1. Introduction

In France, the railway national passengers’ transport is still characterized by a monopoly. This monopoly is set by the orientation law on domestic transportation (Loi d’Orientation des Transports Interieurs) of 1982 which gave Société Nationale des Chemins de Fer (SNCF) the exclusive right to operate the domestic railway network.\(^1\) Competition is however possible on freight transportation and international passengers’ transportation since 2004 and 2009.\(^2\)

Since the national railway company is still the only company providing domestic railway transportation, one could expect that SNCF’s pricing behavior will be the one of a monopoly. However, two reasons prevent SNCF to act as such. First, if there is no intramodal competition, there is for certain service a strong intermodal competition of air and road transportation. Second, train tickets’ prices are not totally freely set by SNCF. The French state regulates these prices for public service reasons.\(^3\)

This article analyses SNCF’s pricing behavior on most of the origin/destination pairs (O&D) it operates from/to Paris with high-speed trains (TGV), taking into account the limited leeway that the company enjoys to set its prices because of price ticket’s regulation. It studies how the monopoly uses the limited leeway it gets from the French legislator to adapt its prices depending on intermodal competition. To do so, it used two data sets. One encompasses most of the train tickets maximum prices for OD operated from/to Paris by SNCF from 2007-2012. This data set enables to study econometrically the main determinant of SNCF’s pricing behavior. The second data set includes

---

1 Article 18 of this law, today codified as article L.2141-1 of the Transportation Code.
2 International transportation also includes “cabotage”, i.e. the right for a company providing an international service to allow some passengers to do national trips if the train stops in intermediary stations located in the same country than the departure/arrival point. Nevertheless, there is currently only one alternative transport operating company offering international service (between Paris and Venice) and it does not offer cabotage for its passengers.
3 For more details on this issue, see Perennes (2012).
prices for selected planes and trains on specific O&D characterized by air intermodal competition. It enables to compare tickets’ prices of trains and planes on selected routes.

This article can help decision makers to decide which kind of competition is better suited to the passengers’ rail transportation. The European Commission is currently considering to fully liberalize passengers’ rail transportation in Europe. This liberalization means splitting network and operations in order to introduce intramodal competition. On the contrary, other countries in the world (in particular Japan and the US) have chosen to keep a vertically integrated railway industry and rely only on intermodal competition or “yardstick competition” to promote efficiency.

It is organized as follows. First, it briefly describes the market for national passengers’ transportation in France (section 2). It then explains in which extent train tickets’ prices are regulated (section 3). Based on this description, it empirically analyses the main determinants of SNCF’s pricing behavior taking into account the regulatory constraints SNCF faces (section 4). To strengthen the conclusion of section 4, section 5 provides an additional analyze, comparing prices series of train and airplane tickets on selected routes. Section 6 summarizes the main findings and concludes.

2. French market for passengers’ transportation

In mainland France, passengers can use -besides their personal cars- trains or planes to go from one city to another. 4

The main characteristics of the French passengers transportation market are the following:

- First, the motorway network is well developed. It covers the whole country and is in good shape. Nevertheless, motorway tolls are quite expensive.
- Second, the air transport supply is also well developed, with numerous routes offered by the incumbent operator Air France. However, Air France reduced its offer over the past twenty years for some of its O&D that face a strong competition from TGV (Guyard (2004)). 5 In the late 2000s, following the European air transport liberalization, numerous low cost carriers have also started to offer air service between some French city pairs. The air transport supply in France will be described more precisely in sections 4 and 5.

---

4 For legal reasons, there is no long distance coaches in France.
5 For exemple Paris-Lyon, Paris-Marseille, Paris-Strasbourg, Paris-Nantes, etc.
Third, France has an extended rail network. Most of the passengers’ rail transportation between main cities is operated by high-speed trains (90%) even if the high-speed lines represent less than 10% of the rail network (Auphan (2012)). High-speed trains can use both high-speed lines and normal lines. This ability allows them to operate service to numerous cities, even if high-speed lines only constitute a small portion of the entire route. A “non high-speed” offer still exists for some regions, such as Auvergne and Normandy. The passengers’ rail transport supply will be more described more precisely in section 3.

Maps 1, 2 and 3 illustrate the passengers’ transport supply in France.

---

6 This article does not study commuter transportation.
To give an idea of the distances involved, there are 932km between Paris and Nice (9h30 by car and a €176.65 motorway toll, 1h20 by air, 5h37 by train). Between Paris and Brest, there are 592km (6h21 by car and a €28.10 motorway toll, 1h10 by air and 4h29 by train).*

*: Distances, travel time by car and toll fees are given by the website “viamichelin.fr”. Air travel time and train travel time are given by Air France’s and SNCF’s websites.
3. The market for rail passengers- transportation in France

3.1. Description of the national rail passengers’ offer in France

This article focuses on national rail transportation. It studies neither international rail transportation, nor regional (including commuters) rail transportation.

As underlined in the previous section, there are two types of trains in France: high-speed trains (TGV) and “normal speed” trains (Intercités or IC). TGV can use both high-speed and normal tracks, when Intercité can only use normal tracks.

The first TGV was launched in 1981 between Paris and Lyon (south-east part of France). In 1989, an extension of the high-speed network was opened for the west of France. In 1993, a high-speed service was opened for the north of France. In 2001, the high-speed line serving south east was extended to Marseille. In 2007, East of France also got its high-speed line. Finally in 2011, a high-speed line was opened between Dijon and Belfort, in the East part of France. This new line does not serve Paris (Auphan (2012)). The current high-speed network is represented on Map 1.

All in all, the high-speed network (LGV) constitutes less than 10% of the total rail network. However, 90% of the passengers’ traffic is made by TGV since TGV can use both high-speed lines and regular lines. Only a few regions (Normandy, Auvergne, Limousin) do not have a TGV offer. In parallel, for almost all of the cities served by TGV, there is no “regular” Intercités offer.

3.2. Regulation of the train tickets’-prices

National rail transportation in France is still characterized by a monopoly. This monopoly dates back to 1937 and SNCF’s setting-up. When SNCF’s legal form was modified in 1982\(^7\) a new law defined the role, missions and obligations of the newly set company. This law on domestic transportation (Loi d’Orientation des Transports Interieurs, hereafter “LOTI”) also gave SNCF the exclusive right to operate the domestic railway network.

At that time, all consumer goods’ prices (including train tickets) were regulated by the French State. In 1986, a national ruling\(^8\) liberalized consumers’ goods’ prices: from that moment the State has stopped to regulate those prices. Consumer goods’ prices are now freely set. Nevertheless, train tickets prices are an exception to this rule and continue to be regulated directly by the State.

---
\(^7\) SNCF became a 100% state owned company.
\(^8\) Ordonnance n° 86-1243, December 1\(^{st}\) 1986.
Train ticket regulation is defined by the SNCF’s specifications (“cahier des charges”) that were set at the same time than the LOTI in 1982. These specifications are complemented by decrees (arrêtés and décrets). The last version of these complementary decrees dates back to 2011 (Perennes (2012)).

Regulation only affects second class tickets. It does not affect first class tickets. The regulation of train tickets’ prices differs for Intercités and TGV:

1. For Intercités trains, a basic fare \( BF_{IC_i} \) for an O&D \( i \) is calculated by a simple formula:

   \[ BF_{IC_i} = A \times km_i + B \]

   Where \( km_i \) is the number of kilometers for the O&D \( i \), A and B are numeric constants set each year by SNCF and approved by the French Ministry for transportation. Then, a reduction coefficient is applied (if necessary) to this basic fare. For example, kids under 12 get 50% off, some commercial cards give 25 to 60% off, etc.

2. For TGVs, the system is more complex. For each O&D \( i \), SNCF sets a basic fare \( BF_{TGV_i} \) that is approved by the French Ministry of transport. These basic fares cannot -to obey the regulation - depart too far from the “kilometric reference” i.e. the basic fare that would have been calculated if the numeric constants (A,B) defined above were applied. More precisely, the decree 2011-914 gives a 40% leeway to the SNCF. Formally:

   \[ (1-40\%) (A \times km_i + B) \leq BF_{TGV_i} \leq (1+40\%) (A \times km_i + B) \]

   Then a reduction coefficient is applied (if necessary) to this basic fare. SNCF also sells a certain number of cheap tickets several weeks before departure. These tickets called “Prems” have a constant price on all the French territory (i.e. they do not vary depending on the numbers of kilometers).

---

10 Since the 1980s, SNCF is free to set is price for its first class tickets, mainly intended for business travelers. Nevertheless, SNCF chose as a commercial policy to set the first class tickets’ prices equal to 1.5 times the second class tickets’ prices. This is however not a legal rule, just commercial policy.
11 A and B are not exactly numeric constants: different couples (A,B) are defined for different ranges of kilometers (less than 16km, between 16km and 32km, etc.)
12 This regulation is also applied to some Intercités (called “Corail Teoz” or “Intercités avec réservations obligatoires”). However, this article will not study this exception.
4. Empirical analysis of the main determinants of SNCF’s pricing behavior

4.1. How to study SNCF’s pricing behavior

To study more accurately SNCF pricing behavior and SNCF’s reply to intermodal competitive pressure, one should ideally dispose of the set of SNCF’s and of its competitors’ actual prices, along with the date of sale. These data are of course not available because of business confidentiality. Nevertheless, this does not mean that some conclusions cannot be drawn from the available data.

First, one can use the list of regulated basic fares set up each year by SNCF with the approval of the French Ministry of transport. As explained in the previous section, SNCF’s train tickets’ prices are still strongly regulated. For Intercités trains, the national company does not have any freedom to differentiate its price depending on the specific situation of a particular O&D. However, the situation is different for TGVs. The incumbent company submits yearly for approval to the French Ministry of transport a list a train tickets’ basic fares. Each of them can depart for the normal base fare (under the 40% leeway rule) depending on the “conditions of speed and comfort” and on the “competitive situation”.

Since SNCF has the lead on the setting of TGVs’ different basic fares (the Ministry of transport only approves them) and since it is allowed by its specification to adapt them to the competitive situation, one can study how SNCF uses the leeway it gets from the State to adapt these basic fares. One should focus in particular on how SNCF takes into account the competitive pressure from other transport modes.

From an empirical point of view, it means that the relevant variable that should be studied is the ratio between the kilometric basic fare (i.e. the basic fare that would have been set applying the kilometric reference) and the actual basic fare. This ratio lies between 0.6 and 1.4 for each O&D since the actual basic fare cannot depart from more than 40% of the kilometric basic fare. The empirical

---

13 Not only the basic fare, but also the number of passengers benefiting of a reduction coefficient and the number of “Prems” tickets sold.
14 The precise wording is the following “A special base fare can be instituted on an O&D when a) this O&D has for the travelers special advantages in terms of speed and comfort b) this O&D faces a strong competition from another mode of transport and when the setting-up of the special base fare can, by promoting use of the railways, helps SNCF to maintain or improve its financial results” (“Un tarif de base particulier peut être institué sur une relation : a) Lorsque cette relation présente pour les usagers des avantages particuliers de rapidité et de confort ; b) Ou lorsque cette relation est soumise à une forte concurrence de la part d’un autre mode de transport et que l’institution de ce tarif particulier est susceptible, en développant l’usage du train, d’éviter la dégradation ou de concourir à l’amélioration des comptes de résultat de la S.N.C.F. ”) (SNCF’s specifications, article 14).
analysis presented in this section studies the main potential determinants of this ratio (competitive pressure, track access charge, etc.).

Second, this analysis can be complemented by a dynamic comparative study of the tickets’ prices for selected planes and trains on several O&D. One can compare at several moment in time how the tickets’ prices evolve for different transport modes. This dynamic analysis will be held in section 5 of this article.

4.2. Data set

This article focuses on TGV tickets’ price. It does not study Intercités prices. It also only studies the price of tickets between Paris and other cities (and not between two cities other than Paris). This choice was made because the determinants of tickets’ prices for train that do not depart from/ends in Paris are specific (in particular regarding intermodal competitive pressure). They also differ between city pairs (for example these determinants are different for two cities located in the same part of the French territory and for two cities located in different regions of the country).

Endogenous variable

SNCF yearly publishes on its website a document (“Recueil des prix”) that goes over the entire list of basic fares for each O&D. It also included the kilometric references (A, B). This document is available online for the years 2007 to 2012.

To calculate the ratio between actual basic fare and kilometric basic fare (hereafter “the ratio”) the number of kilometers of each O&D is necessary. The problem is that this number of kilometers does not correspond to the actual number kilometers of tracks between the two stations of an O&D. To calculate its prices SNCF uses another measure called “tariff kilometers” which sometimes equates to the actual number of kilometers of tracks but sometimes corresponds to the number of kilometers of tracks of the previous line (i.e. before the building of the high-speed line). In addition, some stations that are close by (for example Marseille and Aix-en-Provence that are distant of 30km) may have the same number of tariff kilometers with Paris. There is no ready-made data set of tariff kilometers. However, this information appears on each tickets sold by SNCF. Therefore, to collect this

15 In particular, the number of tariff kilometers between Paris and Lyon, which is the most important O&D in terms of numbers of passengers, is 512. The actual number of tracks kilometers is approx. 430. That corresponds to the number of kilometers of the former line which went from Paris to Lyon trough Dijon.
information an important work of collection has been held to find train tickets (or electronic images) and to isolate the tariff kilometers for each O&D. 159 tariff kilometers has been collected. \(^{16}\)

With this information, the ratio is calculated as follows:

\[ R = \frac{BF_{TGVi}}{A \times km_i + B} \]

Where BF_TGV\( _i \) is the basic fare as available in the Recueil des prix, (A,B) are the constants that can be found in the same document and km\( _i \) the number of tariff kilometers for the O&D.

**Explanatory variables**

If there is always an alternative to rail transportation by car (since all cities in France are linked to the road network) that is not always true for air transportation. Map 3 shows that there is no air service, for example, between Paris and Lille or Paris and Dijon. In these two examples, the closest airport is one of the Parisian airports, so one cannot fly from these cities to Paris.

The competitive pressure can be addressed on two angles: the price competition and the travel time competition (Crozet (2005)).

- **Travel time:**
  - The travel time by train was collected on SNCF’s website.
  - The driving time was estimated based on data collected on the website “Viamichelin”\(^ {17}\) which is a website that helps individual drivers to plan their trips. To avoid multicollinearity, the model does not use the total duration of the travel (by car/by train) but the relative speed of car transportation compared to rail.
  - The flying time is composed of four parts: the time necessary to go by car from the city center to the closest airport\(^ {18}\), the flight duration, the time necessary to go from the airport\(^ {19}\) by car to Paris center and 30 additional minutes due to check-in and security checks. The flight duration was collected on the airlines’ websites. Almost half of the cities that have a direct TGV connection with Paris do not have an airport at less than 90 minutes’ drive. Therefore, a dummy variable was created that equals

---

\(^{16}\) SNCF’s Recueil des prix gives 172 maximum prices for O&D. Among these O&D, there is no service for 6 O&D (i.e. TGV are no longer going directly from Paris to this city in 2012, but the corresponding basic fare is still mentioned in the “Recueil des prix”). So, only 7 tariff kilometers (less than 5%) are missing.

\(^{17}\) [http://www.viamichelin.fr/](http://www.viamichelin.fr/)

\(^{18}\) The car driving time was collected on “Viamichelin”.

\(^{19}\) This airport may be Paris-Orly, Paris Charles-De-Gaulle or Paris-Beauvais. Paris-Vatry was not included in the sample.
1 if there is a “credible” plane alternative to train, i.e. if the total flying time is equal to or inferior to the duration of the travel by train.

- Price competition:
  - The travel cost by car was estimated through “Viamichelin”. It encompasses toll fees\(^\text{20}\) and gas expense. Prices’ evolution was also taken into account.\(^\text{21}\) To be consistent with the other variables, the model does not use the total cost of the travel by car (gas and toll fees) but the price per kilometer.
  - It is not possible to estimate an “average” price for air transportation since air transportation tariffs are based on yield management principles.\(^\text{22}\) Therefore, the only proxy for price that can be used for price competition is the existence of low cost carriers service (in France, these low cost carriers are Easy Jet, Ryanair, Volotea and Jet Air Fly).

**Control variables**

Another element can impact train tickets’ prices level: SNCF’s costs. If the cost differs for the various O&D, that can explained the relative variation. There is no reason to think that the cost of the rolling stocks differs from one O&D to another. What can however dramatically differ is the cost of the tracks. It is more expensive to run a train on an high speed line, in comparison with a normal line, because the construction of this expensive line still need to be paid off.

---

\(^{20}\) In this article, I do not suppose that the consumers try to avoid toll fees. That is possible in France using the secondary road network, since only motorways have toll booths. This choice is based on two grounds: first only a few drivers have such a cost optimizing behavior, second, since I study the regular price ticket (and not the discounted one sold a few months in advance) the consumer who bought this ticket is less likely to be a costs optimizer.

\(^{21}\) Prices evolution was calculated separately for gas and toll fees. Gas prices were calculated based on the average price of on liter of super unleaded petrol during the first week of January each year (http://france-inflation.com/graph_super.php). For the toll fees, they are reevaluated each year by the government. The government allows each company in charge of a highway to raise its price based on inflation, but also based on the maintenance works required for the highways of which the company is in charge. Therefore, each company is allowed to apply a different fees’ rise. In the dataset, I specify for each O&D the company(ies) that runs the highway(s) between both cities and apply the relevant rise coefficient(s).

\(^{22}\) “Yield management is the process of understanding, anticipating and influencing consumer behavior in order to maximize yield or profits from a fixed, perishable resource (such as airline seats or hotel room reservations).” (Wikipedia) To do so, yield management used market segmentation: its aim is to differentiate consumers according to their willingness to pay. In the transportation business, a good way to differentiate costumers (in particular between business and leisure) is to see when they book their trip (a few days or a few months in advance) and, in the case they are buying a round trip ticket, to see if they stay in their destination city on Saturday night.
Currently in France there is a vertical unbundling between operations and infrastructure\textsuperscript{23}. So, it is easy to single out the costs of using the track by SNCF. They correspond to the track access charges paid by SNCF to the company that owns the network, namely Réseau Ferré de France (RFF). These track access charges are available through an interface developed by RFF for the train operating companies (EPSICO). Here again, the model does not use the total amount of access charge, but the price paid by kilometer, which is also available on EPSICO.

4.3. Data analysis, descriptive statistics

Endogenous variable
In compliance with regulations, the value of the ratio $R$ defined above is never below 0.6 or above 1.4. More precisely, this ratio is on average equal to 1.13 but never go beyond 0.9 with a maximum value of 1.39. In other words, SNCF mostly uses the leeway it gets from the regulation to increase its prices compared to the linear tariff rather than to decrease them.

Table 1 : Value of the ratio $R$

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R$</td>
<td>918</td>
<td>1.13</td>
<td>0.09</td>
<td>0.90</td>
<td>1.39</td>
</tr>
</tbody>
</table>

Note: Obs in the number of observation

The smallest $R$ is found for the O&D Paris-Miramas, a city located in the south of France near Marseilles and Aix-en-Provence at 750 km from Paris. The biggest $R$ is found for Vendôme, a small city located between Orleans and Paris at only 176 km from Paris.

Explanatory variables
Regarding explanatory variables, 363 observations\textsuperscript{24} offer a “credible” air transport alternative (the travel time is similar or shorter by air than by train).\textsuperscript{25} Driving to/from Paris is always longer than taking a train. Train travel can be more than three times faster than car travel as shown by Table 2.

\textsuperscript{23} Before 1997, SNCF owned the rail network. In the 1990s the European Commission asked the European States to separate infrastructure and operation in order to liberalize the railway industry. France followed the European commission requirements and decided to unbundle network and operation.

\textsuperscript{24} Observations have two dimensions: O&D and year. For example Paris-Lyon-2007 is an observation.

\textsuperscript{25} There are three categories of airlines: regular airlines, low cost carriers and business airlines (in France, Airlinair and Chalair). This last category offers service with smaller aircrafts (ATR 42 or 72, 48 to 70 seats or even Beechcraft 1900 19 seats). Here, all three categories are considered.
Table 2: Value of the explanatory variables related to travel time competition

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train Duration</td>
<td>918</td>
<td>186</td>
<td>83</td>
<td>39</td>
<td>392</td>
</tr>
<tr>
<td>Car Duration</td>
<td>918</td>
<td>324</td>
<td>115</td>
<td>101</td>
<td>576</td>
</tr>
<tr>
<td>Relative car duration</td>
<td>918</td>
<td>1.87</td>
<td>0.42</td>
<td>1.27</td>
<td>3.32</td>
</tr>
</tbody>
</table>

Regarding price competition, there are not many low cost carrier alternatives, as showed by Table 3.

Table 3: Number of observations located at 20, 40 and 60 minutes’ drive from an airport offering low cost service to Paris

<table>
<thead>
<tr>
<th></th>
<th>20 minutes</th>
<th>40 minutes</th>
<th>60 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>6</td>
<td>43</td>
<td>78</td>
</tr>
</tbody>
</table>

One can notice that there are only a few observations with a low cost carrier alternative at less than 20 minutes. These observations correspond to 3 O&D (Brest, Landerneau and Agde), and to 2 airline services (Paris-Brest operated by Easy Jet and Paris-Béziers operated by Ryanair). Both were launched in 2011.

Finally, to apprehend the price competition between cars and trains, one can look at several variables, such as the difference between the price of a regular train ticket (the BF_TGV defined above) and the costs of driving (including toll fees and gasoline).

Table 4: Price competition between cars and high speed trains

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs</th>
<th>Mean</th>
<th>Std deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular train ticket price</td>
<td>918</td>
<td>64.99</td>
<td>16.92</td>
<td>28.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Total driving costs</td>
<td>918</td>
<td>83.62</td>
<td>35.86</td>
<td>20.40</td>
<td>186.99</td>
</tr>
<tr>
<td>Difference</td>
<td>918</td>
<td>-18.63</td>
<td>21.29</td>
<td>-86.99</td>
<td>30.29</td>
</tr>
<tr>
<td>Cost by km (car)</td>
<td>918</td>
<td>0.16</td>
<td>0.02</td>
<td>0.08</td>
<td>0.23</td>
</tr>
</tbody>
</table>

*Note: The difference is equal to the price of the regular train ticket minus the driving costs*

On average, it is cheaper for a driver that is alone in his or her car to take the high speed train. It is particularly true for remote destinations with expensive toll fees (Ventimiglia on the Italian border, Monaco, etc.). Driving may be cheaper when the shortest way is a road without toll booths.²⁶

²⁶ As it was explained in footnote 20, the hypothesis here is that the driver chooses the shortest way and does not try to avoid toll booths.
Control variables

There is a wide variation in the track access charges (between €3.30 per km and €21.45 per km). These charges have constantly increased during the time period.

Table 5: Yearly track access charge

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean (per km)</th>
<th>Standard deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>7.68</td>
<td>2.67</td>
<td>3.30</td>
<td>12.94</td>
</tr>
<tr>
<td>2008</td>
<td>8.38</td>
<td>2.65</td>
<td>3.91</td>
<td>14.33</td>
</tr>
<tr>
<td>2009</td>
<td>8.93</td>
<td>2.89</td>
<td>3.98</td>
<td>15.39</td>
</tr>
<tr>
<td>2010</td>
<td>9.66</td>
<td>1.77</td>
<td>6.40</td>
<td>13.53</td>
</tr>
<tr>
<td>2011</td>
<td>10.78</td>
<td>2.44</td>
<td>6.54</td>
<td>15.23</td>
</tr>
<tr>
<td>2012</td>
<td>12.03</td>
<td>3.02</td>
<td>6.38</td>
<td>21.45</td>
</tr>
<tr>
<td>Total</td>
<td>9.58</td>
<td>2.98</td>
<td>3.30</td>
<td>21.45</td>
</tr>
</tbody>
</table>

Note: This table gives the track access charges cost per km for each OD.

The most expensive track access charges can be found in 2012 for O&D that are totally covered by high speed tracks (in opposition with normal tracks) (Vendôme, Lyon Saint Exupery, Macon Loche TGV, etc.).

4.4. Empirical analysis

As explained in the description of the data set, data are available for 6 years, between 2007 and 2012. Therefore, it is possible to use panel-data models. Since some explanatory variables are time-invariant (car relative duration) or “quasi time invariant” (plane relative duration, existence of a low cost service, existence of a “credible” regular airline alternative) a random-effects model is used (Panel RE). To start with, one can also estimate the influence of the various variables with a simple pooled ordinary least square regression (OLS) using all O&D for all years, with a cluster-robust standard error.

The ratio (R) is supposed to be correlated with the existence of an airline service for the O&D (“plane alternative”), the existence of a low cost carrier service (“low cost alternative”), the total driving time, the driving cost per kilometer and the average access charge per kilometer. The results are presented in Table 6.

\[ \text{For some O&D, low cost carriers have started to offer a service between 2007 and 2012 sometimes using airports that were not used by the national company Air France (for example Beziers Airport). Therefore, the total flying time and car drive to the airport may change between 2007 and 2010 for some O&D. However, that only affects a few O&D in the dataset.} \]
Table 6: Results of empirical models

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>PANEL RE (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane alternative</td>
<td>-0.0903***</td>
<td>-0.0377***</td>
</tr>
<tr>
<td></td>
<td>(0.0126)</td>
<td>(0.0137)</td>
</tr>
<tr>
<td>Relative car duration</td>
<td>0.0557***</td>
<td>0.0631***</td>
</tr>
<tr>
<td></td>
<td>(0.0154)</td>
<td>(0.0168)</td>
</tr>
<tr>
<td>Low cost alternative</td>
<td>-0.0644***</td>
<td>-0.0133**</td>
</tr>
<tr>
<td></td>
<td>(0.0138)</td>
<td>(0.0042)</td>
</tr>
<tr>
<td>Cost per km by car</td>
<td>0.7484***</td>
<td>0.5357***</td>
</tr>
<tr>
<td></td>
<td>(0.2622)</td>
<td>(0.0493)</td>
</tr>
<tr>
<td>Price per km access charge</td>
<td>-0.0136***</td>
<td>-0.0061***</td>
</tr>
<tr>
<td></td>
<td>(0.0019)</td>
<td>(0.0006)</td>
</tr>
<tr>
<td>_cons</td>
<td>1.0734***</td>
<td>0.9963***</td>
</tr>
<tr>
<td></td>
<td>(0.0428)</td>
<td>(0.0319)</td>
</tr>
<tr>
<td>N</td>
<td>864</td>
<td>864</td>
</tr>
<tr>
<td>n</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>r2</td>
<td>0.4977</td>
<td></td>
</tr>
<tr>
<td>r2 within</td>
<td></td>
<td>0.1547</td>
</tr>
<tr>
<td>r2 between</td>
<td></td>
<td>0.4088</td>
</tr>
<tr>
<td>r2 overall</td>
<td></td>
<td>0.3988</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses
*p<0.05, ** p<0.01, *** p<0.001

For both models, regressors are jointly significant, with a p-value of 0.000. Almost half of the variation is explained with $R^2$ around 0.4-0.5. All the coefficients have the same symbol. The constant is close to 1 that means it is inferior to the average value of R in the data set (1.13 as explained in part 4.3).

Regarding the estimated coefficients, the existence of an air alternative to train and/or of a low cost carrier service decrease the value of the ratio. That means that if there is intermodal competition, SNCF decreases its tickets’ prices. That is coherent with intuition.

Relative car duration is harder to interpret. As explained in part 4.3, this variable is always positive and always superior to 1. In both models, if the driving time is almost equivalent to the train time travel (i.e. the relative duration is close to 1) it increases the ratio but less than if the train is most “time competitive” (for example if the relative car duration is close to 3). This is also coherent with intuition.
The effect of the driving cost per kilometer is similar to the one of relative car duration. This variable is always positive. The most expensive the driving cost per kilometer, the higher the ratio. This means that when driving is expensive, SNCF can increase its prices. This is also coherent with intuition.

The only “illogical” coefficient is the influence of the access charge price per kilometer. The negative sign means that the ratio is smaller for an O&D with expensive access charge than for an O&D with lower access charge. That means that SNCF is not passing to the passengers the difference in its “production costs”. On the contrary, the more SNCF pays RFF for tracks access, the cheaper the tickets are. This anomaly needs to be further investigated.

4.5. Conclusion of empirical analysis

Based on the descriptive statistics and on the empirical analyses it is possible to conclude that SNCF take into account intermodal competition when it sets its basic fares.

However, the analyses conducted in this part are only relevant for basic fares, which do not fully correspond to the price really paid by passengers. Indeed, as explained in part 4.1, passengers - especially when they book their tickets in advance- do not pay basic fares but discounted fares (“Prems”). The pricing behavior of SNCF is indeed partially based on the same principles than the ones used by airlines companies (yield management) with some restrictions due to state regulation (Mariton (2008)). As it was explained above the “basic fare” is a legal price cap for SNCF.

Therefore, it may be worthwhile to look at “hour by hour” prices to see if SNCF’s and airlines companies’ prices evolve similarly. If some common pattern can be found in both pricing behavior, this will be an additional proof that SNCF faces strong intermodal competition on some O&D.

5. Comparative analysis of price time series for selected O&D

5.1. Data set

As explained supra, there are only a few cities in France with an airport that offers a direct service to Paris. Including Genève, which is a Swiss city located near the French border and whose airport can be used by French citizen living in the Alpes, 19 cities/airports have a direct connection with Paris
competing with a TGV service. Only 5 airports (Brest, Biarritz, Genève, Nice, and Toulouse) offers low cost service to airports “Paris Orly” or “Paris Charles de Gaulle”.

For these 19 cities, price data for service from Paris were collected between July 25th 2012 and October 22nd 2012 for two departure times: a Thursday morning (October 25th 2012) and a Friday evening (October 26th 2012). October 26th 2012 was also the last day of class before the “Toussaint” holidays for French schools. Therefore, a lot of passengers were expected by the SNCF on this precise Friday evening.

Every 8 hours, the various tickets’ prices for SNCF, Air France and a low cost carrier (Easy Jet) were collected on their websites.

5.2. Results

Given the nature of the data at disposal, the simplest way to analyze price evolutions is to compare the prices of different groups of tickets (train/regular airline/low cost) for an O&D and for one time period (Thursday morning/ Friday evening) on a graphical representation.

For some O&D (like Paris-Toulouse), there seems to be a strong correlation between low cost carrier’s and SNCF’s prices. The evolutions of the minimum price for one seat on the Friday night train/plane are the following.

---

28 “Business airlines” as defined in footnote 25 are not included. If they were, four additional airports (Agen, Annecy, La Rochelle and Lannion) have a direct connection with Paris.
29 Including “Paris Beauvais” airport used by Ryanair, two additional cities (Marseille and Beziers) have a direct connection to Paris.
30 The initial plan was to collect data for 3 months, i.e. till the day of departure of the train. Unfortunately a strike took place on October 26th 2012. Therefore some trains were cancelled and it was not possible to collect data a few days before the 26th.
Figure 1: Evolution of the prices for one seat (train/plane) Paris-Toulouse, October 26th 2012

Note: Prices represented in this figure correspond to the cheapest tickets available on each website.

On this graph, Air France’s prices are high and seem to be uncorrelated with Easy Jet’s and SNCF prices. This may be explained by the fact data were collected only for a one way ticket (no return flight) when one of the yield management principle for regular airlines is to strongly differentiate prices between one way and round trip tickets, in order to separate leisure passengers from business passengers.

Another interesting fact is the strong differentiation between Easy Jet’s prices and SNCF’s prices in the last few days before the departure. This is explained by the fact SNCF’s prices almost hit the price cap defined by the regulation. The limited leeway enjoyed by the SNCF to set its prices restricts the use it can make of yield management principles.

For several O&D, Air France prices are not always constant. For these O&D Air France’s prices do not evolve with as many “prices steps” as Easy Jet’s or SNCF’s prices. There is generally one important change in prices which occurred when cheap not refundable tickets are not available anymore. This can be seen for example for the O&D Paris-Lourdes on Thursday morning.
Figure 2: Evolution of the prices for one seat (train/plane) Paris-Lourdes, October 25th 2012

Note: Prices represented in this figure correspond to the cheapest tickets available on each website.

This important price rise happens almost at the same time than a smallest rise in SNCF’s prices. Here again one can notice that a few days before departure, SNCF’s cheapest price corresponds exactly to the price cap defined by the regulation (i.e. the basic fare used in the empirical analysis in part 4).

Similar evolutions (regarding the link between SNCF’s and Easy Jet’s prices and regarding the evolution of Air France’s prices) can be observed for other O&D, even if there are less blatant.
5.3. Conclusions of qualitative comparison of data prices series

To conclude, three “rules” emerged from this qualitative comparison of price series:

1. SNCF’s and Easy Jet’s prices are correlated.
2. Air France’s prices are usually much higher than Easy Jet’s/SNCF’s prices. However a strong increase in Air France’s prices is usually followed by a small increase in SNCF’s prices.
3. A few days before the train/plane departure SNCF’s prices hit the maximum price set by regulation, therefore taking the train is a much cheaper option than flying (either with a low cost carrier or a regular airline).

A more quantitative approach may be valuable to consolidate these findings.

It would also be interesting to try to understand the causes of the correlations between SNCF’s/Easy Jet’s prices on the one side and Air France’s/SNCF’s prices on the other. Are these correlations based on an intentional pricing behavior of transports companies or are they linked with the fact all these companies used the same kind of pricing models (based on yield management)? The reply to this
question may be important to ascertain if transports companies act as an oligopoly or if the market works properly.

6. Conclusion

Based on the analyses conducted in this article, one can conclude that (i) SNCF adapts its price depending on the potential intermodal competition it faces (ii) for O&Ds with intermodal competition prices of different companies (SNCF, Air France and low cost) are correlated (iii) train tickets’ prices regulation effectively restricts SNCF’s ability to set its prices: a few days before departure train is usually the cheapest alternative.

These analyses still need to be strengthen to correct some methodological difficulties (especially regarding the access charge in the empirical analyses) and to introduce more formalization in the analyses of prices data series.

However, these findings may already be taken into account by the French and European policy makers in the context of the rail industry liberalization. Even if a complete intramodal competition is hard to put into practice in the short run because of the organization problems it triggers (Perennes 2012b), intermodal competition may be a good way to damper the monopolistic behavior of the railroad incumbent. For O&Ds with no viable airline alternative (in particular when both cities are “too close” to each other), a solution to increase intermodal competition may be to allow private long distance coaches (Abraham, 2011).

French legislators should also reconsider the goal of the price regulation set by laws and decrees. Has this regulation a public service objective, allowing each French citizen to travel for a reasonable price in the whole country, knowing that Easy Jet is sometimes cheaper than SNCF? Or is the goal of this regulation to limit SNCF monopolistic behavior, when this article has proved than SNCF used the limited leeway it gets from the legislator to adapt its basic fares to competition? The goal of this regulation has to set in a more transparent way. Therefore more adapted and more transparent regulation rules can be set.
References

Abraham C. (2011) L’ouverture à la concurrence du transport ferroviaire de voyageurs, Centre d’Analyse Stratégique


Perennes, P. (2012) "Pourquoi les tarifs de la SNCF sont-ils régulés?", Concurrence, 3-2012)