Liberalization of Passenger services in the Spanish Railway sector. A first approach.

Carlos Gutiérrez-Hita\textsuperscript{1}

University of Alicante, Spain

(Work in progress)

Abstract

European Union began to open the railway sector to competition in recent years. Directive 2012/34/EU amended and recasting the previous Railway Packages and the Commission’s 4th Railway Package will contain the basic provisions for market opening in the railway sector. This paper assesses the ongoing steps towards liberalization of long distance railway passenger services in Spain. The first route that will be open up to competition is the network of conventional & high speed lines under the Levante corridor. An update of the legislative reforms and the main objections and advices by part of the EU commission and the National Commission of market and competition (CNMC) is presented. Furthermore, simultaneous and sequential decision making models are used to highlight how market liberalization and the regulation framework may affect consumer surplus and social welfare. Indeed, liberalization processes should decrease the social deadweight loss from the monopoly status quo and also lead to a more competitive pricing. It is concluded that Spanish railway liberalization process can be improved in a number of aspects, mainly by unbundling the business of leasing rolling passenger units, by modifying the infrastructure access fee, and facilitate that new operators enter in more than one railway corridor. Finally, it is concluded that other issues as closer substitutes and product differentiation may affect liberalization.

Keywords: Railway market liberalization, competition, regulation.

JEL classification: K2, L1, L5, L92.

\textsuperscript{1} Campus San Vicente del Raspeig, Faculty of Economics, 03690. Department of Economic Analysis Foundations. Email: carlosghita@ua.es. Tel. +34 965 90 34 00. Ext. 3254.
1. Introduction

Following the recent directives and programs of the European Union (EU), some European countries began to open the railway markets to competition in the last two decades. In the railway market, liberalization means that new operators enter the market in passenger services, cargo services, or both. EU Member States must also have regulatory bodies in place to monitor railway markets and to ensure fair competition in the case that rail companies believe they have been unfairly treated. In addition, a European Railway Agency (ERA) was created in 2004. Directive 2012/34/EU amended and recasting the previous three Railway Packages. It contains the basic provisions for market opening in the railway sector. Further proposals are made in the Commission's 4th Railway Package.² It is expected to run by 2020 for the opening-up of the national passenger market, and 2023 for the public service obligations (PSO).

The present paper focus on the first attempt to opening-up to competition the long distance railway passenger services in Spain. Spain’s government approved a series of structural reforms of the transport sector, including the liberalization of railway passenger market. Public Works Minister Ana Pastor announced in winter 2014 the end of RENFE's monopoly in the long-distance railway passenger market. The current government in force expects that the liberalization process jointly with a new regulatory framework yields to a better range of services, more competitive prices, an increase of railway passengers service as well as the optimization of RENFE's management. Spanish railway configuration includes a vertical separation of infrastructure and the provision of the service. Network infrastructure management (ADIF) remains as a public monopoly which manages the national network. The monopoly by RENFE since 1941 remains as a public firm as RENFE-Operadora (RO, hereinafter). It works under a four commercial companies as a first step towards liberalization (Royal Decree-Act 22/2012): RENFE Passengers, RENFE Freight, RENFE Leasing (rolling stock and passenger units), and RENFE Manufacture and maintenance.

The first route to be opened up to competition will be the network of conventional & high speed lines in the Levante corridor (passenger services from Madrid to Cuenca, Albacete, Valencia, Alicante and Murcia). The rail passenger operator license will allow a private operator to provide railway passenger services in competition with RO, for an initial period of 7 years. In this stage, Spanish government decided to allow only a new operator and thus, the aforementioned sector will become in a duopoly. The new operator may determine the frequency of its services and prices freely and may enter into a rolling material leasing contract with RENFE-Leasing society, while creating its own rolling stock fleet.

First, a briefly review of the main liberalization processes in Europe is presented in order to compare the strategy of the Spanish government with those countries where part—or totally—of the railway network has been opened up to competition. Second, I review the legislation related with the first steps towards liberalization of railway passenger services in the Spanish railway market. Third, simultaneous and sequential decision making models are used in order to specify how market liberalization and the regulatory framework may decrease the social deadweight loss from the monopoly status quo and lead to more competitive pricing. We also focus in the role that market definition, the role that different level of demand in each railway corridor (middle-distance services, and long-distance services) plays in the process, and how close substitutes may alter an effective way towards liberalization. Finally, it is conducted an assessment based on the reports by the National Commission of market and competition (CNMC, Comisión Nacional de Mercados y Competencia) and the qualitative results suggested by the oligopoly models presented. Overall, it is concluded that in order to improve the successful opportunity of the liberalization process a number of changes in regulatory measures as well as some particular market features should be discussed.

An open question is whether railway services can be exploited as a competitive market, i.e. under an oligopoly configuration, or not. Some countries as United Kingdom have a franchise system whereas others prefer to open the (almost) entire network to competition. There is an open debate about the controversy between the concepts of competition for market versus competition in the market (see, for instance Geroski 2003).  

Literature describing the liberalization models followed by countries around the world is wide. In De Rus and Campos (2009) is empirically examines the implementation of High Speed Railways in a number of countries. They study operating and maintenance cost and some implications concerning liberalization. Concerning regulation or railway networks, in a recent paper by Laurino et. al. (2015) it is concluded that overall, public authorities still play a dominant role after liberalization because vertical integration structures remain. They also emphasize that liberalization processes depend on the shape of the transportation system in each country and the monopoly structure before liberalization. Overall, there is no common wisdom about how a liberalization process has to be done. Indeed, it is the main argument to study each particular case in deep. Concerning the Spanish market there are some studies about the ongoing liberalization. The main studies available are by CNMC (see references) and Comité de regulación ferroviaria (Spanish rail network regulatory board). In De Rus, G. and Inglada, V (1997) it is conducted a cost-benefit analysis of the high speed network and its implications for the market configuration. A nice revision of ongoing liberalization processes (including Spain liberalization plans at that date) can be found in Gómez-Ibáñez and De Rus (2006).

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3 Under competition for market a regulator gives a franchise to an operator whereas competition in the market usually includes oligopoly competition.

The rest of the paper is structured as follows. Section 2 briefly sketched the *state-of-the art* in the opening-up to competition of railway markets at the EU level. Section 3 describes the relevant legal framework in force in Spain at this moment and the government route map aimed to liberalize the *Levante corridor*. The main objections by part of different economic agents involved in the process, and some statistical evidence are also highlighted. Section 4 presents different competition models involving different regulatory measures and the proposed market configuration in the way towards the liberalization. Section 5 concludes with some policy recommendations.

2. Liberalization of the railway sector at EU level. A briefly review

In this section we briefly describe liberalization processes in the major European countries at this moment. EU legislation should lead to a convergence of national railway legislation packages and thus, to exploit a unique railway market under a harmonized European legislation in reasonable period of time.

At European level, The United Kingdom was a pioneer in railway liberalization. It has used franchising to split up British Rail extensively. They promoted the entry of new operators with the Railways Act in 1993. There was a concession system and the infrastructure was privatized. After some failures a most recent Railway Act was passed in 2005. British Rail ceased to exist and almost any railway business was privatized with more than one firm in each sector, aimed to ensure competiveness. After the incident at Hatfield the private company Railtrack becomes in Network Rail, which is the owner and infrastructure manager of most of the rail.5 Network Rail manages operations by private train operating companies (TOCs), responsible for passenger transport, and freight operating companies (FOCs). The British system is organized by a system of concessions for exclusive operation which is extended during seven to ten years. In many cases a concession is a bundle of urban, regional and long distance services. An interesting issue is that engineering of rolling stock is competitive, which a number of firms that lease out rolling stock and thus, new entrants gain access to it under competitive prices. Moreover, it improves competition because rolling stock does not depend of the incumbent operator. Rolling stock maintenance was divided in six firms, avoiding cross subsidies.6 The effects of liberalization in the British market are mixed. First, the use of passenger services and its productivity increases, with stable employment. Second, as public funding has increased because the franchise system the government studies to increase rail fares as well as reduce public support. Overall, the British railway system is composed of firms that compete for the market in some segments and compete in the market in others, with no historical incumbent firm after an extensive period of liberalization.

5 Network Rail is a 'not for dividend' and the Secretary of State for Transport is a 'Special Member' of the company’s board of management and possesses additional powers over other members.

6 The first division of this segment was Rolling Stock Operating Companies (ROSCOS). Later on, it became in this two separate segments of firms.
Germany is a vertically integrated model, which keeps the infrastructure manager and the service operator under a holding company. Moreover, the railway system was opened up to competition in 1994. Regions have taken powers to manage passenger transport. Regional services are organized by mean of tendering processes or directly assigned to a company because the absence of enough competition in the market. The government subsidize this segment (is assumed to be a Public Service Obligation, [PSO]). Competition in the market takes place in long distance services with no public funds and no PSO. Still, the incumbent Deutsche Bahn has maintained its dominance in long distance routes. From an initial period of unfair competition the results of the liberalization process vary across segments. The regional market is improved and moved from direct allocation to a public tender scheme. In the long distance segment however, the government reduce routes previous to the entrance of new operators. This fact, jointly with the advantage of the incumbent DB and the lack of public fund yields to a decrease in passengers and frequencies. Prices also arise over the Price index in both segments. The challenge is to induce more competition in the long distance services by decreasing incumbent market power and maybe, by the implementation of a franchise system.

The Italy railway system is vertically-integrated. Government authorities opened up the market to competition in 2000. Long distance passenger market is structured under two regimes: tendering schemes and free competition, whereas regional and urban services operate under exclusive contracts. A holding incumbent company (Ferrovie dello Stato) possesses the whole capital of the firms involved. The infrastructure administrator, the Railway undertaking company Trenitalia, an engineering firm, station management and logistic are the main four companies in the market. The main peculiarity of this market is that the incumbent operator Trenitalia has no obligation to get access to rolling passenger material. The companies Arenaways (in 2010) and Italo (in 2012) entered the competitive segment of the market. Overall, liberalization increase productivity as well as decrease the direct employment.

Sweden began the liberalization process in the 80s. The former national incumbent was split in two companies: Trafikverket, which manage infrastructure and also tendering processes, and SJ AB, the railway service provider.7 In 2001 SJ AB was divided in eight companies. Concerning the passenger services the liberalization process finished in October 2010. Since 1990 regional services were management for the Regional authorities and long distance services as well as freight transport remain under SJ. Until 2010, tendering processes are applied to regional routes and long distance services. Nowadays, the long distance market is totally open up to competition. It is remarkable that in Sweden entry cost are almost zero. The process to obtain licenses of operation, safety certificates and approval of rolling stock is free of charge. After 4 years of full liberalization new operators account for a 10% of the markets but prices have experimented a reduction (mainly because total cost decrease due to a lower direct

7 Until 2010 the infrastructure management was Banverket. The new company also has air, sea, and road transport.
employment). With respect to those lines under tendering processes the number of competitors is still reduce.

Meanwhile in France, reluctance to replace public ownership of the infrastructure, operator, and maintenance of the national railway poses a substantial obstacle for market opening reforms.

3. Spanish liberalization process. A first step

In 2015 Spanish authorities amended the Law 39/2003 (17/11/03) by presenting a first approach to a new railway sector law (NRSL, hereinafter). That amended follows the obligation to cope with the Directive 2012/34/EU and also some modifications in the Spanish national regulations in that sector. Indeed, one of the main problems at European level is related with the heterogeneity of regimes across countries (from a huge government intervention in some countries to a wide liberalization in others). After the aforementioned normative packages on the railway sector the EU authorities are in the way to develop a new normative package (the Fourth Railway Package). The main aim is to get ready a total liberalization in 2019. The Spanish competition department (CNMC) considers that some aspect of the government project may protect the former incumbent firm RENFE and thus, effective competition will not take place. After a number of discussions and advices by part of CNMC, agents and firms involved in the market, and political pressures by part of EU the new Railway Sector Law 38/2015 (RSL, hereinafter) was recently passed on September 29th. The main aim of this new regime is to impulse the railway sector as a competitive mode of transport in the new market environment where opening-up to competition have to be undertaken as a prerequisite.

In order to understand how the configuration of the Spanish railway network may influence the liberalization process it is included here the evolution of passenger traffic and the distribution of track attending the type of power and gauge. Figure 1 and Figure 2 account for this information. A first insight is that more than 60% of the total network is fiddled by electricity and also the lines served by HSR have increased in the last years. Thus, a natural question arises, if the passenger rolling material exhibit complementarities along the network why do not open to competition almost the entire HSR market? Of course, to answer this question involves not only technical reasons but also political and economic controversy matters. In what follows, it is described more in detail Spanish HSR corridors and the passenger rolling material used in them. Finally in the third part of this subsection, I assess a critical discussion of the liberalization process.

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8 It replaces the former Law 39/2003 on November 17th.
3.1 Spanish HSR corridors.

The core of the almost Spanish High Speed Network is Atocha railway station, located in Madrid. There are four High speed corridors have connection at this point, and also by-pass facilities will be possible to connect directly each other without any stop at the actual Atocha terminal station. Picture 1 depicts the Spanish HSR network. In the near future a fifth corridor (the Mediterranean railway corridor) will link the corners of the other three corridors, closing a complete network. In what follows, it is described these four corridors.9

9 There is also a short fifth corridor, the North-Northeast corridor (from Madrid to Valladolid). It is expected to be the starting point to get access the High speed network infrastructure currently under construction in the Basque Country and in the very North-West of Spain (Galicia).
Table 1 resumes the main features of both HSR corridors and the former Iberian network where both infrastructures are almost duplicated. Notice that except for the category “Mixed rolling material”, all the rolling passenger material is able to run through UIC and Iberian gauge.\textsuperscript{10}

<table>
<thead>
<tr>
<th>Railway Corridors</th>
<th>Gauge</th>
<th>Distance (kilometers)</th>
<th>Commercial speed</th>
<th>Long distance</th>
<th>Middle distance</th>
<th>Mixed Rolling material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madrid-Andalucia</td>
<td>Iberian</td>
<td>656</td>
<td>140-200 k/h</td>
<td>ALVIA S130, ALTARIA TALGO VI, VII</td>
<td>Mixed Rolling material</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UIC</td>
<td>636.8</td>
<td>300 k/h</td>
<td>AVE 100, 103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madrid-Levante</td>
<td>Iberian</td>
<td>945</td>
<td>200 k/h</td>
<td>ALVIA S130, ALTARIA TALGO VI, VII</td>
<td>Mixed Rolling material</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UIC</td>
<td>603\textsuperscript{12}</td>
<td>300 k/h</td>
<td>AVE 102, 112</td>
<td>NOT OPERATED</td>
<td></td>
</tr>
<tr>
<td>Madrid-Valladolid-León</td>
<td>Iberian</td>
<td>362</td>
<td>200 k/h</td>
<td>ALVIA S130</td>
<td>Mixed Rolling material</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UIC</td>
<td>340</td>
<td>350 k/h</td>
<td>AVE 103, 112</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: data collection (ADIF, RO, Spanish Ministry of Infrastructure). Own construction. Grey: HSR corridor proposed for liberalization. Yellow: services not operated by RO.

\textsuperscript{10} The company TALGO was pioneer in developing this facility in 1969. The system was intended to achieve the France Network without interruption, allowing TALGO RD 3\textsuperscript{rd} generation trains to get Paris and Zurich (and other minor destinations) under the same train configuration. Two types of locomotives, a Diesel 2000T, and an electric 7600 (mixed voltage) were ready to run. Later on, this facility was extensive to other locomotives and coach wagons.

\textsuperscript{11} 55 kilometers are suitable for mix use (the so-called third rail with polyvalent concrete sleepers), Iberian gauge and standard gauge, from Figueres to Perpignan.

\textsuperscript{12} This infrastructure will have 955 kilometers, including the lines Monforte-Node to Valencia, Monforte-Node to Murcia, and Valencia to Castellón.
3.2 An assessment of the ongoing path towards liberalization

It is remarkable that Spanish authorities have in the way to liberalize the service before 2019 (the deadline). However, CNMC and EU competition policy authorities have expressed some disagreement with the process in its current formulation. There is an open debate about the current expansion of the HSR Network. The extra cost incurred in the new high speed lines lowers the maintenance and improvements budget of the conventional lines. Indeed, in most of the cases the network is duplicated and thus, in order to avoid cannibalization of the new HSR lines, the government decides to cease some services (aimed to increase the occupation of the HSR services). This is the case in the relation Madrid-Barcelona, where the ALVIA services ceased to exist (see Table 1). Moreover, a number of middle distance services exploited with conventional (under Iberian gauge) rolling stock were eliminated (see also Table 1). Some lines are now covered by HSR middle distance trains (AVANT service) at higher cost than the conventional ones. The government argues that these lines were unprofitable and they run with a continuous lower occupation. However, PSO should ensure these types of lines to be in operation.

Concerning the Levante corridor, middle distance services decrease in the last 5 years and the time schedule do not allow to connect other train (in a reasonable time) to gain access to other destinations. Moreover, almost any conventional train using this corridor runs under the UIC network because Talgo-Bombardier S-130 (and similar rolling stock) has the ability to interchange gauge. The final result is that customers have no substitutes to get access the main destinations and the service is offered at higher cost due to the increase in the access fee charged by ADIF. One of the main arguments of the Spanish government is that Levante corridor has a huge demand. However, part of this demand is stolen from the conventional services (Iberian gauge) that can be offered at a lower cost. Moreover, demand in other corridors as Madrid-Barcelona-France borders is extremely high in comparison with the Levante corridor. Figures 3 and 4 present passenger traffic by corridor and by middle stations, respectively.
It is shown that the HSR linking Madrid with France borders has the highest demand. Indeed, also between the end of the line, one can check that non-terminal stations also have larger demand (Zaragoza, Lleida and Tarragona-Reus are part of the Madrid-France borders HSR).

As the process anticipate the deadline of the EU authorities, the aim of the Spanish government seems to design a no constrained process, avoiding coping with certain EU rules by 2019. Indeed, the current process only permits one entrant which follows the doctrine competition for market. A tendering process will yield seven years concession to compete with RO in a duopoly market. This duopoly includes high speed trains and speed trains both operated under UIC gauge. Middle distance services with conventional rolling stock are excluded (there is no AVANT HSR services in the Levante corridor). With this decision RO keep also monopoly rents in the middle distance segment, which is a case of market foreclosure and the so called liberalization of that corridor is only partial.  

It is reasonable to think that railway services have a particular configuration, i.e. a rail network can be occupied only for a train (for instance, two aircrafts may fly at the same time by using two sky highways at different altitude) and duplicate a network is extremely costly so at a given time the company that use the network has a monopoly. This is a very important matter to support that only a competitor is able to enter the market with no negative profits. This is true now and also seven years later, so for a given network is so difficult to increase the number of competitors. One exception to this argument is that demand may increase and thus more passenger use service. As the track is unique and the time-slot is limited (24 at the most) this yield to double rolling compositions but no more competitors (this also yields to economies of scale because the load curve is concave). As a result, if the goal of the authorities is to open the market under effective competition, that is, a fair competition in the market, a number of changes should be implemented, (a) To include middle distance services under AVANT configuration, and (b) to favor complementarities by opening other corridors to competition.

An argument to maintain under monopoly other corridors in the short run and get access only a competitor in the current liberalization step is to avoid the so called loosner and winners result. This is a controversial issue because it means that the government’s aim is not to maximize consumer surplus and social welfare jointly with reasonable price schemes in order to increase demand. Otherwise, it seems to be intended to keep the incumbent dominant position avoiding redistribution of rents in two ways,

- First, by increasing consumer surplus and promote rail transport as a closer substitute of air transportation, bus transportation and private vehicles.
- Second, by creating a profitable market where potential entrant may obtain positive profits.

13 The following firms have the ability to compete for the market: ACS, Globalia, Acciona, Ferrovial, Comsa, and the bus-companies Alsa and Interbús.
There are other reasons related with the successfully of the liberalization process. They can be divided in market and legal issues. Market issues includes the access fee that ADIF charge to operators. Currently, the Spanish government has imposed a price cup in order to favors lower prices, especially in the segment of HSR services. However, it hides a non-negligible problem of ADIF budget. Indeed, ADIF had experimented continuous negative profits. In order to improve this situation in the near future the access fee has to be increase to cover maintenance expenses. Related to it, is the cost of electricity. A part of the access fee includes the cost of feed catenary. As it is well known, Spain has a huge problem of abuse of dominant position in this market. ADIF negotiates every year the expected electricity to feed the network. Obviously, this cost is totally assumed by the firms who gain Access to the network. An increase in the competitiveness of the electricity market could induce a more reduce price in the contracts signed by ADIF. This year 2015 only three electricity firms signed contracts with ADIF.

Unbundling RENFE-passengers and RENFE-Leasing is also relevant. Spanish authorities stipulate that access to rolling stock has to be guaranteed but maintain an asymmetric access under the current liberalization project. Indeed, RENFE-Passengers has free access to rolling stock, so this is an internal cost passed thorough these two firms within the holding RO. As it can be checked in the next section, bundling both market segments can benefit consumers when competition is for the market, because it provides lower prices, but at the cost of leave a narrow market for the entrant. However, if the number of firms increase this effect disappeared and the competitive effect is greater than the aforementioned effect. Moreover, there is also possible that other foreign firms as SNFC may enter the market by using its own material, but at the moment it is not allowed. Again, it is intended to maintain the dominant position of RO so an effective liberalization does not take place. In the case of unbundling the lease of rolling stock an important issue is to allow the new firm to become private or keep it under public hands. The latter may induce a more efficient market segments because engineer firms may lease (or sell) rolling stock directly to new operators and the government only certify the rolling stock. Finally, concerning market definition, it is interesting to study how closer substitutes affects the demand for railway passengers routes. In particular, savings in time and fares are significant parameters from the consumer preferences point of view. In this respect, an increase in prices and stations located so far from the city centers may affect the competitively of HSR vs air transport and bus transport.

Among the most important legal issues it can be cited transparency in the license processes and tender processes. Corruption may affect the incentives to gain access to the railway business. Also the time required to obtain the necessary certificates influence the decision to enter the market. Regulatory uncertainty can be avoided, establishing rules, transparent processes and deadlines, concerning the time of concessions and the rules under which the

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14 Axpo Iberia S.L. covers urban trains and HSR (AVE), 2.1 TWh. The total amount for this year was 2.7 TWh. The rest of 0.6 TWh are produced and served by Endesa and Gas Natural Fenosa. The total amount is 384.5 million €: energy costs (237.9 million € divided in 21 slots) and access cost to transport network and distribution network (146.6 million €). Source: www.adif.es.
market works. Finally, it is also recommended that ex-ante and ex-post regulation were played by different agencies.

Next section attempts to model the ongoing liberalization process to make explicit some of the issues treated above as well as some of the recommendations to get an effective competition in a liberalized market.

4. An explanatory model on railway liberalization

Following the above discussion, in this section different models of oligopoly competition are introduced to give economic robustness the main insight and conclusions. Depending on the way firms exert market power and the market configuration, that is the ex-ante regulatory measures, the railway liberalization process may achieve different results in terms of prices and overall social welfare. In this setting, the monopoly solution corresponds to a natural monopoly. The proposed duopoly market configuration, as it is intended by the RSL, is considered the benchmark model. It is introduced two regulatory changes in order to analyze their effects in the market. Simulations with more than two firms are conducted to highlight the impact that changes in some parameters of the model have on prices and social welfare. To keep tractability of the model, it is assumed that demand is linear \( p(Q) = A - Q \). In accordance with the government tendering process, the market will be open to competition gradually. During the first seven years (since 2016) the market includes an incumbent firm (I) and an entrant firm (E) and thus \( Q = \sum_{i=I,E} q_i \). This is the so-called market for competition as a way to achieve a future market in competition.

Railway industry is complex and it bears many types of cost. As I pointed out in the previous section a number of licenses are necessary at no negligible cost to run locomotives, rolling stock and wagons. Once such costs are incurred, they are assumed to be sunk cost. In addition, a fixed fee \( c > 0 \) is satisfied to ADIF in order to gain network access, the ability to run a train, and to occupy a given number of station platforms. This fee is common to both operators with the only difference that the incumbent, the former natural monopoly operated by RO, has the ability to operate trains during the whole time slot whereas the entrant has to gain access for any time slot. In fact, this is the main reason to assume an incumbent leadership and then, competition takes place à la Stackelberg. There are other reasons to assume that the incumbent operator exerts leadership in the market,

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15 A more complex and complete model is available upon request. Qualitative results are maintained except for extremal parameter values (almost corner-solutions). In order to keep tractability it is also assumed in the present version of the paper that \( A=1 \).

16 As it was specified previously, this duopoly market will operate during 7 years. Later on, the market should be open to full competition (i.e. by allowing more than two operator companies).
• It is a well-known company and thus customers, no matter the product is homogeneous, psychologically perceive RO 'better than' any other company in the market.
• It exploits a schedule that fit customer preferences, which is a proper combination of both, business and tourist 'travel-time'. In other words, it operates the well-known schedule, leaving the remaining time-slot available to the entrant company.

Another important cost is the traction power system, typically by electricity or diesel. Run a passenger train unit (locomotive and wagons) has a huge cost, in particular at the beginning of the journey, which almost became in a quasi-fixed cost. Differences in passenger occupation and luggage are relative small in comparison with the acceleration cost. According to most of the studies (see for instance His 2001, Hwang 1998) the electricity consumption profile incurred by HSR has a quasi-concave shape which moves upwards as the load of the train increase. A proper analytical approximation of traction power costs is $f_e + q_i \cdot e$, where

- $f_e$ stands for the quasi-fixed cost incurred in accelerating a high speed train ($\Delta$) and covers a given distance $d$, ($f_e = \Delta + d$),
- $q_i \cdot e$ captures the upwards movements as a result of passenger and luggage occupation (which increase train weight, the load curve and finally, electricity demand), where $e > 0$ is the added marginal cost for a given distance $d$.

Figure 3 describes the analytical approximation. Operational cost by ticketing, advertisement, passenger attendance, etc. is assumed to be the same for the two companies, $\gamma \cdot q_i$, where $\gamma > 0$. Finally, the entrant firm has to assume the cost of leasing rolling passenger material to offer the service. This is a controversial issue in the Spanish railway liberalization discussions.

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17 In the Levante corridor, almost any train is run by locomotives fiddled with electric power.
The current situation only establishes a business separation between RO and RENFE-Leasing, but both belong to the same group. This potentially introduces a great obstacle for fairly competition because the incumbent receives an extra amount of money as a result of leasing. Lease material includes the maintenance, so total cost are modelled as a two-part tariff,

\[ T(q_i) = \alpha + \sigma \cdot q_i, \]

where \( \sigma > 0 \). Let me resume fixed cost as \( F = c + f_e \), and variable cost as \( m = e + \gamma \), leaving endogenously given \( T(q_i) \) because, depending of the model of competition, the incumbent may perceive an extra income as a result of leasing rolling passenger material.

In what follows it is introduced alternative duopoly models to achieve a more competitive market in the way towards a market in competition. Figure 4 sketch the oligopoly models studied depending on the regulation applied to the market. We focus in two possible changes in the regulation, following the recommendations of the CNMC and also at the EU level. First, it is recommended unbundled RENFE-Leasing and the RENFE-passengers and to create a public firm that allows equal opportunities to access rolling material. Second, by allowing both firms to gain access at the whole time-slot under equal opportunities (and thus, removing the current time schedule in which RO offers a well-known time table). There are other regulatory changes that we will study when the models equilibrium is set, and the end of the section. They includes,

- Changes in \( f_e \) and \( e \): it involves the electricity contracts that are negotiated each year as a package between the parties involved in the market.
- Changes in the access fee \( c \): a different access charged by ADIF to the firms in a given corridor.

\[ \begin{array}{c|c|c}
\hline
n=2 & \text{Leadership} & \text{Fair competition} \\
\hline
\text{Bundled} & \begin{array}{c}
\text{Stackelberg} \\
\text{RENFE-passengers + RENFE-Leasing}
\end{array} & \begin{array}{c}
\text{Cournot} \\
\text{RENFE-passengers + RENFE-Leasing}
\end{array} \\
\hline
\text{Unbundled} & \begin{array}{c}
\text{Stackelberg} \\
\text{RENFE-passengers}
\end{array} & \begin{array}{c}
\text{Cournot} \\
\text{RENFE-passengers}
\end{array} \\
& \text{RENFE-Leasing} & \text{RENFE-Leasing} \\
\hline
\end{array} \]

\( ^{18} \) It is also recommended that it gradually becomes in a fully privatized firm, with public participation but an independent board of administration.

\( ^{19} \) There are other aspects concerning liberalization and regulation, but they exceed the aim of this article, which focus in the first steps of the liberalization and the main issues amended by the European authorities and CNMC.
4.1 The benchmark: on modeling Royal Decree 38/2015.

Under the current government plan (RD 38/2015) the *Levante corridor* will operate as a bundled configuration and the current time-slot, where RO exploits the peak hours in the time schedule (and thus, the incumbent has the leader advantage). By using the simple game theory concept of backward induction the model is solved to characterize (a unique) subgame perfect equilibrium (SPE). At the second stage the entrant firm maximizes,

\[ \pi_E = p(q_I, q_E) \cdot q_E - m \cdot q_E - T(q_E) - F, \]

where \(m\) and \(F\) are the total marginal cost and fixed cost incurred to carry passengers, respectively. The corresponding reaction function in response to a given movement by part of the leader company is \(\varphi(q_I) = (1 - m - \sigma - q_I)/2\). Notice that any increase in marginal cost of maintenance cost yields the entrant to offer a lower quantity, and the same occur if the incumbent increase the level of passengers. This is a straightforward effect in order to preserve the profitability of the exploitation of the service. The incumbent firm, as a leader on the market, may anticipate any behavior of the entrant by \(\varphi(q_I)\), and also is benefit by the leasing of rolling material. Thus, it maximizes,

\[ \pi_I = p(q_I, \varphi(q_I)) \cdot q_I - m \cdot q_I + T(q_E) - F. \]

Optimal behavior with respect the quantity of service offered, \(q_I\), yields (by backward substitution) to equilibrium profits,

\[ \pi^B_E = \frac{m^2 - 2m(1 - 2\sigma) + (1 - 2\sigma)^2}{16} - (F + \alpha), \]

\[ \pi^B_I = \frac{m^2 - 2m(1 - 2\sigma) + 1 + 4\sigma - 4\sigma^2}{16} - (F - \alpha). \]

Market price and quantities offered by each firm are,

\[ p^B = \frac{1 + 3m + 2\sigma}{4}, \quad q^B_E = \frac{q_I - \sigma}{2}, \quad q^B_I = \frac{1 - m}{2}. \]

A first insight is that any increase on \(\sigma\) and \(m\) decrease both entrant and incumbent profits, as it is expected. However, due to the bundled configuration, an increase in \(\alpha\) has a positive effect in the incumbent firm and a negative effect in the entrant firm. However, the total effect is zero. In fact, under a symmetric entrant-incumbent configuration (a duopoly) there is no positive effect when unbundling of the two businesses is applied. This is because competition is narrow and it seems that such a measure (unbundling) may be delayed. As it is expected, price (alternatively total quantity) decrease when \(\sigma\) or \(m\) increases.

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20 The monopoly solution is straightforward and it is included in Appendix A for comparison purposes.
In the last decades, antitrust agencies and competition policy have focused in the effects that liberalization processes have in consumers, which is measured by the consumer surplus (CS). We present a disaggregated study of total welfare to capture this tendency. Indeed, total welfare may increase due two facts: by increasing CS, by increasing the firm’s market power (and thus, profits), or both. The following two expressions accounts for the CS and industry profits under the current market design (as it is capture by our model),

\[
CS_B = \frac{[(2\sigma - 3(1 - m)]^2}{32}, \quad W_B = \frac{[2\sigma - 3(1 - m)](m - 2\sigma - 3) - 2F}{32}.
\]

On one hand, a further inspection reveals that CS decrease due an increase in \( \sigma \). This is because an increase in the marginal cost of leased material maintenance has a negative effect: the income increase of the incumbent firm per unit of transport maintenance is lower than the negative effect on the marginal profitability per unit of transport of the entrant firm. As the incumbent firm has two businesses (sells units of transport and lease material) and also exerts its leadership, it exploits its market power to pressure equilibrium price upwards with the subsequent business stealing effect. On the other hand, it has a straightforward economic intuition that an increase on \( m \) reduce CS. Finally, when we focus in aggregate welfare partial derivatives reveals that increases in \( \sigma \) and \( m \) has a negative effect in \( W \)\(^{21}\).

### 4.2 Steps towards market in competition.

In this subsection it is assumed that two regulatory measures are taken. First, the government may unbundle RO and RENFE-Leasing in two independent businesses. Thus, the incumbent and the entrant firm undertake the same opportunities to access rolling equipment (passenger units). The new independent firm could be a public or private firm, or a partially state-owned firm. In the present version I assume that this new firm is private and offer rolling material at zero cost.\(^{22}\) Second, the government may introduce a competitive time-slot assignment. As a result, both firms can offer any time-schedule under equal opportunities and thus, simultaneous fair competition à la Cournot takes place. Thus, as a result of these two measures three duopoly configurations can be characterized,

a) Unbundling + leadership;

b) Bundling + fair competition;

c) Unbundling + fair competition.

In what follows I characterize these three models in order to compare with the benchmark. Concerning model a) the only conceptual different is that the incumbent has to pay to get access to rolling material an thus, the objective function have to include this cost,

\(^{21}\) Entrant profits and incumbent profits decrease as \( \sigma \) and \( m \) increase.

\(^{22}\) This assumption does not alter the qualitative result of the model.
\[ \pi_i = p(q_i, \varphi(q_i)) \cdot q_i - m \cdot q_i - T(q_i) - F. \]

In addition, the unbundled lease firm (RENFE-Leasing), \( L \), has a profit function \( \pi_L = \sum_{i=1}^{E} T(q_i) \), where the marginal costs are normalized to zero. With respect the model b) the conceptual different relates with the reaction function of both firms. Under this configuration there is no advantage to capture demand so the entrant and the incumbent react at the same time in response to any rival’s decision (as a Cournot market). Finally, the c) model includes both regulatory measures and the market becomes almost symmetric, in the sense that both competitors confront the same cost structure and access the time-slot under competitive conditions. Thus, each firm maximize,

\[ \pi_i = p(q_i, q_j) \cdot q_i - m \cdot q_i - T(q_i) - F, \quad i, j = I, E, \quad i \neq j. \]

Table 2 includes prices, profits, consumer surplus, and welfare of the above three models. It provides useful information concerning the effects of regulatory measures.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price</strong></td>
<td>((1 + 3m + 3\sigma)/4)</td>
<td>((1 + 2m + \sigma)/3)</td>
<td>((1 + 2m + 2\sigma)/3)</td>
</tr>
<tr>
<td><strong>Profits</strong></td>
<td>(\pi_i = \frac{\varphi + (1 - \sigma)^2}{8} - (F + \alpha))</td>
<td>(\pi_i = \frac{\varphi - 7m\sigma + 1 + 5\sigma(1 - \sigma)}{9} - (F - \alpha))</td>
<td>(\pi_i = \frac{\varphi + (1 - \sigma)^2}{9} - (F + \alpha))</td>
</tr>
<tr>
<td><strong>CS</strong></td>
<td>(\frac{9(1 - m - \sigma)^2}{32})</td>
<td>(\frac{(2(1 - m) + \sigma)^2}{18})</td>
<td>(\frac{2(1 - m - \sigma)^2}{9})</td>
</tr>
<tr>
<td><strong>W</strong></td>
<td>(\frac{(3(1 - m - \sigma)(5(1 - m) + 3\sigma) - 2F}{32})</td>
<td>(\frac{(4(1 - m) + \sigma)(2(1 - m) - \sigma) - 2F}{18})</td>
<td>(\frac{(1 - m - \sigma)(2(1 - m) + \sigma) - 2F}{9})</td>
</tr>
</tbody>
</table>

\(\varphi = m^2 - 2m(1 - \sigma), \quad m \leq \frac{2}{3}, \quad \sigma \leq \frac{m}{2}, \quad m + \sigma \leq 1.\)

Assuming that marginal costs have a weighted importance in firm’s profits \(m \leq \frac{2}{3}, \sigma \leq \frac{m}{2}, m + \sigma \leq 1\) it is conducted a comparison among prices, consumer surplus and welfare depending on the value of \(m\). Fixed cost are normalized to zero.

Concerning CS, it is observed that as variable cost increase is better for consumers that the incumbent firm remains bundled. In the limit, the monopoly outcome reveals better than any other configuration. This is because as variable cost increase the average cost also increase and diseconomies of scale arise, so the best configuration is to keep one firm with huge market power and saving cost (it does not lease rolling stock) or, in the limit, exploit the service by a natural monopoly. However, for a relative lower variable cost \([0 < m < 0.285 \text{ and } 0 < \sigma < 0.715]\), it can be checked that \(CS_b > CS_a > CS_b > CS_c > CS_M\). In other words, when marginal cost due to electricity and operations are relative low, marginal cost of maintenance can be relative high. Under these conditions the current framework stated by the RD 38/2015 provides an improvement for consumers. The economic intuition is the following: the extra market power
exerted by the incumbent by maintenance of rolling stock leased to the entrant relaxes prices and thus, quantity increase, yielding a higher CS. This situation varies as $m$ increases (and $\sigma$ decreases). Overall, it can be checked that welfare ($W$), CS and prices follow the same path. Thus, the framework stated by RD 38/2015 is better than unbundling for consumers when variable cost are relatively low; however, as variable cost increase simultaneous competition with unbundling reveals better and, for extremely high $m$ a monopoly is the best situation. These insights change as the number of firms increase (number of operators is larger than 2). Indeed, an increase in the number of entrant firms may increase the potential demand and also getting economies of scale induced by complementarities. It can be the case if the government authorities allows competition in more than one corridor and/or middle distance services are also open up to competition.

5. Conclusions and policy recommendations

In this paper it is conducted a critical review of the ongoing liberalization of railway passenger services in Spain. In 2000's EU began to open the railway sector to competition. Directive 2012/34/EU amended and recasting the previous Railway Packages and the Commission's 4th Railway Package will contain the basic provisions for market opening in the railway sector. In Spain the first route that will be open up to competition is the network of conventional & high speed lines under the *Levante corridor*. Objections and advices by part of the EU commission and the National Commission of market and competition (CNMC) have been revised as well as the recent Railway sector Law passed in September 2015.

First, it is concluded that the current status of the liberalization process should be include more than one railway corridor in order to increase potential demand. Moreover, middle distance services are suitable to take part in the tendering processes conducted to choose the entrant firm on the next 7 years. Second, some issues as the effect of the level of access fee, the cost of electricity and unbundling the lease of rolling stock should be taken into consideration. Third, the (simplest) simultaneous and sequential decision making models presented to highlight how market liberalization and the regulation framework may affect consumer surplus and social welfare are on the line with the recommendations by part of EU authorities and CNMC. Indeed, liberalization processes should decrease the social deadweight loss from the monopoly status quo and also lead to a more competitive pricing but it strongly depends on the ex-ante regulatory framework stated by the government.

Overall, it is concluded that Spanish railway liberalization process can be improved in a number of aspects, mainly by unbundling the business of leasing rolling stock, by modifying the infrastructure access fee, and facilitate that new operators enter in more than one railway corridor. Finally, it should be considered that closer substitutes may affect the successful of the liberalization process.
Appendix A: The natural monopoly configuration.

The monopolistic firm (RENFE) maximizes \( \pi_M = p(Q) \cdot Q - m \cdot Q - F \). Optimal behavior yields the following profits, price, and quantity

\[
\pi_M = \frac{(1-m)^2}{4} - F, \quad p_M = \frac{(1+m)}{2}, \quad Q_M = \frac{(1-m)}{2}.
\]

With CS and total welfare (W),

\[
CS_M = \frac{(1-m)^2}{8} - F, \quad W_M = \frac{3(1+m)^2}{8} - F.
\]

References

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