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Florent LAROCHE

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Keywords: Open-access competition, price, frequency, France, regulation, railroads

J.E.L. Classification: L1, L110, L130, L5, L920



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TITLE: Goodbye monopoly: the effect of open access passenger rail competition on price and frequency in France on the High-Speed Paris-Lyon Line

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ABSTRACT:

Paris-Lyon is the busiest High-Speed Line in Europe and has been open to open access competition since 18 December 2021. The purpose of this article is to explore the first effects on the price and frequency of competition between the Italian company Trenitalia and the French incumbent SNCF. The analysis is based on a large database ($n = 971$) collected from September 2019 to July 2022. The main challenge is to isolate the COVID-19 pandemic effect from the competition. A similar route without competition (Paris-Bordeaux) was selected to control the effects. The method relies on a descriptive analysis with an original dynamic timetable approach in the discussion. The results highlight an increase of frequency by 5% and a decrease in price by 10%. The prices charged by the newcomer are lower than those of the incumbent (-30% to -40%) though without enough volume to change the global equilibrium. Although far from a big bang, the comparison with the control route suggests a positive effect on price that moderates the economic catch-up effect following the COVID-19 pandemic in an inflationary context. More specifically, SNCF appears relatively insensitive to competitive pressure from Trenitalia. It has not significantly changed its price since the new offer was introduced and has maintained its trains.

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INTRODUCTION:

Initially planned for 2020, the COVID-19 pandemic shook up the calendar, so the first competitor finally entered the French national rail passenger market in open access on 18 December 2021. The newcomer, Trenitalia France, launched its service on the Paris-Lyon High Speed Line (HSL). It is currently limited to this route but this event already marks a historic step for French rail, after more than 80 years of state monopoly by the SNCF, and represents a symbol for European transport policy, 30 years after the well-known Directive 91/440/EEC. A major railway network in the European Union, France was often described as a “fortress” by its neighbours because of its slow progress in the deregulation process.

The purpose of this paper is to draw up the first overview of the market considering prices and frequencies after 6 months of competition. Much academic literature on the topic has been produced but the French case is specific and could fill a gap for several reasons. Firstly, a large part of the literature is based on national case studies like in Italy (Bergantino *et al.*, 2015; Beria *et al.*, 2016; Desmaris and Crocchio, 2018; Beria *et al.*, 2019; Beria *et al.*, 2022), Czech Republic (Tomes *et al.*, 2016; Tomes *et al.*, 2018; Jandova and Paleta, 2019; Fitzova *et al.*, 2021; Tomes, 2022), Sweden (Alexandersson and Rigas, 2013; Froidh and Nelldal, 2015; Vigren, 2017) and the UK (Temple, 2015) and Spain more recently (Montero and Melero, 2022). The main results highlight a benefit for users in terms of price and frequency. However, their intensity strongly depends on the initial context and the national organisation of the market (Laroche and Lamatkhanova, 2022). Many barriers to competition remain (Bougette *et al.*, 2021) and experiments in open access are still rare in Europe with a large number of bankruptcies and failures (Alexandersson, 2009; Finger, 2014; Perennes, 2017; Tomes, 2022). The French case is particularly interesting in this European picture. Secondly, the newcomer is far from being an unknown entity. Trenitalia France has experience in High Speed Rail competition in open access gained by its mother company, Trenitalia, in Italy. It has also gained experience of the French network since 2011 thanks to the night service “Thello”, which was the first independent rail passenger operator to run in France on the international market from Paris to Venice. Consequently, the company already had good knowledge of the French network, its technical specificities and constraints (Crozet *et al.*, 2022). Only a few companies had as many advantages to enter a market, thereby increasing the interest of the French case. This is also the first time in Europe that a national incumbent has been directly engaged in open access competition on an HSL against another major incumbent, as the Spanish case is different because of the tendering process (Montero and Melero, 2022). Thirdly, the Paris – Lyon HSL was the first to be built in Europe and has since become the busiest, with 44 million passengers in 2019. It is also the most profitable for the national incumbent. This line is renowned for high access charges, capacity constraints and its role of laboratory for SNCF, with the development of several technical and service innovations such as the signalling system in the cab, the Duplex (double deck) High Speed Train (HST) and, since 2013, the low-cost service Ouigo (“homemade” competition). Finally, and last but not least, the institutional context is favourable in France to competition with a proactive policy from the regulatory agency (ART) and the network manager SNCF Réseau. For its first year, Trenitalia obtained a discount of 37% on access charges and facilities (-16% for the second year and -8% for the last year) to find available slots in accordance with the system in force intended to compensate for the entrance costs for a newcomer.

The analysis is based on a large database ($n = 971$) collected from September 2019 to July 2022. Key variables were collected like price for second class seats, schedules, travel times, etc., every Tuesday one week before departure. The main challenge in this panel is to isolate the COVID-19 effect from the entry of the newcomer. Laroche (2022a) showed that the long distance market was affected during the pandemic with a falls of -5% in frequency and -16 % in average price for long distance train services

between September 2019 and November 2021. The method took into account this challenge by considering four periods: before the COVID-19 pandemic (October 2019), during the pandemic (October 2021), during the entry of the newcomer (December 2021 / January 2022) and six months afterwards (June 2022). Obviously, it is still difficult in July 2022 to determine the consequences of the COVID-19 pandemic and its effects, especially in terms of travel behaviour. Consequently, a similar route without competition was selected (Paris-Bordeaux) to control the effects on the Paris-Lyon line. The method relies on a descriptive analysis with an original dynamic timetable approach in the discussion.

The main results highlight a contrasted situation. On the one hand, the newcomer maintained its role by reducing its price (between -30 and -40%) and increasing its offer (from two to five services per day). The effect had to be moderated by a discount on the access charges and the difference could be reduced with the end of subsidies. On the other hand, the incumbent demonstrated moderation by reducing its premium offer (Inoui) by -14% and its prices (-8%) between 2019 and 2022. The low cost offer (Ouigo) remained stable (-2%) and prices increased by 19%. Considering the two HST services offered by SNCF and Trenitalia, the frequency on the Paris-Lyon line increased by 5% and prices decreased by -10%. The results are still far from the big bang announced (Laroche, 2022b) but it is interesting to compare them to the control route without competition where frequency increased by 14% and prices by 24%. After the COVID-19 pandemic, the catch-up effect on price seems to be more pronounced on the Paris-Bordeaux line than on the Paris-Lyon line. This could be the main benefit of competition for the users.

There are several policy implications. Firstly, it is clear that competition should have a positive effect on user welfare with a consistent offer with more diversity and moderate prices. The last point is significant in an inflationary context. Secondly, the development of the newcomer highlights the importance for public institutions to anticipate competition with adapted regulatory tools such as support for access charges and the identification of available slots. The French national regulatory agency and the network manager have carried out extensive and profitable preparatory work, and gained feedback from other experiences to make the first six months of competition a success without major technical or organisational failures. Finally, a danger could be to consider only the user surplus. Traditionally, the Paris-Lyon HST line was the support for the incumbent to subsidise other HST routes in deficit. A price war could jeopardise this equilibrium and have a negative effect for users on the other routes. It would be interesting to further analyse the case of Bordeaux and the considerable price increase (24%), making it necessary for the public authorities to monitor this rise in cost for users.

The paper is organized as follows. In Section 1, we provide a more in-depth literature review of the results expected from open access competition. In Section 2, we describe the initial context and the database. In Section 3, the method is presented followed by the main results in section 4. Finally, the results are discussed in section 5 before we conclude in section 6.

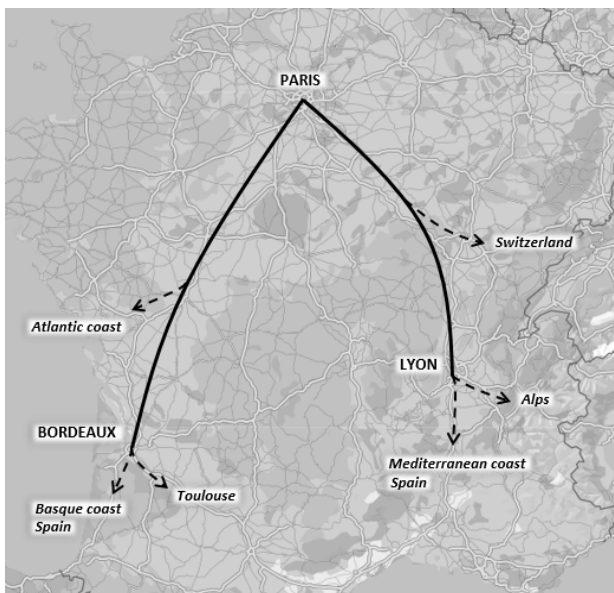
1. LITERATURE REVIEW

Subsection 1.1 describes the context of the Paris-Lyon HSL. Subsection 1.2 presents its services before competition, then subsection 1.3 provides a review of the literature to highlight what could be expected from the deregulation process.

1.1 The Paris – Lyon HSL

The Paris-Lyon HSL was commissioned in 1981. It was the first in Europe and 40 years afterwards, it is still a success with 44 million passengers in 2019. 430 km long, figure 1 shows that the HSL concentrates a large number of origin-destinations from Paris to southeast France, Switzerland (Lausanne, Zurich, Geneva), the Alps (Grenoble, Chambéry), the French riviera (from Marseille to Nice), towards Spain, and, of course, Lyon and Saint Etienne. It is important to mention that several downtown and suburban stations in Lyon and Paris are linked to the HSL (Gare de Perrache and Gare Part-Dieu for Lyon, Gare de Lyon and Paris-Bercy for Paris). Saint Exupéry station is situated at the airport of Lyon, 28 km from the city. This station is used by few trains (exclusively Ouigo) but it is possible to reach the central station in Paris from the suburban stations of Marne La Vallée and CDG airport. In this paper, we consider all these origin-destinations between Paris and Lyon as one market.

Figure 1: Map of the study analysis perimeter (Paris-Lyon and Paris Bordeaux).



Source: Author based on Google Map

The consequence of the high number of connections is the saturation of the HSL line during peak periods on the busiest part of the line. A victim of its own success, more than 200 trains per day run on the busiest part (Laroche, 2014). Several innovations have been provided to increase capacity such as the implementation in 1981 of a standard for a new signalling system (TVM 300), its improvement in 2001 to reduce the buffer time between each train to 4 min and in recent years, investment in the implementation of the European railway traffic management system (ERTMS level 2) by 2030. The objective is to increase commercial capacity by 30%, by reducing the buffer time to two minutes between each train (Laroche, 2014). Whatever the case, with around 30 trains per day between Paris and Lyon in 2019 and a high utilisation rate during peak periods, the network manager is faced with a huge challenge to open this route to competition and find competitive available slots.

From the economic viewpoint, the Paris-Lyon HSL is the most expensive in France in terms of access charges for two reasons. Firstly, the French network is well-known to be one of the most expensive in Europe because of the choice to cover its full cost on the basis of a Ramsay-Boiteux pricing policy (Crozet, 2018). Secondly, the HSL has the strongest market power in France due to the high number of surplus users (many business travellers).

Consequently, open access can lead to issues for traffic management, including the marketing of the slots and the business model to be adopted for the newcomers.

1.2 Service organisation before competition

The route was under the monopoly of the SNCF until 18 December 2021. However, it concentrates different types of services. The traditional High Speed Train service is the best known and oldest. To satisfy demand and take into account scarcity in slots, it is composed mainly of Duplex HST with a capacity of 510 seats in single train. Most of the trains are doubled and the effective seat capacity is around 1020 seats per trip. The commercial objective is to run at least one train per hour from 6 a.m. to 21 p.m. between Paris and Lyon.

From 2013, to cope with the economic crisis and the development of intermodal competition (carpooling and coaches), SNCF launched the first low-cost HST in Europe (Ouigo). It was a considerable challenge for several reasons. Firstly, there is no bar or convenience as in the traditional offer. There are only second class seats with a total of 634 seats. Secondly, the O-D are outside the city centres, mainly at secondary stations in suburbs or further away such as Saint Exupéry station for Lyon and Marne la Vallée and CDG airport for Paris. Last but not least, there is no physical agency to market the new product. All the marketing is digital. The objective was clearly to capture a new, younger and less profitable market than that usually catered for. The basic price fell from 25€ to 10€ and has been a complete success. In 2019, it represented 30% of the train offer on the Paris-Lyon line and it is possible to travel from downtown to downtown or from suburbs to downtown.

Finally, mention can be made of a subsidised service on the Paris-Lyon line organised by the local authorities. This service is marginal insofar as there are only four trains per day and it uses the traditional line (no HST) for a travel time of around 5 hours. We will not consider this service in the rest of this paper.

The consequence of this situation is a diversified and original offer on the Paris-Lyon HSL. It raises questions regarding the market positioning of a newcomer between two already well-established offers: premium for Inoui and low-cost for Ouigo.

1.3 Expected results from the literature

The first result was the observation of a limited number of successes throughout Europe in terms of open access. Perennes (2017) showed that it usually takes several years for open access to settle after officially opening. Newcomers are rare and try to minimize the risks, with large scale entry extremely rare and bankruptcy common. Bougette *et al.* (2021) explained this limited entry by the persistence of barriers such as the burden of access charges to the network and the recurring difficulties of access to essential facilities like rolling stock, mechanical maintenance workshops, data and competent staff. Nash *et al.* (2019) identified access to rolling stock and staff as major barriers because most of the time they are in the hands of the incumbent. These impediments have also been identified for the freight

market (Laroche *et al.*, 2017). Consequently, 30 years after the start of the deregulation process in Europe, Tomes (2022) recently reported that the number of cases of open access since 2000 is limited. Nash *et al.* (2019) observed that until now, competition for the market has been more common than in open access because of fewer financial risks. A large share led to bankruptcies and only some of them can be considered as successes in Italy, Austria, Czech Republic and Sweden. However, this success is often limited to the main route and the best market shares obtained are around 30% for the newcomers MTR and Flixbus in Sweden and 49% for Westbahn in Austria (Crozet *et al.*, 2022). Also, competition was until recently mainly supported by outside operators on traditional lines. Regarding HSR, the newcomer Italo in Italy was an exception in Europe. This appeared to change after the entry of Ouigo in Spain in May 2021 and the entry of Trenitalia in France in December 2021. These last two entries have occurred in the face of national incumbents with strong financial support. It could be the sign of a new step in railway competition in Europe.

The second result is global consensus about the benefit for users in terms of frequency and price. Theoretically, competition should have a positive effect on social welfare by increasing frequency and reducing price (Lang *et al.*, 2013; Feuerstein *et al.*, 2018; Broman and Eliasson, 2019). Empirically, the effect is clear on frequency. Bergantino *et al.* (2015) showed that frequency increased by 56% on the main route (Milano – Rome). This was confirmed by Desmaris and Crococo (2018) for an Italian case study and more recently by Montero and Melero (2022) for a Spanish case. According to Tomes *et al.* (2018), frequency increased by 35% in Austria and 65% in the Czech Republic between 2010 and 2016 on routes subject to open competition. Also Laroche and Lamatkhonova (2022) showed a significant relationship between routes with competition and frequency in a European benchmarking study. This effect can be explained by the structure of the railway industry which is characterized by large economies of scale (Crozet *et al.*, 2022). Consequently, competition is driven more by volume (Cournot competition) than price (Bertrand competition) and price decrease is a derived effect (Crozet *et al.*, 2022). There is more debate about prices. In some cases, they have decreased drastically, as in the Czech Republic (-46% between 2011 and 2014) and Austria (-20 to -25% between 2010 and 2016) according to Tomes *et al.* (2016) and Tomes *et al.* (2018). In other cases, the effect is more complex. In a recent detailed study, Beria *et al.* (2022) showed that price on the Turin-Venice route decreased by -21% to -26% after the entry of Italo in May 2018. However, more than six months afterwards, the reduction was around 15%. This confirms older results such as a decrease of -15% observed for the second class price by Beria *et al.* (2016) on the Milano – Ancona route between 2013 and 2014. The newcomer (NTV) was presented as a price-taker. In Sweden, Vigren (2017) measured a fall of 12.8% in 2015 following the entry of the newcomer MTR on the Stockholm – Gothenburg route. Finally, Laroche and Lamatkhonova (2022) did not find a significant effect of competition on price when comparing routes with and without competition in seven European countries. This does not mean that there is no effect but some networks can have more similar performances without competition than others. A large proportion of the effect depends on the initial stage, the capacity of the newcomer to compete in the long term and the potential demand. For the French case, the equation is rather simple but the result difficult to predict. The initial stage shows an incumbent already competitive regarding price, especially because of its strategy of market segmentation between a premium and low-cost offer. It could be a challenge for the newcomer to find the right positioning to compete effectively. Regarding its capacity to compete in the long term, several questions must be answered regarding Trenitalia's financial support and capacity. Finally, according to Crozet *et al.* (2022), there is still potential demand to be captured on the already busiest route in Europe. The following sections propose to test these assumptions for the French case.

2. DATA COLLECTION

The data were collected every week from September 2019. The day of collection was Tuesday followed by (d-7); the method used to collect the data was manual web-scraping. In spite of the time required, manual collection is more reliable than automatic collection to avoid double counting or other usual mistakes on official websites. The collection was based on the following three websites. The main website was SNCF-connect.com for the largest share of the offer from the incumbent. However, it was necessary to complete the research with the website dedicated to its low-cost offer, Ouigo.com. Finally, the data for the newcomer were collected on its website, Trenitalia.com.

The collection was done train by train in one way (toward Paris). We took into account the price for the second class, the type of train (Ouigo, Inoui, etc.) and the departure/arrival schedule. By deduction, it gave different useful variables such as the price per kilometre, travel time, frequency, etc.

Finally, two routes were considered (cf. figure 1): Paris-Lyon and Paris-Bordeaux. The interest of the second route is that it is comparable with the first one but without competition. From the economic and demographic standpoints, they are not strictly comparable. There are 1.3 million inhabitants in the Lyon metropolitan area versus 749 595 for Bordeaux. The HSR is more recent in Bordeaux (2018) than in Lyon (1981). However, the travel time is quite similar, a little bit longer for Bordeaux because of the greater distance (586 kilometres for Bordeaux versus 466 kilometres for Lyon), and they both have large hinterlands, the Basque coast and Toulouse for Bordeaux and the French Riviera and Marseille for Lyon. It is certainly the best case for a reliable control route. Also, both routes have the characteristic of serving different stations at their departure and arrival. We took into account all these stations without discrimination. Consequently, Lyon-Saint Exupéry to Marne la Vallée is considered as a full part of the Paris-Lyon route as is Bordeaux Saint-Jean to Massy TGV for Bordeaux-Paris.

In total, 971 observations were used in this study; 599 for Paris-Lyon and 372 for Paris-Bordeaux.

3. METHOD

The method used to analyse the effect of competition on price and frequency is based on a descriptive analysis in three steps. The first one presents the positioning of Trenitalia on the time schedule and gives an overview of the evolution of the offer from 18 December 2021 to June 2022. The second one gives the result for prices and frequencies. They are discussed with the results for the Paris-Bordeaux route. Finally, the last step is an original analysis based on a dynamic timetable approach (from 2019 to 2022) to discuss the positioning of Trenitalia, its pricing strategy and the reactions of the incumbent train by train. The timetables are compared with each other from 2019 to 2022.

The main challenge for the analysis was to isolate the effect of the COVID-19 pandemic. As France and a large part of the Europe were still subject to the COVID-19 pandemic in December 2021, it would be hazardous to consider only the year 2021 and 2022. To reduce bias, four periods are considered:

- October 2019: this period was before the COVID-19 pandemic and a normal month for traffic without strikes in France;
- October 2021: a month during the COVID-19 pandemic without lockdown but still with sanitary restrictions with the obligation of vaccination to use rail transport. This month is interesting to use in comparison with 2019 and it gives a picture of the situation before the entry of Trenitalia;

- December 2021/January 2022: this period covers the first month of Trenitalia operation. It was still a difficult period in France with the biggest waves of COVID-19 infection in spite of vaccination;
- June 2022: 6 months after the entry of Trenitalia and before the summer holidays in France.

Price and frequency are given as an average for the period considered. The global price is a weighted average to take into account the diversity of the offer and the weight of each service (Ouigo, Trenitalia and Inoui) in the total. The weight is based on frequency.

Finally, the analysis is circumscribed by several strong data limitations. It is not possible to assess the surplus from the operators because of the lack of information about the occupancy rate. Also, the absence of data on the demand structure and pricing distribution does not allow assessing the user surplus and the global equilibrium. A theoretical model could overcome these limits and could be developed in future research.

4. RESULTS

Subsection 4.1 gives an overview of the offer and schedule positioning of the newcomer. Subsections 4.2 and 4.3 analyse the effect on frequency and price respectively.

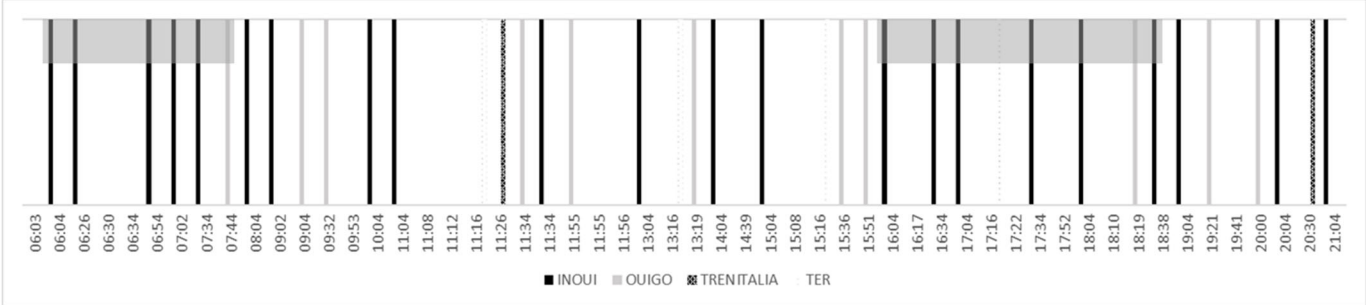
4.1 Market positioning analysis

Historically, Trenitalia is not a pure newcomer in France. It entered the market in 2011 after the deregulation of the international passenger market. They ran a night train from Paris to Venice/Rome and a day train between Marseille and Milan under the brand “Thello”. During this period, it was the first and the only passenger operator to run alongside the SNCF. It positioned itself on a niche market with only two trains per day running on the traditional line. It stopped its activities in July 2021 because of the COVID-19 pandemic but also to prepare the new service with the introduction of high-speed passengers trains between Paris and Milan for the first time on 18 December 2021. The service has been progressively strengthened to reach five services per way and per day in June 2022 including three services between Paris and Lyon only. The first train running only on the French network was launched in April 2022 before the introduction of two others in June 2022. At the same time, it should increase its seat capacity. The newcomer started with the HST Frecciarossa 1000 with a capacity of 462 seats running as a single unit. The objective is to transform each train into a double unit by 2023 to improve capacity and obtain economies of scale (Guihery, 2022). In addition, Trenitalia obtained a discount of 37% on access charges and facilities (-16% for the former and -8% for the latter) to find available slots in accordance with the system in force intended to compensate for the costs of entrance for a newcomer

Figure 2 shows the timetable for the Paris-Lyon route when Trenitalia entered in December 2021. The grey area represents the peak period for the morning and the afternoon. Two comments can be made. Firstly, Trenitalia entered the market only during the off-peak period at 11:26 in the morning and 20:30 in the evening. Both services are far from the peak period. This may be a strategy to test the market and organisation, and to reduce the financial risk. The two services benefit from a lower access charge on the French network because of the off-peak period and take less risk for demand with a base from Milan (Milan – Paris). Secondly, there is a clear difference between the premium and low cost offer from the incumbent. The premium offer (Inoui) is positioned every hour from 6 a.m. to 9 p.m. (15 hours). This amplitude is rather low as a European study showed an average of 16 hours per day for the other European countries (Laroche and Monchambert, 2019). Also, the offer is doubled during the

peak periods (every 30 minutes) with a peak in the morning between 6:00 to 7:00. On the contrary, Ouigo is mainly positioned during the off-peak period with less regularity. This can be explained by the marketing target. The low-cost offer is oriented toward the leisure market which is less sensitive to frequency than the business market (premium offer).

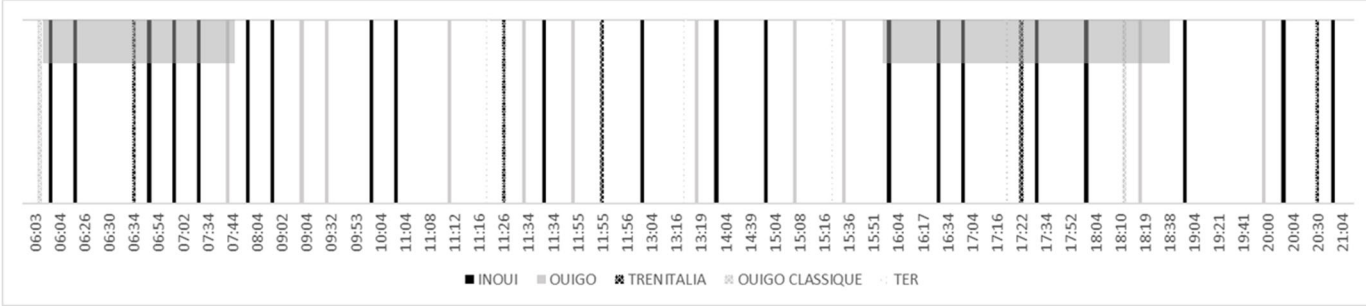
Figure 2: Paris - Lyon timetable in January 2022.



Source: Author

Figure 3 gives the timetable six months later in June 2022. A first observation is the increase of the Trenitalia offer from two to five services during a day. The second one is the new positioning with one train during the morning peak period and another in the afternoon. The third train is positioned at noon. These new services are provided only on the Paris-Lyon axis and highlight the desire of the newcomer to construct a stronger timetable to capture more demand that includes business travellers. Faced with this development, the incumbent has moved slowly. The global amplitude is unchanged with the principle for the premium service of one train per hour throughout the day and one every 30 minutes during peak periods. The low cost offer has been adapted but it is difficult to draw conclusions as the timetable is usually floating. However, a remarkable fact is the introduction of a new low cost service “Ouigo classique”. The principle is the contrary of the high-speed offer with a return to traditional trains on traditional lines. The basic price is €10 and rarely more than €20. The objective is not to compete with Trenitalia but rather with the alternative modes (coach and carpooling) and may anticipate the entry of new competitors into this market segment. For example, this was the project of Flixbus in 2019 but the COVID-19 pandemic stopped the project.

Figure 3: Paris - Lyon timetable in June 2022.



Source: Author

4.2 Effect on frequency

Table 1 gives the evolution of frequency (average number of train per day) on the Paris-Lyon routes only for the high speed services over four periods: October 2019, October 2021, December 2021/January 2022 and June 2022. The objective is to compare the situations by taking into account the effect of the COVID-19 pandemic on the period. Three points of comparison have been defined. The first one encompasses the entire period from October 2019 to June 2022. The second assesses the specific effect of COVID-19 on the offer between October 2019 to October 2021, before the entry of Trenitalia. The last considers the last six months with Trenitalia from December 2021 to June 2022. Finally, the frequency is given by type of offer distinguishing Inoui from Ouigo and Trenitalia. Also, the total account is given for the SNCF only and for the incumbent with Trenitalia.

Table 1: Evolution of the frequency by type of service on the Paris-Lyon route between October 2019 to June 2022.

Frequency	oct-19	oct-21	dec-21 / jan 22	jun-22	19/22	Covid (19/21)	Trenitalia (dec21/22)
Inoui	22	18.3	21.5	19	-14%	-17%	-12%
Ouigo	11	13	9.3	10.8	-2%	18%	16%
Trenitalia	0	0	2	5	-	-	150%
Total (SNCF)	33	31.3	30.8	29.8	-10%	-5%	-3%
Total (SNCF+Trenitalia)	33	31.3	32.8	34.8	5%	-5%	6%

Source: Author

As can be seen, the global evolution of the offer during the period 2019/2022, increased by 5%. This covers various elements. The Inoui offer decreased by -14% while the Ouigo offer stayed stable (-2%) and Trenitalia entered the market with 5 services per day. The total number of trains in October 2019 was 33 and was around 35 in June 2022. These two additional trains hide a reduction of the incumbent's offer of -10% in the period that Trenitalia only partially offset.

Considering the frequency per period, we can observe that the offer from the SNCF was highly unstable with a minimum in October 2021 due to the COVID-19 effect (-17% in comparison to October 2019), a better situation in December 2021 returning to the level of 2019 and a new reduction in June 2022. It is interesting to observe that the evolution was the opposite for the low-cost offer, with a maximum in October 2021 and a minimum in December 2021. This highlights the difficulties that the incumbent had to adapt its offer during the period and the strong effect of the COVID-19 on demand.

However, the last period between December 2021 and June 2022 suggests that the global frequency increased due to the Trenitalia offer. June 2022 marks a maximum in the number of trains since 2019 with 2 more trains in spite of the reduction of 3 SNCF trains. The difference for the SNCF was fully supported by the premium offer with a reduction from 22 to 19 trains per day while the low cost offer returned to the initial stage. It could have been a reaction to the newcomer or the effect of the reallocation of rolling stock to another route as observed in Sweden by Froidh and Nelldal (2015). In any case, the SNCF left a share of the market to Trenitalia and users gained two new services a day in June 2022. It was far from being the major change expected by the literature.

4.3 Effect on price

Regarding price, table 2 gives an overview of the evolution using the same method as shown in table 1.

Table 2: Evolution of prices by type of service on the Paris-Lyon route between October 2019 to June 2022.

Price	oct-19	oct-21	dec-21 / jan 22	jun-22	19/22	Covid (19/21)	Trenitalia (dec21/22)
Inoui	85.4	69.7	63.5	78.4	-8%	-18%	23%
Ouigo	33.2	25.2	27.9	39.5	19%	-24%	42%
Trenitalia	0	0	33.5	44.6	-	-	33%
Total (SNCF)	68.0	51.1	53.1	64.3	-5%	-25%	21%
Total (SNCF+Trenitalia)	68.0	51.1	51.9	61.5	-10%	-25%	18%

Source: Author

Considering the full period from October 2019 to June 2022, the average price per day for all the high speed services decreased by -10% and only -5% for the incumbent. The change was rather low but it covered different trends. More than frequencies, prices were strongly impacted by the COVID-19 pandemic with a fall between October 2019 and October 2022 by -25% on the Paris-Lyon route. The Inoui services were less impacted than those of Ouigo, -18% and -24%, respectively. Consequently, the last six months, since the entry of Trenitalia, display a dynamic of economic catch-up. Prices increased by 18% in total with +23% for Inoui, +42% for Ouigo, respectively, and even for the newcomer (+33%). This result appears to contradict economic theory if considering only the last year to assess the effect of Trenitalia. It better explains the importance of considering a longer period with an initial stage before the COVID-19 pandemic in 2019.

To better assess the effect of competition, it is interesting to consider only Inoui and Trenitalia. The global result integrates the low-cost offer which is difficult to compete with regarding price and is not fully substitutable in terms of the comfort provided by Trenitalia. In this case, the effect was stronger insofar as the average price for the newcomer was €45 versus €78 for the incumbent (-42%). This type of situation has been already identified in the literature by Bergantino *et al.* (2015) who found that the newcomer set a lower price than the incumbent (-29% vs -34%) but its critical mass was not sufficient to significantly reduce the global price. However, we can observe that the price for Inoui in June 2022 remained lower by €7 than the price observed in October 2019 when Ouigo's price increased by €6. It may be a sign of difficulties for the Inoui offer because of fewer business trips following the COVID-19 period, moderating the catch-up effect in the face of the newcomer. The comparison with the Paris-Bordeaux route without competition should give more elements to distinguish both effects.

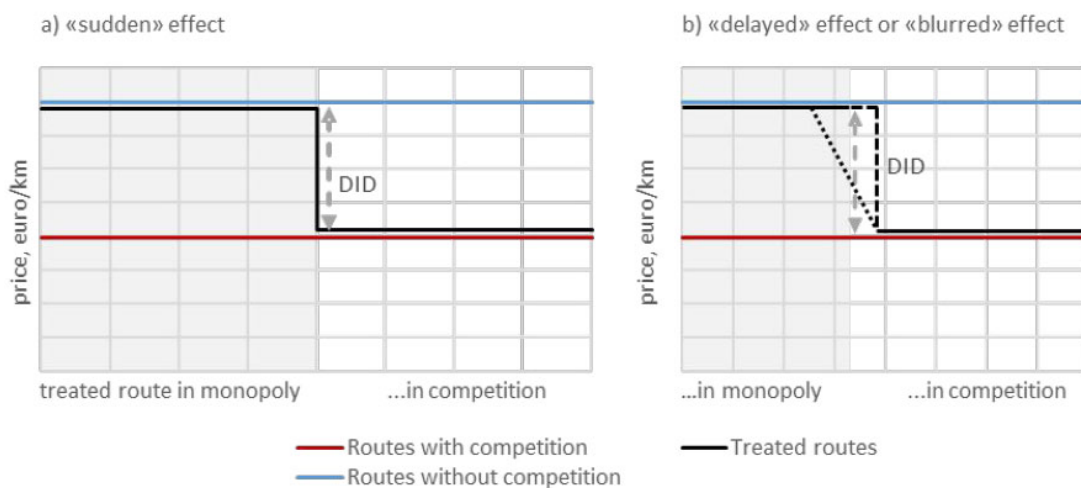
5. DISCUSSION

In section 5 we discuss the results in two steps. Subsection 5.1 takes the analysis further by comparing the Paris-Lyon route to the Paris-Bordeaux route without competition after which subsection 5.2 proposes a dynamic analysis of the timetable and pricing strategy train per train on the Paris-Lyon route.

5.1 A discrete but positive effect of competition on price

Beria *et al.* (2022) published a study comparing routes in Italy with competition to routes without competition to better assess the effect of competition on price. They found that prices decreased more significantly on the route with competition than others by -21 to -26% in the first six months and -15% in the long term. In this subsection, we propose to apply a similar approach with the Paris-Bordeaux route. According to Beria *et al.* (2022), we should obtain the following result in figure 4 where two situations are possible. The effect of competition is “sudden” and the incumbent has to quickly reduce its prices or the effect is “delayed” because the incumbent anticipates or is subject to considerable inertia.

Figure 4: Theoretical expectations about the effect of competition, without exogenous effects.



Source: Beria *et al.*, 2022

Table 3 gives an overview of the evolution of frequency for the Paris-Bordeaux line. It is surprising to observe that the frequency increased by 14%, more than on the Paris-Lyon line, for both market segments: Inoui (10%) and Ouigo (42%). Although the evolution between October 2019 and October 2021 was quite similar between both routes for the Inoui and Ouigo services (with better performance on the Paris-Bordeaux line), the trajectories changed after the entry of Trenitalia. Without competition, the Inoui services caught up and increased their frequency between December 2021 and June 2022. This was the opposite on the Paris-Lyon route. It certainly confirmed the strategy of wait and see by the SNCF to maintain its profits in the face of Trenitalia and uncertainty on travel behaviours after the COVID-19 pandemic.

Table 3: Evolution of frequency by type of service on the Paris-Bordeaux route between October 2019 to June 2022.

Frequency	oct-19	oct-21	dec-21 / jan 22	jun-22	19/22	Covid (19/21)	Dec-21/Jun-22
Inoui	20	16.8	17.3	22	10%	-16%	28%
Ouigo	3	5	5	4.3	42%	67%	-15%
Total (Inoui+Ouigo)	23	21.8	22.3	26.3	14%	-5%	18%

Source: Author

Regarding price, table 4 reveals a radically different situation from that of the Paris-Lyon line. Prices decreased less during the COVID-19 period on the Paris-Bordeaux line but the catch-up effect was stronger as prices in June 2022 were higher than in October 2019. The situation was totally the contrary between the routes except for Ouigo for which prices increased. For Inoui, they decreased by -8% in the period for the Paris-Lyon line versus 23% for the Paris-Bordeaux line. Consequently, the entry of Trenitalia could have a positive effect on price by moderating the temptation for the SNCF to catch-up on the loss due to COVID-19 on the Paris-Lyon line to the benefit of the users. It could also explain its moderation in terms of frequency to maintain its financial margin.

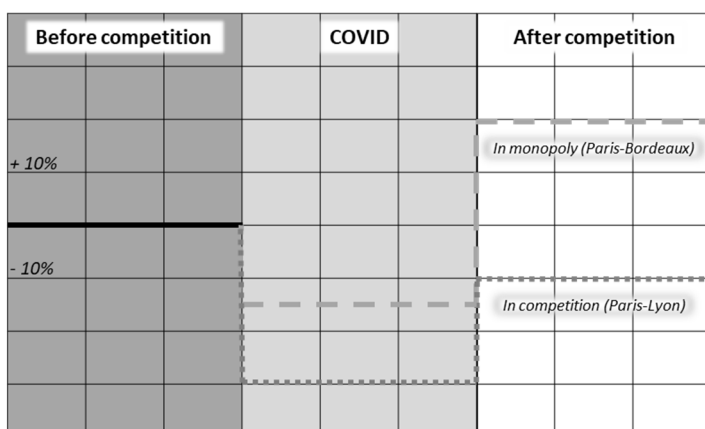
Table 4: Evolution of prices by type of service on the Paris-Bordeaux route between October 2019 to June 2022.

Price	oct-19	oct-21	dec-21 / jan 22	jun-22	19/22	Covid (19/21)	Dec-21/Jun-22)
Inoui	72.5	64.1	68.7	89.4	23%	-12%	30%
Ouigo	28	25.9	33.2	46.8	67%	-8%	41%
Total (Inoui+Ouigo)	66.7	55.3	60.6	82.6	24%	-17%	36%

Source: Author

Finally, figure 5 shows the model from Beria *et al.* (2022) applied to our case study. Some adaptations were necessary to take into account the COVID-19 effect with three periods: before competition in October 2019, “during” the COVID-19 pandemic in October and December 2021/January 2022 and after competition started in June 2022. The result confirms the prediction by Beria *et al.* (2022) with a higher price on the route under monopoly and a lower one in the case in competition. The price per kilometre became higher on the Paris-Bordeaux line in June 2022 than on the Paris-Lyon line. It was respectively €0.11 and €0.15 in October 2019 versus €0.14 and €0.13 in 2022. It is true that the effect for the Paris-Lyon line was limited (-10%), as predicted (Laroche, 2022b), but it is already a good result regarding the economic catch up on the Paris-Bordeaux line and the inflationary environment.

Figure 5: Comparison of the effect of competition on price between Paris-Lyon and Paris-Bordeaux, with the COVID-19 pandemic effect.



Source: Author

5.2 Pricing analysis by timetable dynamics

This last subsection proposes an original analysis through a dynamic timetable approach. The objective is to further discuss the price effect of Trenitalia on the incumbent. It is based on four timetables. The first was the timetable in October 2019, the second in October 2021, then in December 2021/January 2022 and the last in June 2022. In each slot, the type of train (Inoui, Ouigo and Trenitalia) is given as well as the average price observed in the period. The two offers on the traditional line (TER and Ouigo classique) are excluded from the analysis. The results are shown in two tables, before 12:00 for table 5 and after for table 6. They allow better understanding of the introduction of the new offer by substitution or creation.

We propose a train by train analysis in three steps. The first considers the positioning and the price of Trenitalia in comparison to the direct train competitor. The second consists in measuring the evolution of the incumbent's prices from 2019 to 2022. The last step consists in assessing the effect of Trenitalia on the incumbent, assuming that the trains before and after the Trenitalia train should be cheaper than the average.

Table 5: Compilation of four timetables by type of service and average price from October 2019 to June 2022 on the Paris-Lyon route (part 1 from 6:00 to 12:00).

Period		06:04	06:26	06:34	06:54	07:02	07:34	07:44	08:04	09:02	09:04	09:32	09:53	10:04	11:04	11:12	11:26	11:34	11:34	11:55	11:55
Oct-19	Type	INOUI		INOUI	INOUI	INOUI	INOUI	OUIGO	INOUI	INOUI	OUIGO		OUIGO	INOUI	INOUI			OUIGO	INOUI		
	Av. Price	97		97	97	97	97	35.8	91.8	91.8	29		48	81.3	70			35.5	72		
Oct-21	Type	INOUI		INOUI	INOUI	INOUI	INOUI	OUIGO	INOUI	INOUI	OUIGO	OUIGO	OUIGO	INOUI			INOUI	OUIGO		OUIGO	
	Av. Price	74.1		78.6	77	81.2	78.7	22.5	78.2	76.7	20.5	37.8	27.8	58.4			50.8	24.8		33.4	
Dec-21/Jan-22	Type	INOUI	INOUI		INOUI	INOUI	INOUI	OUIGO	INOUI	INOUI	OUIGO	OUIGO		INOUI	INOUI		TRENITALIA	OUIGO	INOUI	OUIGO	
	Av. Price	73.2	72.3		80.6	85.5	76.9	30.6	56	70.8	17	26.6		59	60		39.6	19.1	49	28.6	
jun-22	Type	INOUI	INOUI	TRENITALIA	INOUI	INOUI	INOUI	OUIGO	INOUI	INOUI	OUIGO	OUIGO		INOUI	INOUI	OUIGO	TRENITALIA	OUIGO	INOUI	OUIGO	TRENITALIA
	Av. Price	80.1	91	41	97	89.8	78.5	44.8	73.7	72	28.7	44.7		74.1	66.3	45.3	65.5	49	59.5	47	34.5

Source: Author

Train of 6h34

The first train of the day operated by Trenitalia is a creation. It replaces an Inoui moved 8 minutes before at 6:26. It is interesting to observe that the change for the SNCF was made on the entry of Trenitalia in December. It may be the sign of anticipation by the incumbent or by the infrastructure manager. In terms of price, the slot is during the peak period with an average price from the SNCF for

the train before and after of €91 and €97, respectively, with an average price of €41, Trenitalia is highly competitive (-56%) and represents a strong gain for the user. However, we observe that in spite of Trenitalia, the incumbent did not drastically reduce its prices between 2019 and 2022. Indeed, the reduction was limited to -3% for the two trains in direct competition (6:26 and 6:54) while it was on average -12% for the two others in indirect competition (6:04 and 7:02). This is the contrary of what could be expected. Also, the two trains in direct competition were above the average in June 2022 for the Inoui price (€78.4) at €94. The incumbent seemed to be perfectly insensitive to the newcomer in this peak hour slot.

Train of 11:26

This was the first train to run on the French network on 18 December. The Inoui train of 11:04 was temporarily moved to 11:26 making it a creation. The interest of the Trenitalia train is that it came from Milan and was positioned during an off-peak hour between two Ouigo trains (11:12 and 11:34). The direct Inoui competitors are scheduled at 11:04 and 11:34. We propose to base the analysis only on these trains, the others being too far in the schedule to be competitive (10:04 and 13:04). Regarding price, although Trenitalia was cheaper in the beginning, this was no longer the case. The average price in June 2022 was €65.5 versus €62.9 for SNCF (+4%). However, the incumbent’s prices decreased by -11% from 2019 to 2022 and were lower by -20% than the average in June 2022. They were lower than the average by -17% in October 2019. Here again, the situation is unexpected with a newcomer being more expensive than the incumbent. We can assume that the competition from Trenitalia was not for the Paris-Lyon segment but certainly more for the Milan-Paris route with higher charges because of its international status.

Train of 11:55

This train is a creation and has the feature of being in almost direct competition with the previous one. The difference is that this service was dedicated to the Paris-Lyon route while the latter was dedicated to the Milan-Paris route. The price is more competitive with the SNCF train at 11:34 and even with the direct competitor Ouigo at 11:55. With two Trenitalia trains within a period of 30 minutes, the pressure could be maximal on the incumbent which has three trains. The prices for the two Ouigo trains increased by 39% between 2019 and June 2022 in spite of the Trenitalia offer being -28% cheaper. This is another singular situation where Trenitalia is cheaper than the low-cost offer by SNCF. It is strengthened by the fact that the incumbent does not seem to move on prices.

Table 6: Compilation of four timetables by type of service and average price from October 2019 to June 2022 on the Paris-Lyon route (part 1 from 12:00 to 21:00).

Period	13:04	13:19	14:04	14:39	15:04	15:08	15:36	15:51	16:04	16:17	16:34	17:04	17:22	17:34	17:52	18:04	18:19	18:38	19:04	19:21	20:00	20:04	20:30	21:04
Oct-19			INOUI	OUIGO	INOUI				INOUI	OUIGO	INOUI	INOUI		INOUI	OUIGO	INOUI	OUIGO	INOUI	INOUI	OUIGO	OUIGO		INOUI	INOUI
	69		91.8	40.8	91.8				81.3	23.3	91.8	91.8		91.8	48	91.8	22.8	91.8	86.5	32.2	28		68.3	45
Oct-21	INOUI	OUIGO	INOUI		INOUI		OUIGO	OUIGO	INOUI		INOUI	INOUI		INOUI	OUIGO	INOUI	OUIGO		INOUI	OUIGO	OUIGO	INOUI		
	49.7	25.6	74.5		76		16	30.2	68		73.9	91.4		79.5	24.1	70.4	22		55	26	21	48.2		
Dec/Jan	INOUI	OUIGO	INOUI		INOUI		OUIGO	OUIGO	INOUI		INOUI	INOUI		INOUI		INOUI	OUIGO	INOUI	INOUI	OUIGO	OUIGO	INOUI	TRENITALIA	INOUI
	47.5	24.5	62		64		20.6	24	60		74.1	85.5		83		66.1	19.8	60.6	62.5	16.8	20	47.3	34.4	43
Jun-22	INOUI	OUIGO	INOUI		INOUI	OUIGO	OUIGO		INOUI		INOUI	INOUI	TRENITALIA	INOUI		INOUI	OUIGO		INOUI		OUIGO	INOUI	TRENITALIA	INOUI
	56.5	43.8	69		72.2	34.5	47.7		80.7		81.2	87	44.5	90.8		92	33.1		74		29.6	61.5	54.5	45

Source: Author

Train of 17:22

The train of 17:22 is a creation, the second for Trenitalia during the peak period with two direct competitors at 17:04 and 17:34. The situation is similar to the morning with a strong price difference between the newcomer and the incumbent (-50%). The average price for the SNCF did not change

much between the initial stage and June 2022, with respectively €91.8 and €88.9 (-3%). Also, the average in June 2022 is higher than the average of the Inoui prices. Consequently, we find a situation similar to the morning with a creation by the newcomer and no specific reaction from the incumbent.

Train of 20:30

Finally, the last train is a creation between the two last trains of the day by the SNCF (20:04 and 21:04). The Trenitalia train is the second to link Milan to Paris during the day. It is interesting to note that it is in a situation similar to its counterpart especially in terms of price. It is more expensive than the average Trenitalia services (€44.6). Also, it is a little bit more expensive than the SNCF with €54.5 for Trenitalia versus €53.2 for the SNCF (+2%).

To conclude this subsection, the train by train price analysis highlights highly diverse situations behind the global trend. We note that all the Trenitalia services are creations and not substitutions of Inoui trains. The reduction of trains by SNCF observed in section 4 does not seem to be directly linked to the Trenitalia offer. In general, Trenitalia is cheaper by -34% than the SNCF, considering the direct trains in competition. There are only two cases out of five where Trenitalia is more expensive. But these trains come from Milan and were the first to run in December 2021. The difference may stem from technical or organisational constraints, making the service costly, as is usually the case for international traffic. Last but not least, the SNCF seems to be quite insensitive to competitive pressure from Trenitalia. It did not change its price significantly under the impact of the new offer and maintained its trains. This result is unexpected regarding the literature and further research would be necessary to take better account of the yield management price strategy adopted by the SNCF, and the occupancy rate. Both types of information are difficult to obtain from the incumbent but as the yield management strategy is based on the price elasticity of demand, we can assume that in the case of a high occupancy rate prices change slowly.

6. Conclusion

The objective of this paper was to explore the first effects on price and frequency of the new competition in open access from Trenitalia in the face of the incumbent, SNCF, on the Paris-Lyon HSL. This topic is of great interest for research and public policies. Firstly, it is a symbol of Europe and the policy in favour of competition implemented since the 1990s by the European Commission. The French network is the last of the biggest in Europe to open up to competition. It is also an interesting case study as the Paris-Lyon HSL was the first to be built in Europe and is well-known to be the busiest HSL with strong limits to infrastructure capacity during peak hours. Finally, this is the first time in Europe that two old national incumbents are competing directly in open access on an HSL. In Italy, Trenitalia was faced with a new company while the Spanish case is different due to the type of competition (tendering) and services with low-cost from SNCF versus traditional services from RENFE (Montero and Melero, 2022).

According to the literature, the expected results were a net effect on frequency by increasing it and on prices by decreasing them in favour of the users. The results highlighted a contrasted situation. First of all, the market positioning analysis showed that Trenitalia started cautiously with two trains in the off-peak period on the international Paris-Milan route via Lyon. It increased its offer during the first six months to reach five trains in June 2022. The three other trains were specific to the Paris-Lyon route and with two being positioned during the morning and the afternoon peak periods. It could be a

strategic move to attract a larger share of demand from business travellers during the peak period. However, the offer remained marginal versus that of the incumbent. Secondly, the analysis of the global trend for frequency and price between October 2019 and June 2022 highlighted an increase by 5% and a decrease by -10%, respectively. This is far from a big bang and the variations are very weak. Regarding frequency, Trenitalia created five new trains and the SNCF removed three Inoui. The detailed analysis showed that the removals were not directly linked to the newcomer and could also be an effect of the COVID-19 pandemic and the evolution of business traveller behaviour. However, it is surprising when considering the Paris-Bordeaux control route where frequency increased by 14%. The incumbent could also be applying a strategy of moderation to maintain its profits through better control of volume in reaction to the newcomer. Whatever the case, the users gained two services on the Paris-Lyon route and a better travel choice. Regarding prices, the results are also limited. We can observe a slow reduction by -10% in total (including Trenitalia offer) between October 2019 and June 2022. The reduction was only -5% for the incumbent in the same period. The prices practised by the newcomer are lower by -30 to -40% (in spite of an increase of 33% between December 2021 and June 2022) than those of the incumbent but there is not enough volume to change the global equilibrium. The train by train analysis confirmed the relative insensitivity of the incumbent to competitive pressure. The prices for the Inoui trains in direct competition with Trenitalia ones during the peak period changed less between October 2019 to June 2022 than the rest of the time. During the morning peak period, the average price for the two Inoui trains in direct competition fell by -3% while that of the two others in indirect competition fell by -12%. However, when we compare the evolution of prices on the Paris-Lyon route to the Paris-Bordeaux control route we observe a considerable difference. The prices increased by 24% on average providing evidence of an economic catch-up effect after the financial loss suffered during the COVID-19 pandemic. Although competition did not move prices down on the Paris-Lyon line, it certainly had a positive effect of moderating price in an inflationary context. Finally, it appears that the SNCF is displaying a wait and see attitude that could belie railway inertia (Froidh and Nelldal, 2015) in the face of competition from Trenitalia on prices but limited regarding frequency. Also, the challenges are considerable for Trenitalia to maintain its competitive pressure. We can see that in its two international relationships where advantages have been obtained in the form of temporarily reduced access charges, prices are similar to those of the SNCF. It will have to find the right equilibrium on the Paris-Lyon route between price, frequency and commercial capacity to offset the progressive reduction of the discount on access charges from the French network manager (-37% during the first year, -16% the second one and -8% during the last one).

To conclude, the implications of this research are several. Firstly, this study is one of the first on the French case. It gives key results on the effect of competition in open access between two major operators and highlights the considerable inertia of the incumbent. Secondly, the analysis proposed an original method based on a dynamic analysis of the timetable and prices train by train. It highlighted the complexity of the reality behind the global trends. Finally, the results open the way to a wider area of research to better assess the surplus of the economic actor and better understand the regulatory process implemented for this competition, the strategy employed by the actor and the challenges of traffic management for the network manager.

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