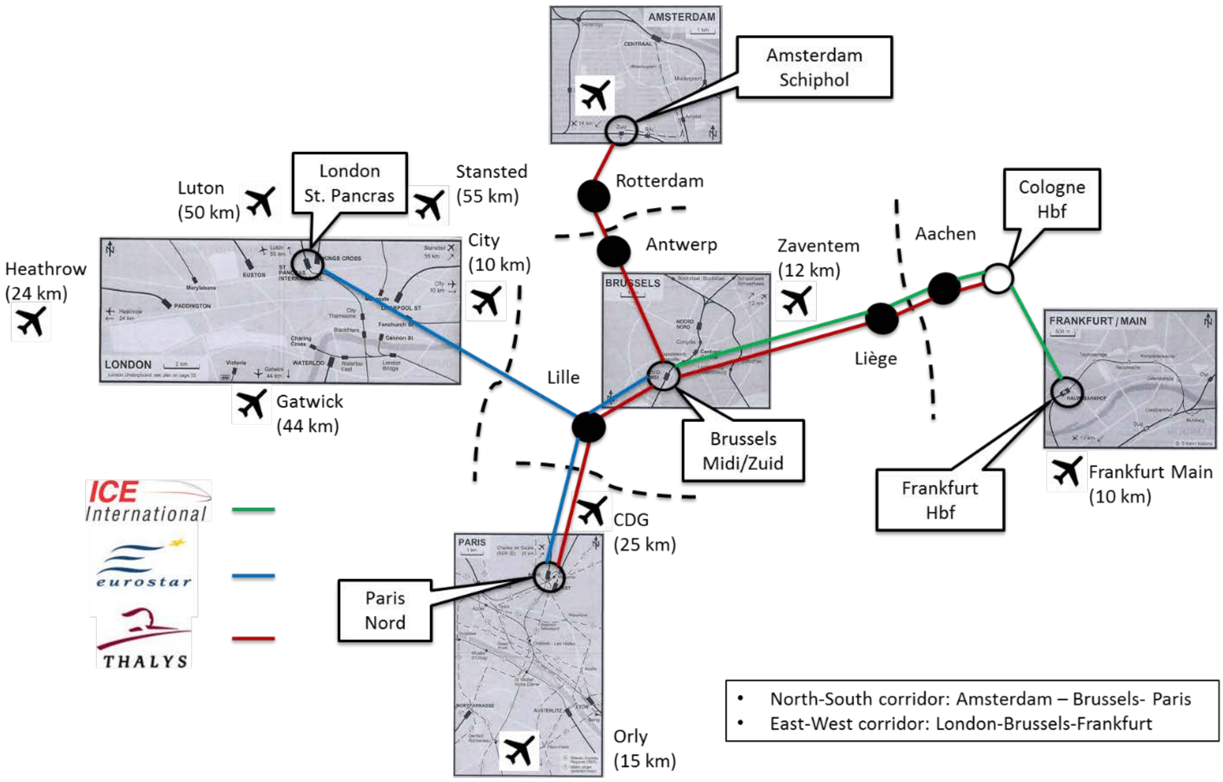


Figure 2: West-European High-speed market

The observed rail-air market shares for London-Paris and London-Brussels in 2002 were 62-38% and 44-56% and increased to 69-31% and 62-38% respectively in 2005 (EC 2006). In 2008, 50% of passengers travelling from Paris to Brussels used the Thalys train services and 81% of travellers from Paris to London took Eurostar trains (UIC,

† www.railwaygazette.com, 20 October 2015

2008). The correlation between rail journey time and market share is strong. Steer Davies Gleave concluded that 90% of the variation in market shares across the routes studies could be explained by the estimated generalised journey time which takes, besides the scheduled journey time, also the check-in time and an allowance for the frequency into account. Punctuality, ticket price and time/cost involved in access to terminals were other important factors mentioned by operators (EC 2006).

3. Competition model

An open market with free competition will find in time its equilibrium between demand and supply. This also goes for transport markets, where regulators set the environment and rules for network access and competition, operators strategically decide on product design and set prices for the type of services they provide and travellers choose a transport mode and an operator to travel on a given city-pair. In practice, the free market axiom is not fully valid for the high-speed market. Incumbent railways act as monopolistic or oligopolistic market players making it hard for new entrants and competitors to gain market share. Our interest is to find a method to evaluate market shares in an oligopolistic market where train operators compete with each other (intra-modal) and with airlines and private cars (inter-modal) by offering distinctive train services to potential travellers with an attractive price setting. The aggregation level on the supply side needs to be on transport modes and operators to capture operators' strategic behaviour. On the demand side, distinction between business and leisure market segments is necessary to meet differences in travellers' behaviour and requirements concerning service and pricing. The goal is to simulate different market scenarios after the recovery of the equilibrium outcome and to incorporate governmental policies. It is required that the model can be applied to specific Origin-Destination pairs with the use of limited data requirements.

Berry presented an econometric supply and demand model for oligopolistic markets with differentiated products (Berry 1994). A discrete-choice model for consumer behaviour is adapted to model market demand, where the consumers' utility depends on the product characteristics. Regarding the supply side, firms, in our case train operators, are modelled as price-setting oligopolists. The model gives an approach to find the market equilibrium between supply and demand. Ivaldi and Vibes (2008) give an application of the game theory model as described by Berry to the competition in the intercity passenger transport market. In this game, consumers choose a mode and an operator to travel on a given city-pair and firms decide on service quality and prices. The model is used to evaluate inter- and intra-modal competition for business and leisure travellers on the 475 km Berlin-Cologne link between airlines, rail operators and private cars. Specific cases are presented to study the effect of LCC airlines entering the market, higher kerosene taxation and the entrance of a new low-cost rail operator. The same methodology has been elaborated by Prady and Ullrich and applied to the competition between road and rail in the freight transport market between Italy and France of (Prady and Ullrich 2010). They analyse the effect of building a rail tunnel between Lyon and Turin on the market shares of freight shippers. The same model theory and some indicative results are given for the Paris-Amsterdam link by De Rus et al (2009), with the remark that the presented economic model is quite relevant to describe the strategic interaction between transport operators of the same or different modes. Adler et al. (2010) use the economic model to calculate social welfare from market share evaluations in 27 European Union countries for four Trans-European network scenario's with competing high-speed rail operators, hub-and-spoke legacy airlines and regional low-cost carriers. More recently, this discrete choice model was used to evaluate the market shares on the Milan-Rome intercity transport link, where the entry of new rail and air operators in 2012 was simulated (Mancuso 2014).

3.1. Demand: travellers choice set

We consider the transport between a city-pair as one market where travellers can choose to travel from origin to destination between distinctive transport modes and competing operators. We assume that travellers first choose between the possible transport modes before selecting their preferred operator. This discrete-choice structure can be presented as a nested logit model where one can choose from three alternative transport modes (figure 3). In the market, travellers can choose from J competitive alternatives consisting of m railway operators, n airlines and the private car[‡]. There is an outside alternative considered as potential consumers may choose not to travel.

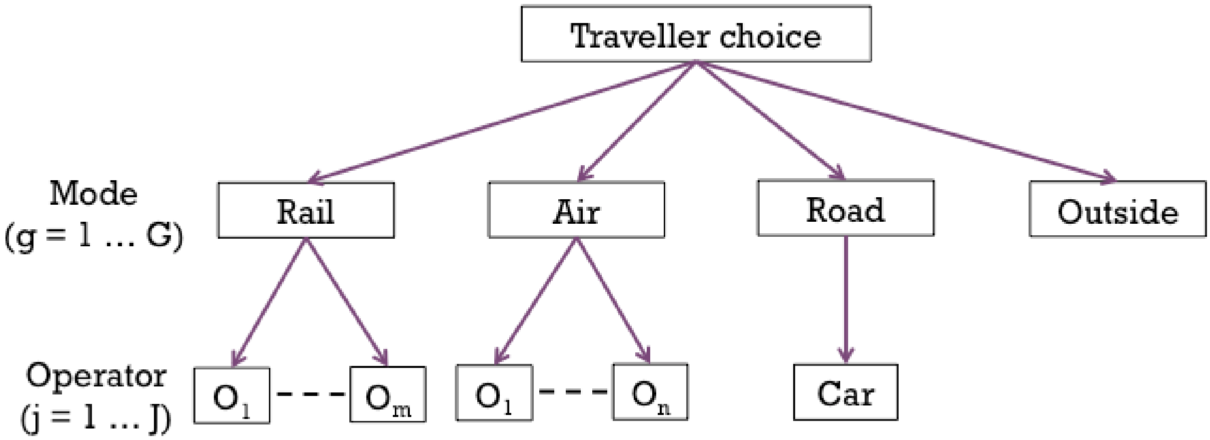


Figure 3 - Discrete-choice mode for travellers

The utility of traveller *i* for alternative *j* can be written as follows:

$$U_{ij} = V_j + \varepsilon_{ij}$$

Where V_j represents the mean utility level common to all travellers and ε_{ij} the unknown random part of traveller's *i* preferences for service *j*. The traveller chooses the utility-maximising alternative:

$$U_{ij} \geq U_{ij'}, \quad \forall j' \neq j$$

The mean utility of alternative *j* depends on the service quality Ψ_j and price p_j offered.

$$V_j = \Psi_j - h \cdot p_j$$

The parameter h represents the utilities' sensitivity to price.

Ψ_j can be expressed as a linear combination of K quality parameters assigned to the service alternative *j*:

$$\Psi_j = \sum_{k=1}^{K} Q_{jk} \cdot \alpha_j$$

Traveller *i* will choose the alternative *j* that maximises his utility. In the nested logit specification alternatives within the same mode *g* are closer to each other than between transport modes. The random part of travellers' *i* preferences for service *j* can be split into two random components for intra- and intergroup correlation:

$$\varepsilon_{ij} = \nu_{ig} + (1-\sigma) \cdot \nu_{ij}, \quad \forall i = 1, \ldots N$$

The parameter σ represents the correlation between alternatives within the same group and must lie between 0 and 1. If σ = 1, there is a perfect correlation of preferences for products within the same group; so these products are

‡ "Private car" is seen as being offered by an operator competing with the other alternatives.

perceived as perfect substitutes. If σ = 0 there is no correlation of preferences: consumers are equally likely to switch to products in a different group as to products in the same group in response to a price increase (Ivaldi and Verboven 2005).

The probability of choosing alternative j is the product of the two sequential discrete choices for the transport mode *g* and the operator *j* within this mode:

$$s_j = s_{j|g} \cdot s_g$$

Where $s_{j|g}$ is defined as:

$$s_{j|g} = e^{V_j/(1-\sigma)/D_g}$$

and the probability of choosing mode *g*,

$$s_g = \frac{D_g^{(1-\sigma)}}{\sum D_g^{(1-\sigma)}}$$

with,

$$D_g = \sum_{j\in g} e^{V_j/(1-\sigma)}$$

Actual market shares are the observed outcome of aggregated travellers choices. Expressing the mean utility level as a function of observed market shares as stated by Berry (1994):

$$V_j = \ln(s_j) - \ln(s_0) - \sigma \cdot \ln(s_{j|g})$$

With $s_j = q_j/N$ and $s_{j|g} = q_j/N_g$ and q_j being the number of travellers with alternative *j* and N the total number of travellers. S_0 is the market share for non-travellers. From these formulas, the own price elasticity of demand and cross price elasticity can be derived as elaborated by Ivaldi and Vibes (2008):

Own Price elasticity:

$$\eta_j = \frac{dq_j}{dp_j} \times \frac{p_j}{q_j} = h \cdot p_j \cdot \left(s_j - \frac{1}{1-\sigma} + \frac{\sigma}{1-\sigma} s_{j|g} \right) \quad \forall j$$

Intra modal price elasticity:

$$\eta_{j,k} = \frac{dq_j}{dp_k} \times \frac{p_k}{q_j} = h \cdot p_k \cdot s_k \quad if\ \ j \neq k, k \notin g,\ j \in g$$

Inter modal price elasticity:

$$\eta_{j,k} = \frac{dq_j}{dp_k} \times \frac{p_k}{q_j} = h \cdot p_k \cdot s_k \cdot \left(\frac{\sigma}{1-\sigma} \cdot \frac{s_{k|g}}{s_k} + 1 \right) \quad if\ \ j \neq k,\ j,k \in g$$

The consumer surplus, the expected value of the maximum of utilities, can be computed as:

$$CS = \frac{1}{h} \cdot \ln\left[1 + \sum_{g=1}^{G} D_g^{1-\sigma} \right]$$

The net consumer surplus CS measures the attractiveness of the set of J+1 products in monetary terms, after subtracting the price consumers have to pay (Ivaldi and Verboven 2005).

3.2. Supply: operators and pricing

Airline and train operators provide a single origin-destination transport service. In the framework, the transport mode "Road" is considered to be offered by a competing "operator". The profit function of operator *j* can be expressed by the fixed costs K_j , the marginal costs c_j and the price of the transport service p_j:

$$\pi_j = (p_j - c_j) \cdot q_j - K_j$$

It is assumed that all operators strive to maximise their profit. The price of service j is equal to the marginal costs plus a mark-up term:

$$p_j = c_j + \frac{1-\sigma}{h \cdot (1 - \sigma \cdot s_{j|g} - (1-\sigma) \cdot s_j)}$$

Each operator trades off two effects when considering an increase in price by one unit: i) it increases profits proportional to the current sales level of the firm, ii) it reduces sales, which lowers profits proportional to the current mark-up (Ivaldi and Verboven 2005).The producer surplus is simply the sum of these profits across operators:

$$PS = \sum_{j=1}^{K} \pi_j$$

Total welfare is the sum of producer surplus and consumer surplus as defined earlier.

3.3. Market equilibrium

As stated by Ivaldi and Vibes (2008) Bertrand-Nash competition is assumed, where the Nash equilibrium is defined by a set of J necessary first-order conditions:

$$\ln(s_j) - \ln(s_0) = \psi_j - hp_j + \sigma \cdot \ln(s_{j|g})$$

$$p_j = c_j + \frac{1-\sigma}{h \cdot (1 - \sigma \cdot s_{j|g} - (1-\sigma) \cdot s_j)}$$

The equilibrium is fully characterised by the demand and supply-side equations above, leading to a unique solution (Ivaldi and Vibes 2008). The model parameters h, σ, quality indices ψ_j and the associated coefficients of the quality attributes, the own, intermodal and intramodal price elasticities and the consumer and producer surplus can be computed for the equilibrium situation.

3.4. Calibration and simulation

Before market scenarios can be assessed, the market equilibrium of the economic model presented needs to be calculated. Ivaldi and Vibes (2008) describe a calibration procedure that is applied to the Cologne-Berlin transport market. The observed variables taken as input are prices p_j, market shares s_j , the marginal cost c_j and the service characteristics Q_{jk} for all J alternatives. From the equilibrium, values for the parameters h and σ are recovered as well as the weight factors α_j for the quality attributes. The detailed calibration algorithm is presented in appendix A.

Once the equilibrium and the associated calibration parameters are known, simulations can be run for specific cases. The impact of changes in pricing, marginal costs, the operators' service offering and new entrants in the transport market under study can be assessed. The results of four different simulations are presented in detail by Ivaldi and Vibes (2008).

3.5. Validation

The model is validated based on the data given by Ivaldi & Vibes (2008). Calculations were done in Excel and Visual Basic and the results for the equilibrium outcomes and the simulation describing the entrance of a low-cost train on the Cologne-Berlin market show good conformity with the findings from Ivaldi & Vibes. As marginal costs for the business market are not available, the demand parameters for this segment are recovered by running a Monte Carlo simulation as described by Ivaldi (2008). The mean values for the elasticity distribution for the three modalities were set according to the average values as given by Oum et al (1990): -0.65 for Rail, -0.80 for Air and -0.60 for Car and the standard deviation was set to 2.8 to fit the results obtained by Ivaldi (2008). The same mean elasticity values are used for the Rome-Milan route, but with a standard deviation of 4.0 (Mancuso 2014).

4. The London-Paris Case

4.1. Case description

The London-Paris link is serviced by airlines from the London area with 5 airports (Heathrow, Gatwick, Luton, City, Stansted) and from the Paris area with 2 airports (Charles de Gaulle, Orly). In 2012, airline services were offered by British Airways and Air France between Heathrow and Charles de Gaulle, British Airways between Heathrow and Paris Orly, CityJet between City Airport and Paris Orly and EasyJet between Luton and Paris CDG (figure 4). Eurostar operated the high-speed rail connection between the railway stations London St Pancras and Paris Nord. Besides using airlines or a high-speed train, travellers could also use their private car and ferry (DFDS Seaways, P&O Ferries) or tunnel (Eurotunnel Shuttle) between Dover and Calais.

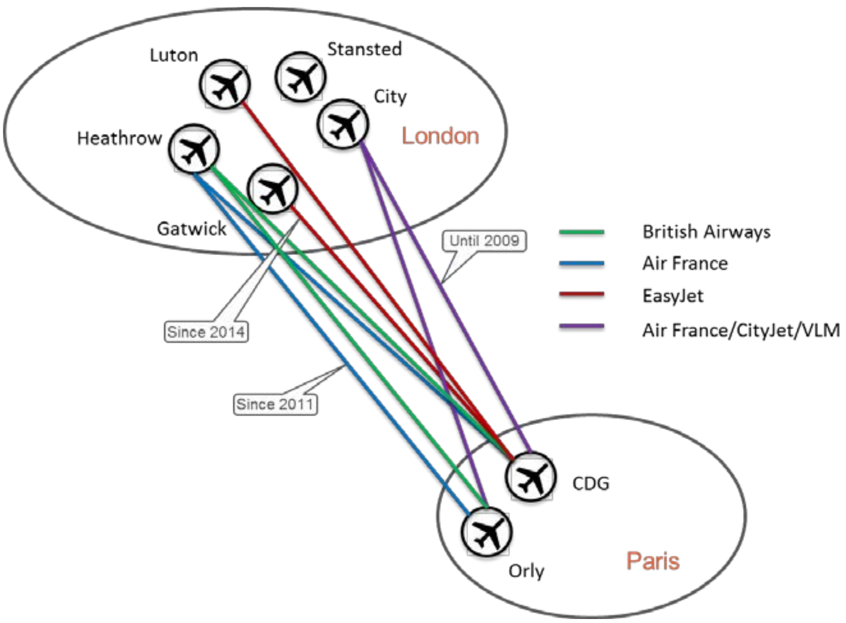
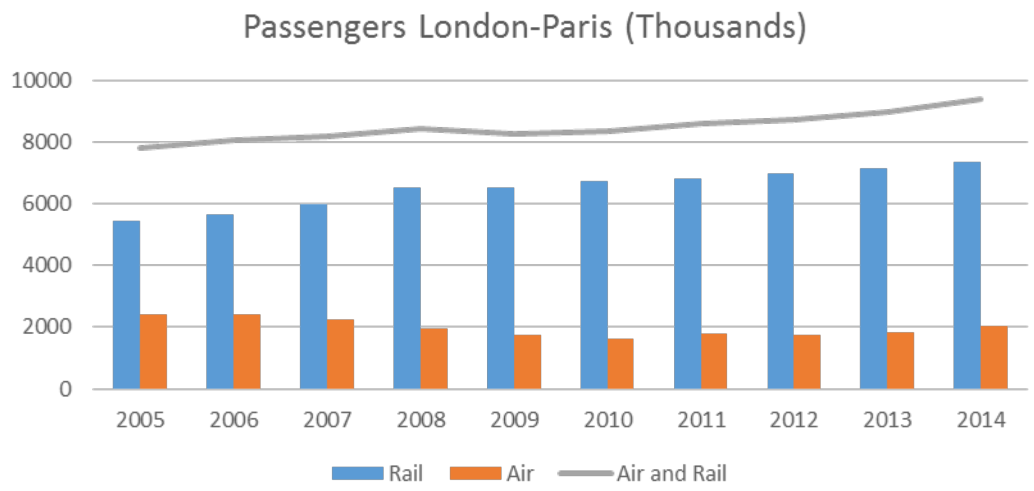


Figure 4 - Air traffic Paris-London market

On the London-Paris link intermodal competition can be observed between airlines, HSR (Eurostar) and private cars. Intramodal competition happens between traditional airlines (British Airways, Air France) and EasyJet being a

Low Cost Carrier. Air traffic is growing again since 2010 after a decrease between 2006 and 2010 (figure 5). British Airways and Air France have a dominant market share on the London Heathrow – Paris Charles de Gaulle connection, but competition from smaller airports and low cost carriers is growing. For an air distance of 350 km



strong competition might be expected. Operators target both business and leisure travellers in this market.

Figure 5 – Air traffic volumes London-Paris (Eurostat, last update 07.05.15, extracted on 14.08.15)

The London-Paris air/rail market has grown by 20% between 2005 and 2014. Rail has a dominant market share of more than 80% since 2008 (figure 6). This market share is overestimated when also private cars are taken into account as an alternative.

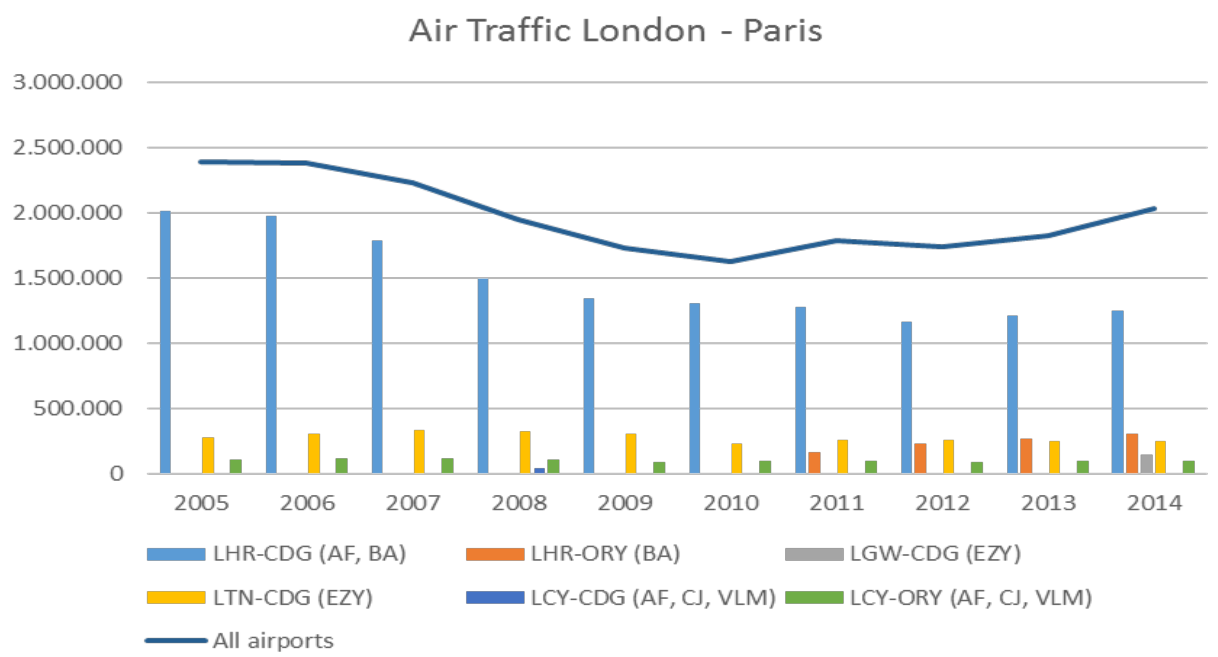


Figure 6 – Evolution of passenger traffic London-Paris (Eurostat, last update 07.05.15, extracted on 14.08.15)

Car users can choose between ferry and Euroshuttle to make the Channel crossing. Most of the ferry services are provided by DFDS Seaways and P&O Ferries. From all private cars using the Dover-Calais connection to cross the Channel 44% takes the ferry (DFDS Seaways and P&O Ferries) and 56% use Eurotunnel (IPS 2012). For 2012 the market share for private cars on the London-Paris route is estimated at 3.6% (see Appendix C).

4.2. Discrete choice model London-Paris

Applying the discrete choice model as presented in figure 3 to the London-Paris market, four nests with one rail operator, five airlines and two car alternatives can be recognised (figure 7). The air mode has been split into a Full Service Carrier (FSC) and a Low Cost Carrier (LCC) nest with 3 and 2 airlines respectively. CityJet and EasyJet fly from secondary airports with a low cost business model. The market shares are calculated by using data from Eurostat, the UK Civil Aviation Authority (CAA), the UK Office for National Statistics (ONS) and Eurotunnel. A distinction is made between the business and leisure market. There are almost three times more leisure passengers than business travellers on the London-Paris route. Private car and to a lesser extent the high-speed train are preferred transport modes for leisure travellers. EasyJet is the preferred airline for leisure travellers. For the outside alternative, we assume 15% for the business market and 30% for the leisure market. Leisure passengers have a higher probability not to travel than business travellers.

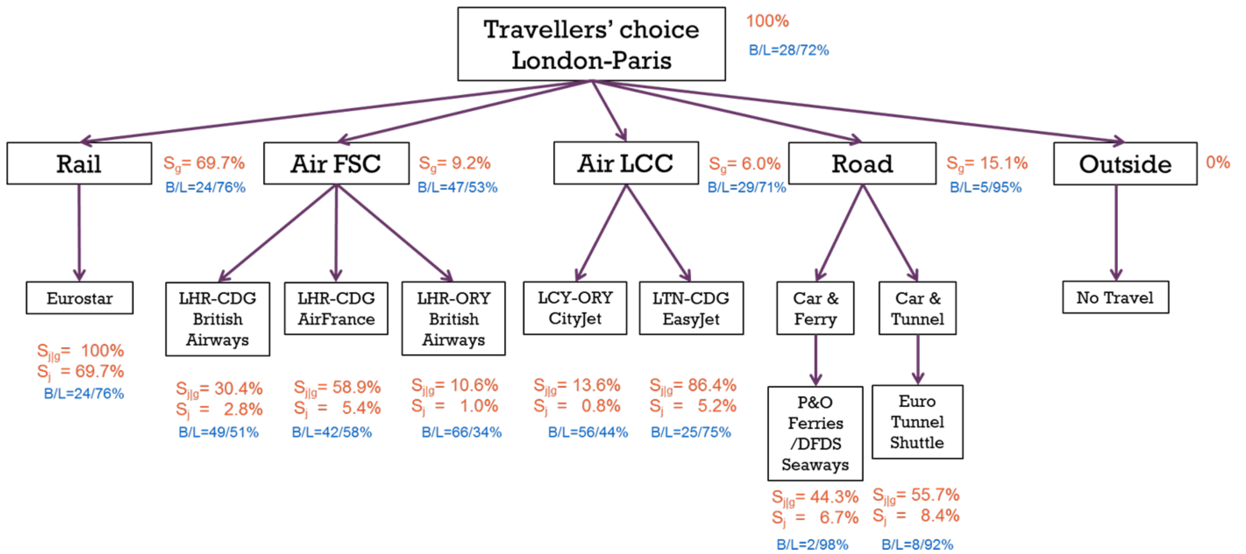


Figure 7 – Nested logit model for London-Paris (numbers based on IPS 2012 data)

4.3. Input data

For the simulations, data is collected for all operators and the business and leisure markets on the London-Paris link. For this purpose, various sources are used which are listed in Table 1. The International Passenger Survey (IPS) is a continuous survey of international passengers conducted at all major ports and routes into the UK and is conducted by the UK Office for National Statistics. It provides information on trip characteristics (departure airport/station, arrival airport/station, carrier, fare, ticket type, trip purpose), traveller characteristics (age, gender, country of residence) and passenger categories (UK and overseas residents leaving from and arriving in the UK by air, rail and sea). The yearly dataset contains approximately 250,000 records of people interviewed. It has been running since 1961. The IPS is used to collect data on traffic volumes, market shares, prices and fares for leisure and business travellers to and from the UK. The IPS 2012 data is analysed using IBM SPSS Statistics version 22 in two subsequent processes: i) the selection process to reduce the dataset by filtering out all irrelevant data and ii) the analysis process to obtain the data needed for the econometric model. The market share for private cars is estimated using some assumptions. From all private cars using the Dover-Calais connection to cross the Channel, 44% takes the ferry (DFDS Seaways and P&O Ferries) and 56% use Eurotunnel (IPS 2012). In 2012, Eurotunnel transported

2,424,342 cars[§] with 3.2 passengers on average resulting in 7,757,894 car passengers. The origin or destination of car passengers are split into the Greater London Area (inner and outer London) and the rest of the UK. The IPS shows a ratio of 20/80%[**]. On the French side, 60% of the car passengers crossing the Channel have their origin/destination in France (IPS 2012). The assumption is made that about 20% of this flow have the Paris region as origin/destination which result in about 2.4% of passengers travelling via Sea or Tunnel on the London-Paris link. As the total number of car passengers via ferry or tunnel in 2012 between London and Paris is 326,940, this results in a 3.6% share of the total market. For the Total Travel Time access/egress time to/from airport/train station/terminal, take-off/taxi time, port processing time, expected delay and landing/taxi time are taken into account besides the scheduled in-vehicle time (train, plane, ferry, shuttle). Marginal costs cannot be observed directly (Prady and Ulrich 2010). “Marginal costs are the additional cost a firm incurs in order to produce one additional unit of output.” (Lipczynski et al, 2013). In passenger transport, a unit of output can be an extra flight, train, seat or passenger. In our model, the marginal costs are the costs associated with carrying extra passengers. Marginal costs are derived from the cost functions related to the specific transport modes on the London-Paris link. For road and rail transport, marginal costs include costs of infrastructure use such as road, rail and tunnel fees and fuel costs (Prady and Ulrich 2010).

Table 1 – Data sources used

Parameter	**Sources**
Traffic volume and market shares	Eurostat, Civil Aviation Authority (CAA), UK Office for National Statistics (ONS), Eurotunnel Registration documents
Load factors	Eurostat, International Passenger Survey (IPS) UK ONS
Service characteristics and attributes:	
• Total Travel Time	Timetables (Thomas Cook for rail) , flight schedules, own calculations
• Service frequency	Timetables (Thomas Cook for rail), flight schedules
• Seat capacity	Eurostat, Swan and Adler, 2006 (aircraft), UIC HS rolling stock database (train)
• Delay on arrival (punctuality)	CAA (air), press releases Eurostar (rail)
Prices and fares	International Passenger Survey (IPS) UK ONS, own calculations (car)
Marginal cost	UIC cost model, Froïdh 2006, European Commission 2006, Alvarez 2010 (rail), Swan and Adler 2006, Givoni 2005, (aircraft), own calculations (car)

Table 2 – Input data (2012)

			Traffic modal	Alternatives shares (%)		Prices (Euro)		Marginal costs		Travel time	(minutes)	Frequency	Punctuality	Capacity
Mode	Connection	Carrier	shares (%)	Business	Leisure	Business	Leisure	Business	Leisure	Business	Leisure	trips/week	(%)	(seats)
Rail	QQS - XPG	Eurostar	69.7	71.1	69.2	117	73	NA	42	177	187	119	92.1	750
Air FSC	LHR - CDG	British Airways	2.8	5.8	1.9	279	117	NA	43	212	242	48	77.0	166
	LHR - CDG	Air France	5.4	9.7	4.1	291	123	NA	43	220	250	51	67.4	166
	LHR - ORY	British Airways	1.0	2.7	0.4	259	123	NA	50	226	256	27	77.6	136
Air LCC	LCY - ORY	CityJet	0.8	2.0	0.5	202	103	NA	40	227	227	30	90.7	50
	LTN - CDG	EasyJet	5.2	5.4	5.1	99	64	NA	23	221	221	18	83.4	158
Car	LDN - PAR	Eurotunnel	8.4	2.7	10.2	127	82	53	28	299	299	252	75.0	5
	LDN - PAR	P&O/DFDS	6.7	0.6	8.6	105	80	51	24	359	359	221	85.0	5

5. Results for the London-Paris route

5.1. Market equilibrium

The Paris-London market equilibrium for 2012 is calculated for business and leisure travellers with outside shares of 15, 30 and 60%. The upper part of table 3 present the associated market shares and the demand parameters calculated from the input data (table 3). The marginal utility of income is higher for leisure (h=0.025) than for business (h=0.013), indicating that leisure travellers are more price sensitive. This is also found in other studies (see table 4). For the London-Paris link, the correlation of alternatives within the same mode is significantly less than 1 in both markets which indicates that the hypothesis that operators in the same group are perfect substitutes can be rejected. This result is comparable with the findings from the Cologne-Berlin (Ivaldi 2008) and Milan-Rome study

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[§] Eurotunnel Registration Document 2012

[**] This assumption is arbitrary as the catchment area for the Dover-Calais transfer is not only restricted to the Greater London area.

(Mancuso 2014). Business passengers on the London-Paris route value particular providers to the same extent as leisure passengers (σ=0.35 for business 15 and σ=0.34 for leisure 30). Results from Ivaldi (2008) and Mancuso (2014) show clearer differences between preferences for leisure and business travellers (table 4).

The lower part of table 3 shows that the own price elasticities for Eurostar is the lowest, which means that Eurostars' market share is relatively insensitive to price. Own price elasticities for FSC airlines are higher in the business market, whereas they are higher for Eurostar in the leisure market. The consumer surplus decreases with higher outside shares. Comparing these results with other studies, it can be observed that rail has in all cases the lowest price elasticity compared to other modes (table 5).

Table 3 – Equilibrium outcomes for the Paris-London market (2012)

			Business			*Leisure*		
Share outside alternative (%)			*15*	*30*	*60*	*15*	*30*	*60*
Market shares (%)								
Rail	QQS - XPG	Eurostar	60.4	49.8	28.4	58.8	48.4	27.7
Air FSC	LHR - CDG	British Airways	4.9	4.1	2.3	1.6	1.3	0.8
	LHR - CDG	Air France	8.2	6.8	3.9	3.5	2.9	1.6
	LHR - ORY	British Airways	2.3	1.9	1.1	0.3	0.3	0.2
Air LCC	LCY - ORY	CityJet	1.7	1.4	0.8	0.4	0.4	0.2
	LTN - CDG	EasyJet	4.6	3.8	2.2	4.3	3.6	2.0
Car	LDN - PAR	Eurotunnel	2.3	1.9	1.1	8.7	7.1	4.1
	LDN - PAR	P&O/DFDS	0.5	0.4	0.2	7.3	6.0	3.4
Marginal utility of income:			0.013	0.013	0.013	0.025	0.025	0.024
Within group correlation coefficient:			0.35	0.32	0.32	0.34	0.34	0.34
Own price elasticities								
Rail	QQS - XPG	Eurostar	-0.61	-0.78	-1.11	-0.74	-0.93	-1.29
Air FSC	LHR - CDG	British Airways	-4.82	-4.78	-4.78	-3.88	-3.94	-3.88
	LHR - CDG	Air France	-4.46	-4.48	-4.54	-3.49	-3.54	-3.51
	LHR - ORY	British Airways	-4.87	-4.80	-4.75	-4.48	-4.55	-4.46
Air LCC	LCY - ORY	CityJet	-3.64	-3.60	-3.56	-3.72	-3.77	-3.70
	LTN - CDG	EasyJet	-1.43	-1.44	-1.45	-1.58	-1.61	-1.60
Car	LDN - PAR	Eurotunnel	-1.79	-1.81	-1.81	-2.32	-2.38	-2.39
	LDN - PAR	P&O/DFDS	-1.97	-1.94	-1.91	-2.38	-2.43	-2.44
Consumer surplus:			144.4	90.3	38.6	76.9	48.5	20.9

Table 4 – Demand parameters from different studies

Link	*Business 15*		*Leisure 15*		*Source*
	h	σ	h	σ	
Cologne-Berlin	0.023	0.15	0.040	0.20	Ivaldi and Vibes, 2003
Paris-Amsterdam	-	-	-	-	De Rus et al, 2009
Milan-Rome	0.011	0.41	0.043	0.34	Mancuso, 2014
Paris-London	0.013	0.35	0.025	0.34	

Table 5 – Own price elasticities from different studies (all elasticity values have negative signs)

	Business 15				*Leisure 15*				
Link	Rail	Air LCC	Air FSC	Road	Rail	Air LCC	Air FSC	Road	Source
Cologne-Berlin	1.77	3.77-4.13	5.39	2.10	1.25	2.11- 2.29	2.40	2.67	Ivaldi and Vibes, 2003
Paris-Amsterdam	NA	NA	NA	NA	NA	NA	NA	NA	De Rus et al, 2009
Milan-Rome	1.15	NA	2.66-3.17	2.29	0.75	NA	3.18-4.36	3.18	Mancuso, 2014
Paris-London	0.61	1.43-3.64	4.46-4.87	1.79-1.97	0.74	1.58-3.72	3.49-4.48	2.32-2.38	

The cross price elasticities at the market equilibrium are presented in table 6a for the business market (with a 15% outside alternative) and in table 6b for the leisure market (with a 30% outside alternative). The high cross price elasticities for Eurostar in the business and leisure market indicate that price changes of this operator have a strong effect on market shares of others. In the business market, private car prices have little influence on market shares of other modes. Eurostar's market share is most influenced by the pricing of British Airways and Air France. In the leisure market, Eurostars' market share in most affected by price changes in private car travel (Eurotunnel and

P&O/DFDS).

Table 6a – Cross price elasticities London-Paris business market (2012)

			Business							
Share outside alternative (%)			15							
Cross price elasticities:			Eurostar	BA	AF	BA	WX	U2	Eurotunnel	P&O/DFDS
Rail	QQS - XPG	Eurostar	-0.61	0.18	0.32	0.08	0.05	0.06	0.04	0.01
Air FSC	LHR - CDG	British Airways (BA)	0.93	-4.82	1.40	0.35	0.05	0.06	0.04	0.01
	LHR - CDG	Air France (AF)	0.93	0.80	-4.46	0.35	0.05	0.06	0.04	0.01
	LHR - ORY	British Airways (BA)	0.93	0.80	1.40	-4.87	0.05	0.06	0.04	0.01
Air LCC	LCY - ORY	CityJet (WX)	0.93	0.18	0.32	0.08	-3.64	0.57	0.04	0.01
	LTN - CDG	EasyJet (U2)	0.93	0.18	0.32	0.08	0.43	-1.43	0.04	0.01
Car	LDN - PAR	Eurotunnel	0.93	0.18	0.32	0.08	0.05	0.06	-1.79	0.14
	LDN - PAR	P&O/DFDS	0.93	0.18	0.32	0.08	0.05	0.06	0.77	-1.97

Table 6b – Cross price elasticities London-Paris leisure market (2012)

			Leisure							
Share outside alternative (%)			30							
Cross price elasticities:			Eurostar	BA	AF	BA	WX	U2	Eurotunnel	P&O/DFDS
Rail	QQS - XPG	Eurostar	-0.93	0.05	0.11	0.01	0.01	0.07	0.18	0.15
Air FSC	LHR - CDG	British Airways (BA)	1.07	-3.94	1.13	0.11	0.01	0.07	0.18	0.15
	LHR - CDG	Air France (AF)	1.07	0.50	-3.54	0.11	0.01	0.07	0.18	0.15
	LHR - ORY	British Airways (BA)	1.07	0.50	1.13	-4.55	0.01	0.07	0.18	0.15
Air LCC	LCY - ORY	CityJet (WX)	1.07	0.05	0.11	0.01	-3.77	0.83	0.18	0.15
	LTN - CDG	EasyJet (U2)	1.07	0.05	0.11	0.01	0.13	-1.61	0.18	0.15
Car	LDN - PAR	Eurotunnel	1.07	0.05	0.11	0.01	0.01	0.07	-2.38	0.62
	LDN - PAR	P&O/DFDS	1.07	0.05	0.11	0.01	0.01	0.07	0.76	-2.43

The quality indices show that business passengers value services provided by Air France between Heathrow airport and Paris CDG the best (table 7a), followed by British Airways on the same route and Eurostar. Flights to and or from secondary airports are less valued, especialy operated by LCC carriers. Private car options have the lowest quality index where the train shuttle is perceived better than the ferry. Leisure passengers value Eurostar the best. Private car and flights with Air France between LHR and CDG are more valued than other flights. The quality attributes for the leisure and business market show the expected signs (table 7b). Longer travel time has a negative effect, while higher frequency, punctuality and capacity have a positive effect on quality. These values can be evaluated in monetary terms. For an outside alternative of 15% for the business market, a travel time reduction of 10 minutes is equivalent to a price increase of €34.97. Five extra trips per week is equivalent to €3.21, while 1% better punctuality is equivalent to €11.02 and an extra seat is equivalent to €0.13. For the leisure market (with an 30% outside alternative share), the values are €6.53, €4.01, €0.96 and €0.32 respectively. Travel time appears to be the most valuable quality factor for both business and leisure travellers. Business travellers value punctuality better than frequency, whereas it is the opposite for leisure travellers. The value of an extra seat is higher for leisure and business travellers.

Table 7a – Quality indices for the London-Paris transport market (2012)

			Business			Leisure		
Share outside alternative (%)			15	30	60	15	30	60
Quality, mode ranking								
Rail	QQS - XPG	Eurostar	2.93	2.07	0.80	3.17	2.29	1.01
Air FSC	LHR - CDG	British Airways	2.95	2.09	0.80	1.07	0.21	-1.10
	LHR - CDG	Air France	3.44	2.60	1.32	1.72	0.86	-0.45
	LHR - ORY	British Airways	2.19	1.31	0.02	0.19	-0.67	-1.98
Air LCC	LCY - ORY	CityJet	0.93	0.05	-1.23	-0.20	-1.06	-2.36
	LTN - CDG	EasyJet	0.23	-0.65	-1.91	0.37	-0.51	-1.79
Car	LDN - PAR	Eurotunnel	-0.14	-1.01	-2.27	1.68	0.81	-0.48
	LDN - PAR	P&O/DFDS	-1.41	-2.32	-3.59	1.52	0.65	-0.64

Table 7b – Quality parameters for the London-Paris transport market (2012)

	Business			*Leisure*		
Share outside alternative (%)	*15*	*30*	*60*	*15*	*30*	*60*
Quality characteristics						
Eurostar Dummy	-5.67	-5.39	-4.78	-5.79	-5.29	-4.71
AF Dummy	2.29	2.24	2.11	1.03	0.95	0.82
LCC Dummy	-3.04	-2.99	-2.86	-0.56	-0.55	-0.44
Car/Shuttle Dummy	-0.13	-0.26	-0.44	-1.08	-1.19	-1.38
Travel time	-0.045	-0.046	-0.047	-0.016	-0.016	-0.017
Frequency	0.008	0.008	0.009	0.020	0.020	0.020
Punctuality	0.152	0.145	0.131	0.032	0.024	0.010
Capacity	0.002	0.002	0.001	0.009	0.008	0.007

5.2. Market simulations

With the model, simulations can be run in order to better understand the situation on the London-Paris transport market. The model is capable of simulating any changes in pricing, service quality or marginal costs after the market equilibrium is calculated. Even the entry or exit of a competitor can be measured in terms of variations in other firms' prices and market shares (Ivaldi 2008). Three situations are further elaborated for the London-Paris market. First, the effect of increasing the infrastructure charges is examined. The Investment Recovery Charge (IRC) for the high-speed link between the Channel tunnel and London (HS-1) was reduced by 80% from £10,937 per train to £2,150 per train at the end of 2009 to help Eurostar to turn-around their loss-making operation. The reduction in the IRC had the desired effect and Eurostar UK made its first profits in 2009 (NAO 2015). Charges levied by Eurotunnel for the Channel tunnel are perceived to be high and are part of a debate around infrastructure and track access charges in Europe. Eurostar has a dominant share on the London-Paris market despite the high Channel tunnel charges. In the first simulation, the effect of raising the infrastructure charges is explored.

Eurostar has ordered 17 new international passenger trains, the first of which came into service at the end of 2015. The new e320 trains have higher seating capacity (around 20% greater), allowing for more passengers at peak time. New trains are forecast to increase revenue due to an increase in the number of passengers, while many of the costs will stay (for example track access costs per train) or fall (more cost-efficient trains) (NAO 2015). The expected effect of these new trains is that service quality will improve, operating costs per seat will go down and Eurostar's market share will increase. The second simulation is aimed at exploring the effect of improving the service characteristics of Eurostar and reducing the marginal costs.

The third case has to do with the entry of a new rail competitor. International rail passenger services have been liberalised since 1 January 2010. The assumption is that an operator offering competing rail service between Paris and London would significantly reduce Eurostar's market share. In 2010, the German train operator Deutsche Bahn (DB) announced that it planned to offer cross-Channel services from London by 2013. In 2014, it announced that its plans were on hold due to operational challenges (NOA 2015). As there is still an opportunity for a new high-speed rail operator to enter the London-Paris market, a simulation is run where a competitor is offering the same type of service as Eurostar but with 25% lower marginal cost.

5.3. Increase of infrastructure charges

The 80% charge reduction for HS-1 is equivalent with a decrease in cost of approximately €18 per passenger (at 81% load factor, 1.23 Euro/Sterling exchange rate). Increasing the rail infrastructure charges again between London and Paris results in higher marginal costs. For the simulation we assume a €18 per passenger increase in marginal costs. The effect is that Eurostar increases the ticket price, but they are losing market share to the air and car modes as might be expected (table 8a and 8b). The effect on the consumer surplus is limited.

Table 8a – Simulation results for increasing infrastructure charges in the Paris-London business market (2012)

			Business					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	235.2	101.0%	126.3	8.0%	130.2	11.3%
Air FSC	LHR - CDG	British Airways	280.1	0.4%	279.1	0.0%	279.1	0.0%
	LHR - CDG	Air France	293.5	0.9%	291.2	0.1%	291.1	0.0%
	LHR - ORY	British Airways	259.4	0.2%	259.1	0.0%	259.0	0.0%
Air LCC	LCY - ORY	CityJet	202.4	0.2%	202.0	0.0%	202.0	0.0%
	LTN - CDG	EasyJet	100.4	1.4%	99.1	0.1%	99.1	0.1%
Car	LDN - PAR	Eurotunnel	127.6	0.5%	127.1	0.1%	127.0	0.0%
	LDN - PAR	P&O/DFDS	105.1	0.1%	105.0	0.0%	105.0	0.0%
Market shares (%):								
Rail	QQS - XPG	Eurostar	43.4	-28.1%	46.7	-6.2%	25.0	-12.0%
Air FSC	LHR - CDG	British Airways	7.0	41.5%	4.3	6.1%	2.4	4.7%
	LHR - CDG	Air France	12.1	46.6%	7.2	5.9%	4.1	4.6%
	LHR - ORY	British Airways	3.2	40.6%	2.0	6.2%	1.1	4.8%
Air LCC	LCY - ORY	CityJet	2.4	40.5%	1.5	6.2%	0.8	4.8%
	LTN - CDG	EasyJet	6.6	44.6%	4.0	6.0%	2.3	4.7%
Car	LDN - PAR	Eurotunnel	3.3	43.1%	2.0	6.2%	1.1	4.7%
	LDN - PAR	P&O/DFDS	0.7	41.0%	0.4	6.2%	0.3	4.8%
Outside alternative			21.3	41.7%	31.9	6.2%	62.9	4.8%
Consumer surplus:			145.9	1.0%	85.8	-5.0%	35.0	-9.2%

Table 8b – Simulation results for increasing infrastructure charges in the Paris-London Leisure market (2012)

			Leisure					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	107.8	47.6%	82.8	13.5%	86.6	18.6%
Air FSC	LHR - CDG	British Airways	117.1	0.1%	117.0	0.0%	117.0	0.0%
	LHR - CDG	Air France	123.4	0.3%	123.1	0.1%	123.0	0.0%
	LHR - ORY	British Airways	123.0	0.0%	123.0	0.0%	123.0	0.0%
Air LCC	LCY - ORY	CityJet	103.0	0.0%	103.0	0.0%	103.0	0.0%
	LTN - CDG	EasyJet	64.7	1.1%	64.2	0.2%	64.1	0.1%
Car	LDN - PAR	Eurotunnel	83.2	1.4%	82.3	0.3%	82.1	0.1%
	LDN - PAR	P&O/DFDS	80.9	1.1%	80.2	0.2%	80.1	0.1%
Market shares (%):								
Rail	QQS - XPG	Eurostar	43.8	-25.5%	42.4	-12.4%	21.6	-22.1%
Air FSC	LHR - CDG	British Airways	2.2	35.5%	1.5	11.8%	0.8	8.5%
	LHR - CDG	Air France	4.8	36.7%	3.2	11.5%	1.8	8.4%
	LHR - ORY	British Airways	0.5	35.5%	0.3	11.9%	0.2	8.5%
Air LCC	LCY - ORY	CityJet	0.6	35.2%	0.4	12.0%	0.2	8.6%
	LTN - CDG	EasyJet	5.9	36.9%	4.0	11.4%	2.2	8.3%
Car	LDN - PAR	Eurotunnel	11.9	37.6%	8.0	11.6%	4.4	8.2%
	LDN - PAR	P&O/DFDS	9.9	36.0%	6.7	11.3%	3.7	8.3%
Outside alternative			20.4	35.8%	33.5	11.8%	65.1	8.5%
Consumer surplus:			73.3	-4.7%	44.0	-9.3%	17.6	-16.0%

5.4. New Eurostar trains

In this case, we assume the capacity to increase by 20% as soon as the current TGV trains with 750 seats are replaced by e320 trains with 900 seats. This results in 20% lower operational costs per available seat. The marginal cost will decrease as well, but less than 20% as charges for the Channel tunnel (€17 per passenger in 2012) will remain the same. Assumed is that a 20% higher train capacity leads to a 10% decrease in marginal costs. The results are presented in table 9a for the business market and 9b for the leisure market.

Table 9a – Simulation results for new Eurostar trains (business market 2012)

			Business					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	108.6	-7.2%	113.4	-3.1%	115.9	-1.0%
Air FSC	LHR - CDG	British Airways	278.9	-0.1%	279.0	0.0%	279.0	0.0%
	LHR - CDG	Air France	290.7	-0.1%	290.9	0.0%	291.0	0.0%
	LHR - ORY	British Airways	258.9	0.0%	259.0	0.0%	259.0	0.0%
Air LCC	LCY - ORY	CityJet	201.9	0.0%	202.0	0.0%	202.0	0.0%
	LTN - CDG	EasyJet	98.8	-0.2%	98.9	-0.1%	99.0	0.0%
Car	LDN - PAR	Eurotunnel	126.9	-0.1%	127.0	0.0%	127.0	0.0%
	LDN - PAR	P&O/DFDS	105.0	0.0%	105.0	0.0%	105.0	0.0%
Market shares (%):								
Rail	QQS - XPG	Eurostar	63.0	4.2%	51.0	2.4%	28.8	1.1%
Air FSC	LHR - CDG	British Airways	4.6	-6.5%	4.0	-2.3%	2.3	-0.4%
	LHR - CDG	Air France	7.7	-6.2%	6.6	-2.3%	3.9	-0.4%
	LHR - ORY	British Airways	2.1	-6.6%	1.8	-2.4%	1.1	-0.4%
Air LCC	LCY - ORY	CityJet	1.6	-6.6%	1.4	-2.4%	0.8	-0.4%
	LTN - CDG	EasyJet	4.3	-6.4%	3.7	-2.3%	2.2	-0.4%
Car	LDN - PAR	Eurotunnel	2.1	-6.5%	1.8	-2.4%	1.1	-0.4%
	LDN - PAR	P&O/DFDS	0.5	-6.6%	0.4	-2.4%	0.2	-0.4%
Outside alternative			14.0	-6.6%	29.3	-2.4%	59.7	-0.4%
Consumer surplus:			149.6	3.6%	92.2	2.0%	38.9	0.9%

Table 9b – Simulation results for new Eurostar trains (leisure market 2012)

			Leisure					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	70.2	-3.9%	72.4	-0.8%	71.4	-2.2%
Air FSC	LHR - CDG	British Airways	117.0	0.0%	117.0	0.0%	117.0	0.0%
	LHR - CDG	Air France	123.0	0.0%	123.0	0.0%	123.0	0.0%
	LHR - ORY	British Airways	123.0	0.0%	123.0	0.0%	123.0	0.0%
Air LCC	LCY - ORY	CityJet	103.0	0.0%	103.0	0.0%	103.0	0.0%
	LTN - CDG	EasyJet	63.9	-0.1%	64.0	0.0%	64.0	0.0%
Car	LDN - PAR	Eurotunnel	81.9	-0.1%	82.0	0.0%	82.0	0.0%
	LDN - PAR	P&O/DFDS	79.9	-0.1%	80.0	0.0%	80.0	0.0%
Market shares (%):								
Rail	QQS - XPG	Eurostar	60.5	2.8%	48.8	0.7%	28.5	2.9%
Air FSC	LHR - CDG	British Airways	1.5	-4.1%	1.3	-0.7%	0.8	-1.1%
	LHR - CDG	Air France	3.3	-4.0%	2.9	-0.7%	1.6	-1.1%
	LHR - ORY	British Airways	0.3	-4.1%	0.3	-0.7%	0.2	-1.1%
Air LCC	LCY - ORY	CityJet	0.4	-4.2%	0.3	-0.7%	0.2	-1.1%
	LTN - CDG	EasyJet	4.2	-4.0%	3.5	-0.7%	2.0	-1.1%
Car	LDN - PAR	Eurotunnel	8.3	-3.9%	7.1	-0.7%	4.0	-1.1%
	LDN - PAR	P&O/DFDS	7.0	-3.9%	6.0	-0.7%	3.4	-1.1%
Outside alternative			14.4	-4.1%	29.8	-0.7%	59.3	-1.1%
Consumer surplus:			78.6	2.2%	48.7	0.6%	21.4	2.2%

Product quality improvement of Eurostar (translated into lower marginal costs) results into an even more dominant market position. The business market is more sensitive to Eurostar's service level than the leisure market as illustrated by the extra seat capacity offering. Consumer surplus increases slightly, but the decrease in the outside alternative indicates that no extra traffic is induced.

5.5. Entrance of a new high-speed rail operator with low-cost trains

A new rail operator introduces a structural change in the transport system. Eurostar's market share would be halved when a new operator would offer the same quality characteristics (travel time, frequency, punctuality, capacity) and prices. In this case, we assume a new operator with marginal costs that are 75% of Eurostar's cost level. The results of this simulation for the business and leisure market is presented in table 10a and 10b.

Table 10a – Simulation results for a new high-speed rail operator entering Paris-London business market (2012)

			Business					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	361.1	208.7%	167.8	43.4%	87.4	-25.3%
		LCC Train	297.6	0.0%	162.6	0.0%	85.7	0.0%
Air FSC	LHR - CDG	British Airways	277.3	-0.6%	277.9	-0.4%	278.7	-0.1%
	LHR - CDG	Air France	287.9	-1.1%	289.0	-0.7%	290.4	-0.2%
	LHR - ORY	British Airways	258.3	-0.3%	258.5	-0.2%	258.9	-0.1%
Air LCC	LCY - ORY	CityJet	201.4	-0.3%	201.6	-0.2%	201.9	-0.1%
	LTN - CDG	EasyJet	97.0	-2.0%	97.8	-1.3%	98.6	-0.4%
Car	LDN - PAR	Eurotunnel	125.9	-0.8%	116.2	-8.5%	126.8	-0.1%
	LDN - PAR	P&O/DFDS	104.8	-0.2%	112.8	7.5%	105.0	0.0%
Market shares (%):								
Rail	QQS - XPG	Eurostar	45.4	-24.9%	39.5	-20.7%	24.0	-15.5%
		LCC Train	44.2	0.0%	38.6	0.0%	24.8	0.0%
Air FSC	LHR - CDG	British Airways	1.4	-70.7%	1.9	-53.1%	1.7	-28.3%
	LHR - CDG	Air France	2.5	-69.9%	3.2	-52.2%	2.8	-28.0%
	LHR - ORY	British Airways	0.7	-71.3%	0.9	-53.6%	0.8	-28.6%
Air LCC	LCY - ORY	CityJet	0.5	-71.2%	0.7	-53.6%	0.6	-28.5%
	LTN - CDG	EasyJet	1.4	-70.4%	1.8	-52.8%	1.6	-28.2%
Car	LDN - PAR	Eurotunnel	0.7	-70.8%	0.2	-89.2%	0.8	-28.4%
	LDN - PAR	P&O/DFDS	0.1	-71.3%	0.3	-40.1%	0.2	-28.6%
Outside alternative			4.3	-71.3%	13.9	-53.6%	42.9	-28.6%
Consumer surplus:			239.4	65.7%	148.0	63.8%	64.0	65.9%

Table 10b – Simulation results for a new high-speed rail operator entering Paris-London leisure market (2012)

			Leisure					
Share outside alternative (%)			*15*		*30*		*60*	
			Value	*Change*	*Value*	*Change*	*Value*	*Change*
Prices (€):								
Rail	QQS - XPG	Eurostar	174.5	139.0%	102.9	40.9%	55.8	-23.6%
		LCC Train	156.5	0.0%	101.9	0.0%	53.4	0.0%
Air FSC	LHR - CDG	British Airways	116.7	-0.2%	116.8	-0.1%	116.9	0.0%
	LHR - CDG	Air France	122.3	-0.5%	122.6	-0.3%	122.9	-0.1%
	LHR - ORY	British Airways	122.9	0.0%	123.0	0.0%	123.0	0.0%
Air LCC	LCY - ORY	CityJet	102.9	-0.1%	102.9	-0.1%	103.0	0.0%
	LTN - CDG	EasyJet	62.9	-1.7%	63.3	-1.1%	63.8	-0.3%
Car	LDN - PAR	Eurotunnel	80.3	-2.1%	75.7	-7.7%	81.7	-0.4%
	LDN - PAR	P&O/DFDS	78.6	-1.7%	85.1	6.4%	79.7	-0.3%
Market shares (%):								
Rail	QQS - XPG	Eurostar	44.6	-24.2%	39.5	-18.4%	23.2	-16.0%
		LCC Train	43.8	0.0%	39.3	0.0%	25.4	0.0%
Air FSC	LHR - CDG	British Airways	0.4	-74.0%	0.6	-54.7%	0.5	-28.9%
	LHR - CDG	Air France	0.9	-73.6%	1.3	-54.3%	1.2	-28.7%
	LHR - ORY	British Airways	0.1	-74.2%	0.1	-54.9%	0.1	-29.1%
Air LCC	LCY - ORY	CityJet	0.1	-74.4%	0.2	-55.1%	0.1	-29.1%
	LTN - CDG	EasyJet	1.2	-73.4%	1.6	-54.0%	1.5	-28.6%
Car	LDN - PAR	Eurotunnel	2.3	-73.0%	0.6	-91.6%	2.9	-28.4%
	LDN - PAR	P&O/DFDS	2.0	-73.3%	2.9	-51.2%	2.5	-28.6%
Outside alternative			3.9	-74.1%	13.6	-54.8%	42.6	-29.0%
Consumer surplus:			131.8	71.3%	80.4	65.9%	35.0	67.0%

In the case of a new high-speed train operator entering the London-Paris market, the shares of the air and car mode are decreasing by 30 to 75% depending on the share of the outside alternative, while keeping the same price level. Eurostar is losing 15 to 25% of its market share as well in favour of the new operator resulting in an almost equal share for both rail operators, but with slightly lower prices for the new entrant due to the lower marginal costs. The outside alternative is decreasing which means that the new market situation attracts extra travellers. The consumer surplus is higher in all cases. The market share losses for the incumbent operators are about the same for the leisure and business market.

6. Conclusion

Eurostar has a dominant market share of about 70% (2012) on the London-Paris market compared to airlines and private car. This share is sensitive to changes in infrastructure charges. If charges would be increased again, after the 80% reduction in 2009 for HS-1, Eurostar's market share would go down in favour of air and road traffic. Introduction of new Velaro trainsets with more seat capacity will make Eurostar's market position even more dominant. A new high-speed rail entrant would completely change the competitive landscape. With the same pricing and quality characteristics Eurostar's market share will be halved. If the new entrant is capable to reduce its marginal costs, the effect will even be bigger and also drive airlines and private out of the market. The business market is less sensitive to prices, but more sensitive to the service level offering.

The econometric supply and demand model for oligopolistic markets with differentiated products as used in this study has proven to be a valuable tool to study competition in transport markets. The application on the London-Paris link gives valuable information on the effect of marginal costs and quality attributes on the competitive position of operators. The results are well in line with comparable studies on the Cologne-Berlin, Amsterdam-Paris and Rome-Milano markets. For the future the London-Paris case can be studied in more detail with the statistical data available from the UK International Passenger Survey for subsequent years. Further application of the methodology on other links will contribute to capture the competitive position of operators in the West European market in more detail.

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