

Competition models and financial sustainability of high-speed open-access passengers rail operators in Europe

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ABSTRACT

Competition is at the heart of the European Union's (EU) roadmap in the field of transport. In rail transport, competition started late and took time to deploy. Just now, almost ten years after the 4th railway package, competition is becoming a Europe-wide affair rather than a collection of single – and often small and short-lived – national experiences. Today it is possible to draw a first picture of how open-access rail competition will be in the coming years, with a primary focus on the profitability of competition in high-speed market. The paper starts providing an overview of the forms that competition can take in the case of a non-cooperative game between two or three firm and an overview of the varied experiences of “on track” competition in Europe to date, on a country basis. Then the paper focuses on a recent case where the financial sustainability appears to be a serious issue: the entry of the Italian company Trenitalia in France, on the main country's route, the Paris-Lyon. The characteristics of the newcomer's business model are recalled, and its medium-term profitability is studied through a model, emphasizing the role of access charges in it.

1. Introduction

Competition is at the heart of the European Union's (EU) roadmap in the field of transport. Today, it is a reality that has profoundly transformed air transport following the gradual liberalization implemented between 1987 and 1997. Low-cost airlines held more than 30 % of the European market before the Covid epidemic, a figure that has increased since then. In land passenger transport, coach transport was liberalized in the 1990s in Great Britain and Sweden, but became a European-scale phenomenon only later after the opening of Germany (2013), Italy (2014) and France (2015) (Grimaldi et al., 2017; Guihéry, 2019). In rail transport, competition was introduced in the 1990s (Sweden, Great Britain, Germany, etc.), but mainly in the form of tenders and competition “for the market”. Cases of competition “in the market,” with two or more operators operating on the same route, have remained inconclusive exceptions, despite the “great expectations” of EU regulators in this field to transform the European market and support the ecological transition. Reasons for the inertia of rail compared to air and coach markets are well-known: presence of state-owned companies, conservative attitude, friction from former monopolists, high sunk costs, slow rolling stock production, high infrastructure access costs and capital

intensiveness of the market.

But the landscape is now finally evolving. As we will see in this paper, several European countries have experienced open rail access for passengers, and further market entries are expected in the coming years, some of which, especially on international connections, substituting previously cooperative situations.

The benefits expected by the European Union, particularly in its White Papers on Transport (2001, 2011), are numerous. The first one corresponds to the increase in consumer surplus following the fall in ticket prices on the one hand and the increase in volumes on the other hand, via the increase in the number of trains in circulation. A phenomenon which could also increase the revenue of the infrastructure managers and contribute to its overall financial sustainability. The second benefit would come from the productivity gains that rail operators would have to make to accompany the reduction in ticket prices. Thirdly, linked to climate commitments, would be to increase the modal share of trains also in the long-distance segment, which produce much fewer external costs than cars or planes.

In the paper we will adopt two perspectives. On one side we will observe and systematize the impacts for passengers (prices, frequency, comfort, etc.) attributable to direct competition. On the other, we will

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discuss the financial sustainability of non-cooperative competition from an industrial perspective. In fact, while the effects for customers are generally acknowledged as positive, the framework conditions, primarily the level of access charges and demand elasticity, may make direct competition practically unsustainable. Therefore, studying the conditions under which a previously cooperative situations becomes non-cooperative duopolies, is of great interest.

The paper is structured as follows. In [Section 2](#) we propose a review of the literature on competitive and cooperative models in rail and formalise the case of a non-cooperative game between two firms, which is the typical situation of head-on duopolies. [Section 3](#) presents an overview of the relatively few cases of rail competition on the market in Europe. This review allows, in [Section 4](#), to point out the main users' benefits of competition. [Section 5](#) introduces the case study, namely the recent and emblematic case of competition between the French operator SNCF and the Italian one Trenitalia on the busiest high-speed line in Europe: the Paris-Lyon axis. The case is developed empirically by proposing a cost model of the newcomer, aimed at checking its financial sustainability. The concluding [Section 6](#) lets us to return to the lessons of the economic analysis of the duopoly and the evolving nature of the strategies of firms in a monopoly situation.

2. The rail sector from natural monopoly to cooperation and competition

Rail transport is characterized by high fixed costs and correspondingly increasing returns, driving to a typical natural monopoly condition. The low level of marginal costs leads to prices that are structurally unable to cover the average costs. Consequently, in all European countries, this led at the beginning of the 20th century to the creation of national public railway monopolies whose operation required subsidies. During almost all the 20th century, competition disappeared from the rail sector ([Jensen, 1998](#)).

With the arrival of high-speed rail, some major changes occurred ([Campos, de Rus, 2009](#)).

The first was that this new type of service could become commercial and operate without subsidies because the time savings reduced the generalised cost of travel, increasing users' willingness to pay. It then became possible to charge higher prices, particularly during peak hours, and thus capture part of the consumer surplus. At the same time, costs did not necessarily increase thanks to the fact that vehicles and crews can be used much more efficiently, not differently from what happened with low-cost airlines ([Dobruszkes, 2006](#)).

A secondary effect of such increased competitiveness of rail is that fast services open the possibility to establish international connections with high potential demand (London-Paris, Brussels-Paris, Geneva-Paris, etc.), previously unexploited by national railways and left to air transport. In Europe, at the initiative of the two main groups SNCF and DB, fast international connections have been generally operated in cooperation with neighbouring countries' operators. For example, connections between London, Brussels, Amsterdam and Paris were operated by two international companies, Eurostar and Thalys, which have recently merged and in which SNCF is now the majority shareholder. In addition, SNCF operates trains in partnership with DB between France and Germany, with SBB between France and Switzerland (Lyria). The same does DB with SBB, OEBB, CD for connections to Switzerland, Austria and Czechia, respectively. Similar collaborations have been established by SNCF with RENFE and Trenitalia on their respective markets, but they did not work very well and ended as soon as the two southern railways wanted to enter independently the French market in open access.

To develop international rail connections, cooperation between national rail companies is the less risky way to reach the break-even point. Formally, it consists in studying a cooperative game ([Albalade et al., 2015](#); [Rategh et al., 2022](#)). As these commercial connections are not subsidized, the costs must be covered by the ticket prices. Consequently,

the break-even point depends on an inverse relationship between revenue per passenger and the occupancy rate. [Fig. 1](#) shows the different combinations between these two variables. The entire area below the blue curve corresponds to a zone of losses for the incumbent operator (or the cooperative service), the area above the curve being that of profits.

For example, if the load factor is 100 % (all seats occupied), the break-even point is reached if when the revenue is equal to the cost. But as soon as the occupancy rate drops, the ticket price per km must be multiplied by a coefficient which increases rapidly: 1.25 if the occupancy rate is only 80 %, 2.5 for 50 % and 5 for 20 %.

The break of cooperation or of the monopoly by a newcomer changes these conditions into a competitive game ([Raturi and Verma, 2019](#); [Bergantino and Madio, 2020](#); [Ma et al., 2021](#)). If the newcomer has lower costs than the monopolist, its break-even curve will shift down and right. For example, with costs 20 % lower, the newcomer can run trains emptier (from 60 % to 43 % in the example) or offer 28 % cheaper rates, or any of the intermediate combinations.

If the demand is perfectly elastic (or more realistically, if there is a lot of latent demand), the newcomer finds its equilibrium benefiting the users, but without harming the incumbent, that will keep its load factors and revenues. However, if demand is limited, the risk is that the occupancy rate decreases for each operator. As a consequence, given that costs are largely fixed, both operators must increase their prices to reach their break-even point, thus running the risk of seeing customers prefer the other operator. Competition, which should lead to lower prices, will therefore not always achieve this objective, but the opposite, which is what already old economic literature reminds us.

Due to the risk of having too many operators, the number of players in head-on competition is most often limited to two, three in just two cases in Europe. Even we commonly refer to this non-monopolistic situation generically as "competition", it would be more appropriate to speak about "duopolistic competition", a situation well described by economic theory. Synthetically, three forms of duopoly exist, linked to the names of Cournot, Stackelberg and Bowley. The model proposed in 1833 by A. Cournot (1801–1877) assumes that two companies produce the same good but that each ignores the choices of the other. Each company will have to anticipate the positioning of the other. It therefore anticipates a "reaction function" of the competitor by acting mainly on the quantities produced. From this perspective, the price is not the key variable, which is just the result of the volume of production chosen. The result of these strategies will depend on the evolution of overall demand and therefore on the price elasticity of demand. If demand is not very elastic, the Cournot equilibrium does not lead to an optimal situation, it is an unstable equilibrium which can lead to exit from the market for one of the firms, or to recurring losses for a company, or even for both.

A century after the Frenchman Cournot, the German H. von Stackelberg (1905–1946) became interested in the unstable nature of duopoly equilibria. For this, he started from the hypothesis that competition between two firms is asymmetrical, one being considered as a "pilot", the other as a "satellite" adapting to what it thinks is the strategy of the pilot firm. But the result of the choices is not definitive, because the behaviour of both firms is adaptive. For this reason, Stackelberg emphasizes the multiplicity of possible equilibria and their unstable nature, which could lead, as with Cournot, to an exit from the market for one of the competitors ([Stackelberg, 1935](#)). In his 1946 textbook, Stackelberg states that "duopolies are markets without equilibrium" (*gleichgewichtlose Marktformen*).

Extending Stackelberg's pessimism, the Englishman A. Bowley (1869–1957) put forward more radical conclusions than Stackelberg. If both duopolists simultaneously choose "pilot" behaviour to force the other to adapt, then a price-war occurs, leading to a situation of overproduction. Two solutions are then possible: bankruptcy or cooperation, for instance through a cartel.

With these three authors, we have, more or less explicitly, a critical analysis of the potential perverse effects of duopolistic competition. As J. Chamberlain and J. Robinson have also shown in their work,

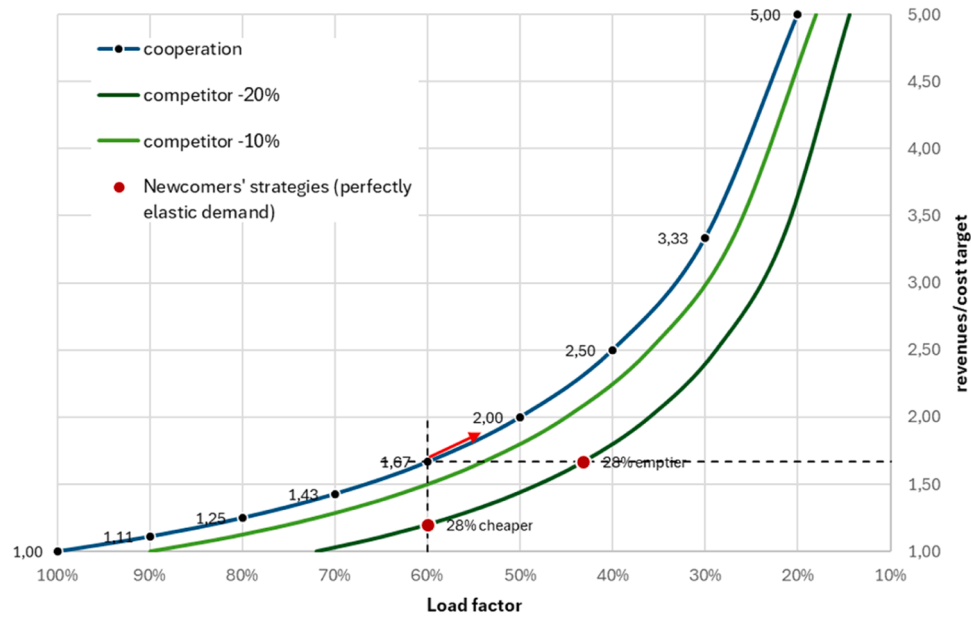


Fig. 1. Relation between load factor and revenues/cost ratio under cooperation and in presence of competition.

competition can turn out to be negative for the community, particularly when there are increasing returns.

The question is therefore why Trenitalia and RENFE, but also SNCF, decided to abandon cooperation. For the first two, the main reason is the desire not to be limited to cross-border connections and not to be dominated by SNCF. The latter, in fact, entered into competition with RENFE on domestic Spanish lines in 2021. Trenitalia did the same in 2022. SNCF also announced its entry on the Italian high-speed market by 2026. The opening to competition on domestic lines therefore marked the end of the cooperative game between the three companies. The question now is to know whether by abandoning cooperation in favour of competition, Trenitalia, RENFE and SNCF can obtain convincing results (financially sustainable and/or socio-economically beneficial), which means if it will exist a new equilibrium and if it will be better off for the customers. Before addressing quantitatively this question in Section 5 through the case of the Paris-Lyon route, let us take the time to provide an overview of competition in the rail passenger transport market in Europe.

3. Panorama of “on-track” competition in passenger rail transport in Europe

Rail competition in Europe is far from being a homogeneous phenomenon that literature has tried to categorise. Tomeš (2022) significantly divide existing cases of competition between intensive and niche operators. Intensive competition is characterized by a) high frequencies offered by the competitor, that however does not reduce the supply of the incumbent, b) initial fares decrease because of additional capacity, but soon recovered by the rise of demand and load factors, without the occurring of a price war, c) newcomers bring new models of supply (e.g. new services) and focus on quality, d) non negligible market share of the newcomers. Niche competition presents different characteristics: low frequency, low market share and low yields. In general, in a niche, the incumbent is not challenged in its industrial and strategic choices, generally resulting in unchanged capacity, prices, quality and network.

Perennes (2017) describes four models: “greenfield good service quality entrants” (companies challenging incumbent in terms of quality and price on main routes), “low-cost, low-quality operators” (competing on prices), “niche markets” (operators on small routes unserved by the incumbent) and “companies offering otherwise a franchised service” (open access services provided by franchise companies in addition to

their contract). Most of observed cases belong to the low cost or to the niche models, but their survival rate is low. Conversely, the few cases of “greenfield good service quality entrants” seem to be more sustainable in the long run.

Beria et al. (2023) is proposing a more articulated classification, based on the supply model (the product of the newcomer, including niche, intensive, HS, conventional, etc. categories, not much differently from the outcomes of the previously mentioned authors did) and on the “focus of competition”. This second dimension is related to how competition deploys, or what is the (main) object of competition, among price, quality, frequency or network development (in the sense of new connections, not supplied by the incumbent).

The idea that competition is not necessarily focusing on prices, as occurred in other industries, is already well settled in literature. Laroche and Lamatkhonova (2022), in fact, distinguish between cases of Bertrand competition (price) and cases of Cournot competition (quantity) and Ristić et al. (2022) deepens the analysis showing, through a theoretical model, that operators compete in the number of offered seats rather than in frequencies.

Without claiming to be completely exhaustive, we look at the emblematic cases of 11 countries that have experimented competition in the market, most often with two or even three competitors, and typically on a major route. Table 1 shows the operators involved in open-access and the market share of new entrants. The sixth column distinguishes the type of competition between niche and intensive competition. The last summarises the main barriers to entry, today typically no more of legal nature, but due to market or network conditions.

We can draw some comments from real world cases. Firstly, the incumbents are in competition with each other in few (recent) cases, while the role of the new entrants must be emphasized. Initially, these were newly created private companies, often small in size, trying to make a place for themselves on busy routes or by offering services abandoned by the incumbent operator (e.g. night trains). Among them, the two leading German operators HKX and Locomore, the Italian Arenaways and the Swedish Blå Tåget have all disappeared from the landscape. Since then, larger firms have appeared, such as NTV and Flixbus. But for operators entering a rail market is no guarantee of success. In the coming years, there will be new entrants but also exits from the market exactly as has been observed for air transport (Budd et al., 2014) or for coach transport (Crozet and Guihéry, 2018). Recent entries are of different nature because coming from some of the national public incumbents trying to

Table 1

Eleven cases of rail competition in Europe. Market shares refer to the entire domestic traffic, in pax.km.

Country	Competition scope	Direct competitors	Market share of non-incumbent new entrants (2022)	Market share of foreign incumbents (2022)	Competition type	Barriers
Italy	Network of HS and mixed-HS services	Trenitalia	19.8 %	0.7 %	Intensive	Severe lack of additional capacity on the main lines
Austria	Mainline competition	NTV Westbahn	12.0 %	0.04 %	Intensive	Diffused presence of PSOs. Rigid regular timetable
Czech Republic	Network of conventional services	ČD RegioJet Leo Express	18.83 %	0 %	Intensive	Diffused presence of PSOs.
Sweden	Mainline competition	SJ MTR Flixbus	5.7 %	43.5 %	Intensive	Diffused presence of PSOs.
United Kingdom	Niche point-to-point services	LNER	n.a.	n.a.	Niche	Limited room available due to franchising model.
Germany	Network of conventional services	Hull, Grand Central DB Flixbus	13.88 %	6.52 %	Niche	Diffused presence of PSOs. Rigid regular timetable. Capacity constraints.
France	Mainline HS competition	SNCF Trenitalia	0 %	0.5 %	Niche → Intensive	Incumbent's low-cost brand Ouigo lowering margins
Poland	Niche point-to-point services	PR PKP, THE	37.6 %	0.3 %	Niche	Diffused presence of PSOs.
Slovakia	Network of conventional services	ZSSK RJ, LE	5.53 %	0 %	Niche	Diffused presence of PSOs. Free transport for large parts of the population, if using the incumbent.
Romania	Niche point-to-point services	CFR Astra, Softtrans	15 %	0 %	Niche	Diffused presence of PSOs.
Spain	Network of HS services	RENFE Ouigo (SNCF) Iryo (Trenitalia, Globalvia, Air Nostrum)	0 %	6.7 %	Intensive	Capacity has been allocated competitively.

Source: Sources: Tomeš (2022), IRG-Rail (2024) and updates by the authors.

expand themselves abroad. The most active is, to date, Trenitalia, with the Spanish brand Iryo, Trenitalia France in France, the franchise Avanti West Coast and the purchase of the Greek Hellenic Train. Equally active is Renfe, to date entering in France from West and taking over the Czech operator LeoExpress and entering into the new Italian company Arenaways, recently refounded. SNCF is leading Eurostar that merged with its direct competitor and becoming monopolist for the cross-Channel connections. Central European incumbents, east of DB (included), look more conservative, continuing their “tradition” of closed domestic markets and collaborations for the international ones.

Information on prices is more difficult to be obtained. An exemplification of prices on selected routes during Autumn 2019 is proposed in Table 2. Prices on the routes in competition are significantly smaller than for similar routes in monopoly (e.g. Milan-Rome vs. Madrid-Barcelona, similar distance). Moreover, with the exclusion of the Stockholm-Gothenburg, also the price excursion, that is the difference between the percentiles and the average, are smaller for the other competitive routes (Beria et al., 2023).

The following paragraphs provide a snapshot of the situation at a given moment in some of the countries presented in Table 1 and enriched with data to bring out some basic trends.

3.1. Czechia

In this country, rail transport accounts for 6.3 % of passenger-kilometres in 2021 (Statista, 2024). New entrants hold nearly 20 % of the entire market through their intensive presence on two major lines. Prague–Ostrava since 2011 and Prague–Brno since 2016, and on other minor connections. For the rest of the Czech rail market, the incumbent ČD is the sole reference operator (Tomeš and Jandová, 2018 and Tomeš et al., 2020).

Prior to 2011, only ČD operated the Prague–Ostrava route, with high fares and the use of subsidies despite high traffic density. In September 2011, the entry of RegioJet coincided with the end of subsidies. In

January 2013, also LeoExpress entered the market and since then, the three operators have been competing on prices and services (Tomeš and Jandová, 2018; Tomeš et al., 2020; Fitzová et al., 2021), but especially on the quality of the service on board (the journey takes at least 3 h and 15 min between Prague and Ostrava, and 2 h and 40 min between Prague and Brno), as this is not a high-speed route. The main results of the arrival of new operators are the following.

- The capacity offered has increased. The number of available seats per day increased from 10,687 in 2010 to 14,594 in 2016 (Tomeš and Jandová, 2018 and Tomeš et al., 2020), but there are now no trains after 11:00 p.m., whereas the former ČD offer provided a late-night connection. Empty trains do not interest operators. In 2018, the average weekly frequency of trains between Prague–Ostrava was 370 for ČD, 152 for RegioJet and 112 for LeoExpress. These figures also reveal the limitations of the saturated infrastructure.
- Ridership has increased significantly. From 2011 to 2017, the number of travelers doubled: 7.5 million starting from 3.7 million. On the routes under competition, ČD has about 41 % of the market, RegioJet 44 %, and LeoExpress about 15 % (Tomeš and Jandová, 2018).
- Average ticket prices have fallen on average, but fare modulation according to the intensity of demand leads to a fairly large gap between call prices and the full fare. Tomeš and Jandová 2018 comes to the conclusion that fares on the Prague Ostrava segment are the cheapest on the market in Europe, in the range of €0.03 per km.
- The level of infrastructure access charges remains very low in the Czech Republic, and is among the lowest in Europe, at around €1 per train.km (for reference, Germany is at €6 per train.km and France at €5 for conventional lines).

Overall, the Czech example, presented as a model of its kind, offers a mixed record. The quality of service has improved, prices for customers have fallen by 44 % between 2011 and 2014, and better frequency has

Table 2

Comparison of prices in €cent per km, selected routes (in competition / no), autumn 2019.

Connection	Company	Distance	10 th percentile	average price	90 th percentile	Price excursion (90th/10th)
Madrid-Barcelona	Renfe	617	10,69	15,40	20,43	1,9
Milan-Rome	Trenitalia	565	10,62	11,59	13,81	1,3
Milan-Rome	Italo/NTV	565	7,96	9,71	12,39	1,6
Stockholm-Gothenburg	SJ	447	6,26	12,90	21,70	3,5
Stockholm-Gothenburg	MTR Express	447	4,77	10,14	17,67	3,7
Paris-Lyon	SNCF	432	10,43	18,85	22,48	2,2
Paris-Lyon	OUIGO	432	3,71	8,33	14,37	3,9
Prague-Ostrava	České dráhy	347	2,08	3,70	4,45	2,1
Prague-Ostrava	RegioJet	347	2,08	3,58	4,39	2,1
Prague-Ostrava	Leo Express	347	1,42	3,57	5,62	4,0
Vienna-Salzburg	ÖBB	296	6,08	13,52	17,79	2,9
Vienna-Salzburg	Westbahn	296	4,80	7,35	9,28	1,9

Source:Source: elaborations on Beria et al. (2023).

been observed. But the infrastructure manager is faced with delicate trade-offs with the services financed under the public service obligations. Finally, competition is not a guarantee of profitability, on the contrary. The incumbent operator was already making losses in 2012. By 2015 they had almost tripled to 7 % of revenues. Only RegioJet is making a profit (6 % of sales). LeoExpress has reduced its losses since 2012, but they remain high, at almost one third of revenues and has been recently taken over (50 % majority) by the Spanish incumbent Renfe.

3.2. Germany

Germany has made a promising start in long-distance rail open access with, among others, an Interconnex Leipzig–Berlin–Rostock link and a Cologne–Hamburg link that started in July 2012 by HKX in 4h20min. But the rise of intercity coaches (Flixbus primarily) liberalized in 2013 in Germany, and the COVID crisis, have greatly thwarted this development.¹ The Interconnex route was closed in 2014. In 2017, a small German company, Locomore, which operated a daily route between Berlin and Stuttgart, filed for bankruptcy. Interestingly, in March 2018, this connection was taken over by Flixtain, in its strategy of expansion in Germany, substituting most crowded coach routes with trains.

According to MOFAIR (2023), the German association of new entrants in the railway sector, DB will have only 58.5 per cent of the regional passenger rail market by 2023. In contrast, in 2023 it will keep 88 % of total long-distance traffic. The remaining operators, mainly the extensive but relatively infrequent network (Fig. 2) developed by Flixtain, account for barely 4 % of the market. New entrants have difficulties in obtaining rolling stock and relevant long-term train paths because of “latent discrimination” by DB, MOFAIR tells us. In addition, the financing needs of new entrants are high, especially in high-speed rail, so that there is no competition in Germany in this segment, but MOFAIR (2023, p.30) mentions that “there is a strong growth potential in long distance rail transport. All of this is likely to become more complicated with the introduction of the “Deutschland-Takt” – a nationwide train schedule – planned by DB in the next few years (2030 +).

In Germany, energies are currently being absorbed by a vast infrastructure renovation program, with spending of almost €10 billion both in 2022 and 2023 (between 2011 and 2023 €91 billion have been invested by the Bund). Added to this, there are discussions on the future of the 49 € Deutschland-ticket, which has met a great success in Germany, but that has a distortionary effect on the medium-distance relations damaging open access operators. In summer 2022, around 52 million of the former 9-euro tickets were sold. The budget for 2023 is 3 billion €, 1,5 billion from the Bund and 1,5 billion from the Länder. Budget for 2024 is in discussion between Bund and Länder: one more

billion € has to be financed.

3.3. Austria

In 2011, the new entrant WESTbahn entered the Austrian market with an offer between Vienna and Salzburg that was 50 % lower in price than the incumbent ÖBB. In parallel with a price war, and as economic theory teaches (see below), WESTbahn’s strategy was to increase frequencies (from 29 connections per day in 2011 to 58 per day in 2018) before reducing this figure because of the pandemic. ÖBB’s and WESTbahn’s offerings are today comparable: 420 weekly connections in 2018 for ÖBB versus 406 for Westbahn.

Between Vienna and Salzburg, between 2011 and 2016, prices fell by 25 % and passenger numbers rose by 25 % (CRNI, Regulatory approaches to rail competitive entries, Tomeš, 2022). The motorway solution between Vienna and Salzburg has seen a sharp decline in traffic between its two metropolises.

The quality of service has also improved. For example, WIFI was introduced by ÖBB in all its trains after its competitor.

The Austrian example also reveals some of the limitations of open access: new entrants concentrate on the most profitable routes, as shown also by the recent extension to Munich. There are many conflicts for train paths and the newcomer does not participate to fare integration. Ticket distribution is fragmented. Connections to regional trains are not provided by the new entrants, so an integrated national timetable plan is no more possible.

3.4. Italy

Italy is today the largest case of open access rail competition. Until 2001, rail transport in Italy was operated by a vertically integrated monopoly, Ferrovie dello Stato (FS). At that time FS was split into functional companies, the two main ones being RFI (the network operator) and Trenitalia (the railway operating company). The liberalization of services started officially very early, in 2003, but its effects occurred years later. A first niche operator – Arenaways – started in 2010 but was wiped out by Trenitalia’s legal resistance and the absence, at the time, of an independent regulatory agency.

A second, much larger company – NTV – started operations in 2012 under the *Italo* brand. Unlike any other European experience, from the outset Italo thought “big” with an investment of several billion euros for 25 new high-speed trainsets. Italo now has 1400 employees and has doubled its fleet to 51 trains, with further expansions planned. The initial idea was to be the premium company in Italy, with better trains and services. However, soon after its entry, it became clear that Trenitalia would not remain idle.

The incumbent increased its frequencies and improved the customer experience and fleet, outperforming Italo in all metrics and thus maintaining its market leadership (including a 10–20 % price premium; Beria et al., 2019). NTV survived, but did not achieve the expected returns and

¹ Germany had 43 billion long-distance trips in 2019, compared with more than 60 billion in France.



Fig. 2. FlixBus's rail network in Germany and 2024. Interestingly, FlixBus has started cooperating with regional operators to expand its catchment area.

struggled financially until 2015, when two events occurred.

The first is that rail access charges were reduced from an average of 12.8 €/trainkm to 8.2 €/trainkm (Desmaris and Crococolo, 2018). The overall increase in ridership and trainkm generated by competition compensated for this reduction, but it is likely that a political input was also present. The second was the overhaul of NTV's strategy, which substituted a "low-cost" logic for its initial ambition for premium service. This has enabled it to expand its offer, load factors and revenues.

Initially focusing on the Italian backbone line (Turin— Milan—

Rome— Naples), Italo has gradually opened other routes to Venice, Verona and Brescia. In 2018, the first east-west link was opened between Turin and Venice (Shtele et al., 2024) (Fig. 3). During Covid the network was further expanded South, operating between Bari and Rome and between Naples and Reggio Calabria). Interestingly, these extensions are conventional services because there is no HSR line. Been conceived to use trainsets during low-demand pandemic, these connections remained active since 2022, showing that there was room for market operations also in the South, despite the competition of PSO trains and the absence



Fig. 3. Map of NTV services in 2020, before Covid.
Source: P. Beria.

of HS lines.²

From a market point of view, Italy's competition is intense. In most cases, the new entrant's offer in terms of frequency and seats is

² While the Naples-Reggio Calabria line is well performing, with speeds ranging from 120 to 180 km/h, the Caserta-Foggia section of the Rome-Bari line is particularly slow. The new HS line is under construction and expected to be partially opened after 2026.

comparable or slightly lower than that of the incumbent. Considering that both operators report high load factors (>70 %), the actual market share should be similar to that calculated for the offer. For example, on the Milan–Rome route, Italo had 33 % of the trains in 2019, now increased to about 40 %.

Among the main ones, the route where Italo is weakest is Milan–Venice, operating in 2019 only 20 % of the trains. The latest available aggregate data for demand refer to 2017 (shortly after the strategic repositioning) Italo was then operating 24.4 % of the trains in the

market or 20.5 % of all long-distance trains or 9.9 % of the total Italian rail market (Beria et al., 2022). These figures have since increased further.

The effect of competition on prices is quite clear. Italo, after 2015, is almost systematically cheaper than Trenitalia by 10–20 % depending on the route and period. Moreover, in early years, a decrease of Trenitalia prices by 30–40 % has been reported. However, these figures are often difficult to interpret because of the significant modulation of prices over time. A recent study related to the opening of the Milan-Venice route (Beria, and Shtele et al., 2022, 2024) used a difference-by-difference approach, estimating a 21–26 % reduction in Trenitalia fares for advance bookings between 2 and 10 days.

The most original point of the Italian experience is the good financial situation of the two operators, on the one hand due to a relatively high train load factor and on the other hand thanks to the lower level of infrastructure fees. NTV lost €6 million in 2015, but in 2016 the profit was already €33 M, and it rose to an astonishing €151 M in 2019. Trenitalia's profits (all activities combined, however) were already over €250 M in 2017 and 2018 but further rose in 2019 to €385 M. Despite the epidemic, 2020 remains positive for NTV but is negative for Trenitalia (including all global businesses, not only Italian long-distance ones), thanks, like elsewhere in Europe, to the received extraordinary subsidies. Post-Covid data is still scant, but the last available financial statement (2022) reports a margin of 118 M€ for NTV. Thanks to these good results, in 2024, the shipping company MSC has acquired a share of 50 % of NTV for about 2b€.

3.5. Sweden

Sweden was one of the first countries to experience head-on competition (Alexandersson and Rigas, 2013), but for a few years entry was limited to small niche operators (Fröidh and Nelldal, 2015), such as Blå Tåget. At the same time, Sweden has developed competition for the market through tenders. Given the country's geography, these services also include medium-distance connections, such as Göteborg-Malmö operated by Öresundståg. Tenders have been done extensively since 2010 and the last direct award was during 2018–2020 for the Jämtland-Stockholm night route (Transportstyrelsen, 2024). Since then, all PSOs are tendered competitively.

Sweden's special regulatory framework is unique in Europe and allows open access on any route, provided that no financial compensation is required, even in presence of a PSO. Given that infrastructure charges are low in Sweden, this means that in principle an operator can also enter the (inter)regional markets, including short, subsidized routes. This has actually happened on some routes, both entirely operated on a commercial basis or by one commercial and one PSO. The first case is limited to the Stockholm-Gothenburg main line, where the use of fast rolling stock makes it possible to exploit the link's characteristics (Vigen, 2017). On this route, since 2015, a new entrant has been operating passenger trains: the Hong Kong-based private company MTR Express. Despite the facilities offered by the Swedish market, MTRX has encountered some resistance, in particular they have been denied ticket sales via the platform of the incumbent operator SJ. The Swedish Competition Authority (SCA) did not consider this platform to be an essential and non-duplicable facility. More recently, in May 2021, FlixBus also began operating on the line, creating the second case of a "tripoly" in Europe after the Czech Republic, reaching a share of 8.5 % in terms of frequencies. However, FlixBus ceased operations during 2024. In the same year, MTRX was sold to VR Group, the Finnish Rail operator.

The three companies are deploying different strategies. SJ uses faster tilting equipment, while MTRX operates with new, comfortable but conventional trains. The maximum speed of both is 200 km/h. FlixBus replicated the model already adopted in Germany, with higher seat density and longer trains running off-peak, slower, and with more frequent stops, for a 3.5-hour trip. On the other hand, the average and

maximum prices are much more practical (see graph).

The effect of MTR entry on incumbent's prices was studied in depth by Vigen (2017). He found that SJ's prices fell by an average of 12.4 % on the Stockholm-Gothenburg route one month after MTRX entry. Surprisingly, the decline is more significant near departure and slightly less (less than 10 %) one month ahead. Current prices, before FlixBus exit, were almost perfectly aligned (Fig. 4). The Swedish case provides useful insights into the long-term profitability of the market. While SJ, with a much larger market, has not suffered losses (but has surely reduced line revenues), MTRX is making losses since the beginning of operations, probably impacted by the entry of FlixBus.

3.6. Spain

Spain is a unique case with respect to the previous ones. While in most countries head-on competition is a matter for companies and regulators, in Spain the main player has been ADIF, the network operator. The process is described by Montero and Ramos Melero (2022).

Given the low level of traffic on Spain's huge HSR network, ADIF was obliged both to attract new operators and to comply with EU requirements for market opening. Informal consultations with potential entrants suggested to ADIF that there was not enough capacity to accommodate all of them and that they would have chosen the Madrid-Barcelona route in a classic cherry-picking manner.

This risk was used by ADIF as a "pretext" to define a different model from the open-access model adopted, for example, in Italy. ADIF designed an optimized schedule for the three busiest high-speed corridors (Madrid-Barcelona, Madrid-Valencia & Alicante, and Madrid-Seville & Malaga), increasing the available slots by 60 %. 70 % of this optimized capacity has been divided into three lots of different sizes, to be awarded competitively to the candidates.

The main criterion for the bid was an *ex-ante* share of slots used as proposed by Crozet and Chassagne (2013): the more a candidate committed to use the lines, the higher the (guaranteed) revenue for ADIF. The remaining 30 % capacity, not included in the framework agreements, is free to be transferred on request to any applicant, including a fourth company not participating in the tender. In this way, ADIF has optimized the use of the network, obtained guaranteed revenues, stimulated competition, and avoided cherry-picking and left open the possibility of further entries.

The outcome of the tender is known: lot A (86 % guaranteed on 60 % of available slots) was won by RENFE, which will reduce its market share, but will nevertheless increase its services by 10 % compared to the past. Lot B (70 % of 30 %, i.e., 40 slots) goes to Iryo, the result of a joint venture between the Italian incumbent Trenitalia and the airline AirNostrum. The remaining Lot C (100 % of 10 % of capacity, or 13 trains/day) went to OUIGO, the low-cost brand of SNCF.

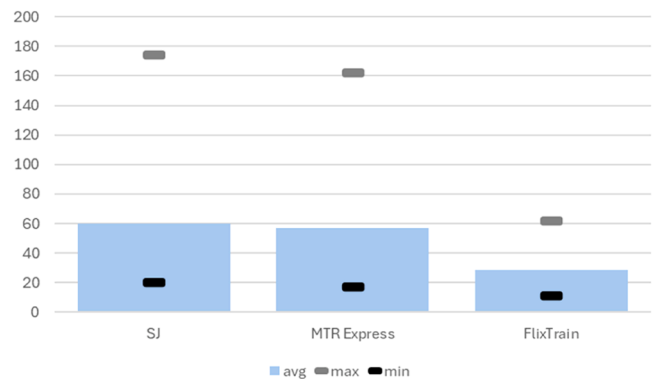


Fig. 4. Comparative price indices (€) on the Stockholm-Gothenburg route (Spring 2023).

Source: authors' elaborations.

The impacts of the entries have been recently collected in a report (CNMC, 2024). In 2023 the total number of passengers on the long-distance segment stepped-up to 41 million, about 25 % more than 2022, but also of pre-covid numbers. Overall, the prices fell significantly thanks to the additional seats capacity. On routes with all three operators (and four brands, comprising AVLO, the low-cost segment of RENFE), the average revenue of the companies fell by around 40 %. A smaller impact between 10 % and 24 % has been measured on routes with just two companies of recent entry, in the Southern Corridor.

The Spanish case is significant also because of the size of the investment. For example, to develop its offer in Spain, SNCF has invested €650 million, nearly fifteen years of its current turnover. Nothing of such size has been observed in Europe except Italy, showing the importance of the barrier to entry effect that the startup of an intensive competition constitutes.

3.7. Out of Europe

Open-access rail liberalisation is mostly a European phenomenon. The only comparable situation is in South Korea, where since 2014 an independent operator, SR Corporation, is providing services in competition with Korail on the HS network. India has opened its market since March 2024,³ but to the only services in operation (Tejas Express and Vande Bharat Express) are actually participated or owned by Indian Rail itself. Other countries are planning to open their network through open-access, the most advanced being South Africa, Malesia, Tanzania.⁴ However, even if in principle this is both for passengers and freight, it is more likely that freight will be first due to the current limited passenger demand combined with low performance of lines.

A separate chapter is US, where no open-access exists or is planned, but where a large newcomer entered the market by *building* and operating new lines. It is Brightline, currently operating in Florida between Miami and Orlando, but planning extension to Tampa and building a new separate line under the same brand between Los Angeles suburbs and Las Vegas.

4. Barriers, impacts and limits of head-on competition

The idea of opening markets to competition is based on its expected benefits to the consumer, namely lower prices and improved quality of service leading to an overall increase in volumes (EC, 2024). Such results have been seen in air transport or telecommunications, but not in the energy sector, even before the current price surge. What about rail transport?

The first observation is that competition is still scarce, despite many years having passed since the 4th railway package. The point is that rail is particularly rich in barriers to entry (Knorr and Eisenkopf, 2022). At least three problems limit the actual competition: the availability of train paths, the interoperability of rolling stock and the extreme capital-intensiveness of the industry. The European rail packages have aimed to remove these obstacles by promoting independent infrastructure managers and by introducing a single signaling standard, the ERTMS (European Rail Traffic Management System). However, their implementation has been very slow and only on some networks, such as the French one. It is easy to imagine the reason for this. The capital intensiveness is an additional structural problem, whose effect is not effectively mitigated by regulatory strategies such as normative simplification or by the promotion of a secondary market for rolling stock in a perspective of ladder of investment (CERRE, 2024).

Where head-on competition exists, it has almost always lowered average fares for users and raised quality, frequency and ultimately patronage (EU, 2024). However, price effects are difficult to be

quantified because of complex fare modulation mechanisms adopted by players and difficulty in creating adequate counterfactuals (Shtele and al, 2024). *Yield management* has a cost for the customer. The price of a ticket varies by as much as four times depending on the operator and the time of travel, as shown in Table 2 for Sweden or France. Yield management is not used only under competition and contrary to popular belief, for example, high speed travel in France may be very affordable according to travel time and advanced purchase. To travel with RENFE from Madrid to Barcelona, prices vary from 41 to 141 € on July 2024. The OUIGO fare on the same line is 9 €. Beria et al. (2023) have observed that the main price-effect of competition with respect to profit maximising monopolists is not a clear average price differential, but a lower price excursion during demand peaks.

When effective, competition is forcing the incumbent operator to reduce its costs and rethink its organization (Álvarez-SanJaime et al., 2016; Cantos-Sánchez et al., 2023). This was the main objective in Italy, and it has certainly been successful, as evidenced by Trenitalia's strong profitability and capability to expand abroad. In a way, this is what has happened in France through the experiment of OUIGO that can be seen as an anticipation of the opening to competition. Here we have the main positive effect of competition, challenging the inertia and under-productivity of monopolies.

Cost reduction, however, might not be sufficient. Despite the efforts of the companies, profitability is not guaranteed (Broman and Eliasson, 2017; Knorr and Eisenkopf, 2022; Börjesson et al., 2021). Competition is eroding margins and many operators are losing money. Excluding the Italian company and RegioJet in Czechia (after many years) and possibly Flixbus, all other newcomers are suffering losses, as expected by Stackelberg. The recent Spanish case, even if still too recent for a definitive assessment, shows that competition might, under some conditions, lower prices to an unsustainable level for the operators (EC, 2024; CNMC, 2024).

Before liberalization takes place, a typical argument against direct competition and more in favour of an administered competition or even cooperation, is the practice of cherry-picking. To limit losses, new entrants often focus on the busiest and most profitable routes rather than on "new" or thin routes. Competition is therefore not a universal solution; it is a lever for change, but it cannot replace a national and regional policy with ad hoc financing.

The considerations on financial sustainability of head-on competition cannot, however, be considered complete without considering the level of infrastructure charges, which vary significantly across Europe (Table 3).

Rail infrastructure pricing, in fact, can be a way to facilitate the entry of new operators or, conversely, an insuperable barrier for them. In Sweden, the Czech Republic, but also in Spain and Italy, rail infrastructure charges are not intended to cover all costs, including investment, contributing to lower access charges, all the rest equal. In a way, open access requires the community to subsidize the infrastructure, sometimes to a large extent, as full cost recovery would likely prevent many entries. This choice might even be beneficial for the infrastructure

Table 3

Average Access Charges per non-PSO services. Selection of EU countries, year 2022.

	TAC per Non-PSO services
	[Euro/train.km]
AT - Austria	2,33
BE - Belgium	18,50
CZ - Czech Republic	0,57
FR - France	19,23
DE - Germany	7,47
IT - Italy	4,41
SK - Slovakia	1,65
ES - Spain	9,14

Source:Source: elaborations on IRG-Rail (2024).

³ <https://www.railway-technology.com/features/private-rail-india/>

⁴ Source: TRA Consulting.

manager if allowing for a better use of capacity (CNMC, 2024). On the opposite side, the French logic of full cost coverage “protects” taxpayers, but constitutes a difficult-to-overcome barrier potentially capable to kill competition in the cradle. In this sense, the recent entry of Trenitalia in France is emblematic, as we will discuss in deep in the next section.

5. The Trenitalia entry on Paris-Lyon: case study

The French railway landscape has changed radically with the reforms set up after the election of Macron as president of the republic (2017). The French government has implemented successfully the fourth EU railway packages of the European Union and has launched an ambitious “new railway pact” (2018), increasing funding but entailing competition both through open-access and tendering.

In order to improve the rail service offered to the 4 million French passengers that used railway every day, new public subsidies in the rail and signal infrastructure have been decided: over 10 years, €3.6 billion will be invested each year (2017–2026). A new special framework for all railway employees has been set up that solve, among other questions, issues of transfer of SNCF staff to rail newcomers. In order to simplify and streamline the organization of the SNCF, its three public establishments - SNCF, SNCF Mobility and SNCF Network - will be merged into a national company with public capital, wholly owned by the State, on January 1, 2020. This new SNCF will have two wholly-owned subsidiaries: SNCF Mobility and SNCF Network.

On the side of competition, the first non-SNCF regional trains will be operated by Transdev only in July 2025, but in a lot of French regions the local deciders do not agree with the tendering rationale. For Paris region, some exceptions have been set up and competition will be compulsory just in 2034 (Transilien network) or 2040 (RER network).

The effects of the EU and domestic reforms on open-access have instead deployed faster and started from the very core of French high-speed market: the Paris – Lyon line, one of the busiest in Europe. The SNCF offers various services there and since December 2021 is directly challenged by Trenitalia France, a subsidiary of the Italian incumbent. We will therefore begin by recalling the heterogeneity of the SNCF products, then we will look at the offer proposed by the competitor Trenitalia for a homogeneous good: the sole direct Paris-Lyon route on the high-speed line (429 km). We will then try to evaluate the gains in consumer surplus following the arrival of the new entrant. Then, to be complete in terms of welfare analysis, we will also assess the chances for Trenitalia to reach the break-even point and therefore to remain on the market for the long term without losses.

5.1. The Paris-Lyon market

There are multiple ways to go by train from Lyon to Paris. To embrace the whole specificities of the market, SNCF offers travellers heterogeneous services, depending on their willingness to pay and their value of time.

The bulk is the high-speed service (called INOUI) which connects Lyon-Part-Dieu to Paris in 1h55. More than 20 round trips per day are offered at prices which also vary greatly. Since the launch of the service in 1981, the practice of yield management has been at the heart of the SNCF high speed business model. The price variation in second class is capped by the Ministry of Transport, but it can range from 1 to 4 times. For first class, prices are free. It is important to note that these services operate without subsidies, neither for operation nor for the infrastructure and for this reason access charges are high (see below).

Since 2020 SNCF also offers low-cost HS services, called OUIGO. Prices vary greatly depending on the period, between €25 and €90 but around an average of 30–40€. It should be noted that only two daily services depart from stations located in the city of Lyon. Most other services depart from Lyon Saint-Exupéry airport, located 25 km from Lyon. To get there, you have to take a bus or a costly tram and pay the price.

Since 2022 is possible to take a train using the former line (460 km) for a duration of almost 5 h. This market service, without any subsidies, is called “Ouigo Classique”. To counterbalance the travel time, but also thanks to significantly lower access charges, the price offered is low, often less than €15 (€3.2c per km). There is also a service also using the former line for the same duration, subsidized by the Burgundy region, the cost is around €30 (€6.4c per km). As in the previous case, this service is mainly used at intermediate stations.

In addition to trains, a handful of air connections operated by Air-France connect the two cities, but prices, frequency and type of aircrafts used suggest that the target is mostly connecting flights and not point-to-point traffic. Many direct buses connect in 5–6 h the two cities, operated by Flixbus and BlaBlaCar Bus in competition, at relatively low prices.

5.2. The Trenitalia entry

In December 2021, Trenitalia⁵ launched a new service between Milan and Paris, via Lyon, competing directly with the INOUI and OUIGO services of SNCF. The Italian rolling stock is an ETR 1000 Frecciarossa (Bombardier Hitachi), the same and newest trains used in Italy. This trainset offers 462 seats, compared to 556 seats for the new SNCF TGVs (510 on the classic TGVs⁶ and 1020 if multiple unit) and 617 for Ouigo— 1288 if multiple unit).

Three classes are offered to the customer:

- executive* comfort (two rows of 5 large recliners adaptable to the direction of travel. Introductory price: 139 € on Paris-Lyon and 165 € on Milan-Paris with a meal and a snack; note the presence of a meeting room with screen, closet, etc.);
- business* comfort in cars 2 and 3 equivalent to 1st class TGV. Introductory prices starting at €29 on Paris– Lyon and €36 on Milan – Paris including a welcome snack;
- standard* comfort for second class cars and introductory prices of €23 on Paris-Lyon and €29 on Milan-Paris.

The service has been a great success, with a very good occupancy rate already in the first few months of operation: 98 % in December for the launch and 81 % in February. Of course, to attract customers, Trenitalia had to initially offer low prices. On average, in December and January, prices were €37 between Paris and Lyon, which did not allow the company to break even (see below). But since then, fares have been gradually raised to 40–50€ (see Fig. 5) and frequencies between Paris and Lyon increased to reach 5 return trips per day in June 2022. This made finally possible to make a daily return trip with Trenitalia, at attractive times for working people but the fare system is designed so that a person making a round trip during the day cannot benefit from the lowest fare twice.

On August 27, 2023, a major landslide in the Maurienne valley interrupted the rail line crossing the Alps for at least a year. The impact on Trenitalia's operations in France was considerable, interrupting the France-Italy link, but also the access to Italian maintenance facilities. Trenitalia's first reaction was to cancel all trains for a few days and reduce internal connections, before reaching an agreement with SNCF to gain access to the French incumbent's maintenance centre in order to manage the regulatory monitoring and maintenance of the Frecciarossa. Since summer 2024, Trenitalia still “blocked” in France, Paris-Lyon

⁵ A wholly-owned subsidiary of FS (Ferrovie dello Stato Italiane). Trenitalia operates in Greece, the United Kingdom, Germany, France and Spain. It carried 600 million passengers in 2019 compared to 1.1 billion for SNCF. Its profit was €593 million in 2019 while SNCF recorded a €301 million loss. The modal share of rail in passenger transport, in % of voy.km, is 5.9 % in Italy (against 10 for France).

⁶ And 370 if single TGV and 740 if multiple unit: this is the TGV put into operation by SNCF on Milan - Turin - Paris.

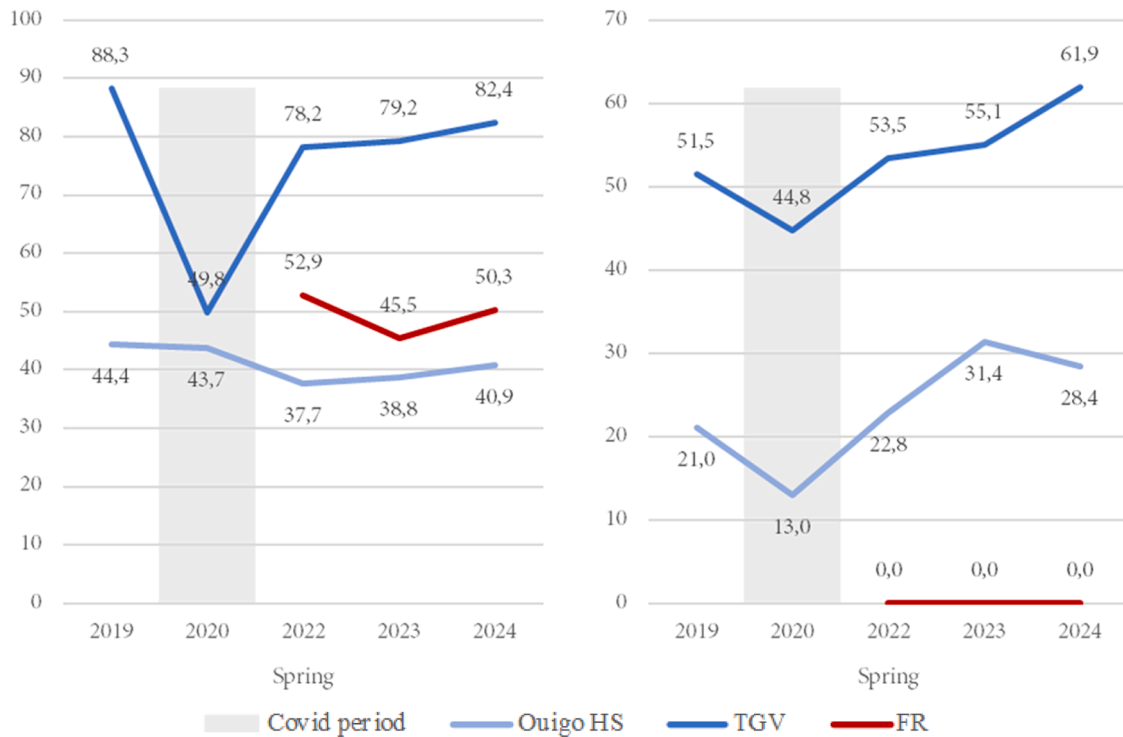


Fig. 5. Average price route (€), Paris-Lyon and Lyon-Marseille, 10 days to departure, Monday-Thursday.
Source: our elaborations on [Beria et al. \(2023\)](#).

connections will be further increased to 6 pairs/day.

The financial impact of this serious incident is likely to be considerable for Trenitalia France, as the additional costs are numerous (travel of Italian technicians to France, rental of access to the SNCF maintenance centre, etc.) as well as the loss of part of traffic coming from Italy.

5.3. Estimating the consumer surplus gains

Almost two years after the launch, the prices charged by Trenitalia remain on average lower than those of SNCF's INOUI services, which have however not increased (Fig. 5). As the number of daily services has increased between Paris and Lyon, it is certain that consumer surplus has increased over the last two years. But its measurement raises some methodological questions.

Let us first recall that given the wide variety of prices and the fact that they evolve according to the elasticity of demand, it is possible that the consumers' surplus is largely captured by the operator. This is the very principle of "Ramsey-Boiteux" pricing (Crozet and Chassagne, 2013). We could even imagine an extreme case where the operator would have very detailed information on the level of demand and would adjust its price in real time to perfectly align it with travellers' willingness to pay. The SNCF is today not very far from this situation because almost 80 % of tickets are sold online and its yield management system is today very sophisticated, leading to instantaneous price variations. In such a scenario, the trains may be full, but travellers have the feeling of having paid a high price due to the capture of consumer surplus by the operator.⁷

To estimate the variation of consumers' surplus, we will use some price observations, which we will consider as average prices paid. They will allow us to estimate the potential gain in surplus for travellers using Trenitalia on the basis of estimated average prices.

Fig. 5, left, gives price for tickets purchased 10 days before departure for a Lyon to Paris trip. The right chart refers to the connection Lyon to Marseille and is used as a counterfactual without competition. We first note that the period was marked by the epidemic and the imposed drop in traffic which led the SNCF to significantly lower its prices, already low thanks to Ouigo self-skimming. Prices then increased without returning to the pre-Covid level between Lyon and the capital, while to Marseille, in absence of a competitive pressure, prices did not reduce and even rose continuously, both for InOUI and Ouigo trains. We can thus infer that the entry into the market of Trenitalia (FR) allowed travellers to benefit from lower prices than those of INOUI services, but also a likely relative reduction of SNCF prices themselves (about -7 %, consistent with -9 % reported by EC, 2024).

The surplus gain is due to three components that induce a variation (reduction) of the disutility of the trip.

1. For users that shift from SNCF to Trenitalia or for new users, the gain is the difference between the prices of the two operators,⁸ divided by two for the so-called "rule of the half" (Neuburger, 1971; Bates, 2003). The principle behind is that shifting users are those with a lower willingness to pay for the original situation, including the new marginal user, or that accept a lower surplus in the new condition, for example adapting the moment of the travel. According to our estimates, the price difference between the two services is approximately €30, so the social surplus gain is the average value of €15 must multiplied by the number of travellers who preferred the SNCF competitor. With 5 daily round trips, Trenitalia offers 4620 seats, or for a 75 % occupancy rate, 3465 travellers per day. We can therefore estimate the consumers' surplus gain at a little over €50,000 per day.
2. Overall, the new entry increased frequency of 20 % (+5 trains/day in addition to the about 20 of SNCF). The increase of frequencies benefits all consumers that can more easily adapt their travel plans.

⁷ We are not completely in this situation since second class prices are capped and the SNCF has even committed to limiting their variability.

⁸ Travel time is exactly the same.

3. Competition indirectly benefited also remaining SNCF customers because, in accordance with the hypothesis proposed by Beria et al. (2022) and depicted in Fig. 5, left, the arrival of Trenitalia led SNCF not to increase its prices as happened in the counterfactual pair Lyon-Marseille. Similar result can be seen in Laroche (2023) that showed that the ticket price per kilometre became higher on Paris-Bordeaux in June 2022 than on Paris-Lyon. It was respectively 0.11€ and 0.15€ in October 2019 against 0.14€ and 0.13€ in 2022. 0.02€ less per km, it is clearly a surplus gain for the travellers.

It is useful here to underline the fact that since the arrival of Trenitalia, the SNCF has slightly reduced its offer (from 22 to 21 round trips per day) and that it has also reduced the number of seats offered in passing, on some trains, from two sets (16 coaches) to one set (8 coaches). In the fall of 2023, SNCF offers more than 33,000 seats per day with the INOUI service alone, but this is around 3000 fewer than in 2019, or roughly as much as the additional capacity added by Trenitalia. Everything therefore happens *initially* as if the demand induced by the arrival of a new entrant was ultimately modest, which leads to questions about Trenitalia's ability to achieve profitability. The point is the capability of competition to increase the overall number of passengers, as happened in Italy or Spain.

5.4. Assessing the potential profitability of Trenitalia

Given the net benefit for the consumers, it is necessary to assess if this situation is financially sustainable for the newcomer. In other words, we need to estimate the average revenue per passenger required to reach the break-even point in relation with occupancy rate.

The main issue for Trenitalia is the level of rail access charges, even if they have obtained a reduction in the first three years of operation (see below). As shown in Fig. 6, rail infrastructure charges on the Paris-Lyon route range from €26 to €39 per train.km compared with about €8 per train.km in Italy.

To discuss about the financial sustainability of Trenitalia's move in the medium term, we can test a "Trenitalia's equation", including rail access charges and finalized, to see if the break-even point can be achieved.

The high level of rail access charges represents a de facto barrier to entry into the French high-speed rail market. To help it overcome this obstacle, the infrastructure manager, who has everything to gain from increasing traffic, has introduced a transitional price reduction that gives Trenitalia time to adapt. Trenitalia received a discount of 37 % in the first year, 16 % in the second and 8 % in the third. These figures apply only to the market charge component (see Fig. 6), but not to the access charge or the circulation charge. This practice is consistent with the differential pricing provisions⁹ of the Transport Regulatory Authority (ART). From this we can deduce that Trenitalia will pay the following access charges for a normal hour traffic from Paris to Lyon: €7291 per train in the first year, €9281 in the second year, €9981 in the third year, and €10,621 thereafter (plus upward adjustments to the tariff schedule).

To this sum, we must add the other operating costs (personnel, equipment, marketing, access to stations, etc.). In absence of any public and line-detailed cost public estimations, we rely on a very recent source (Beria, 2024), providing simplified cost functions for a Trenitalia market train. Assuming a 429 km trip, the production cost access charges excluded is 16.3 €/trainkm or 6985€/trip.

For the second year we obtain a total cost of 16,266€/ride (€6985 + €9281) i.e. for a 462-seats train, a cost per seat of 35.2, rounded up to

€35. We can then calculate the occupancy rate necessary to reach the break-even point according to the ticket price. For an average price of 35 €, the occupancy rate must be 100%, but 43.8 for 80% and 58.3 for 60% (Fig. 7).

The curve presented, built on the same principle as Fig. 1, indicates the occupancy rate-revenue per passenger pairs allowing the break-even point to be reached. The pairs located above the curve make it possible to generate a profit. Unfortunately, in 2022 for its second year of operation, Trenitalia was in the losses side. Losses of €34.5 million were recorded, for a turnover of €39.5 million. We can guess that the actual revenue per passenger was less than €40 while the occupancy rate was less than 70%. Still far from the break-even thresholds shown in Fig. 7.

Given the announced increase in infrastructure charges, Trenitalia will be able to balance its accounts in France in the mid-long term only by increasing the occupancy rate, attracting new passengers, rising the revenue per passenger or a mix of the three. In the longer run is difficult to make predictions, but we can say that SNCF did not add additional trains, and this helps Trenitalia in filling her ones. The observed price gap between InOui and Trenitalia looks still large (50 vs 82 €/trip), which leaves room to Trenitalia to progressively align her prices to the incumbent ones. For example, a 67€ fare would still be 20% cheaper than the incumbent. Trenitalia might also extend its services, for example north (e.g. to Brussels) or south (to Marseille), granting a better train utilisation and a larger customer base.

6. Conclusion

Rail is often presented as one of the solutions that make possible a modal shift that reduces the negative impacts of road and air modes. Huge investments are ongoing in Europe to extend the network and improve the performances of rail transport. However, competition, too, is regarded as one of the key ingredients of a well-balanced modal shift recipe. The long-awaited moment of the rise of competition in the long-distance, and in HS in particular, seems to have arrived, thanks to many signals from the market and from the investors.

Benefits of competition have been more and more studied and documented. Price decrease is just one of the effects, and to date not the main one. Rather, higher frequencies and better quality are probably the main drivers to explain the observed increase of demand across Europe in correspondence of head-on competition.

All these signs of change and optimism should not obscure some facts that call for caution, and that we tried to point out in the paper.

- Fixed costs dominate the industry. On one side, they are powerful barriers to enter the market, limiting its vitality differently from what we observed in the past for air and coach markets. On the other, they constitute a serious limit to the creation of benefits for the consumers. In a market characterised by relatively rigid and finite demand, competition may end in rising final prices, like in a natural monopoly.
- Where competition deploys, it is often duopolistic competition. This model remains characterized by an unstable equilibrium leading either to exit from the market or to an agreement between operators (Broman and Eliasson, 2019; Ristić et al., 2022).
- Rigid and limited demand may induce forms of cherry-picking will have perverse effects on the overall supply and on equalization between services. At the same time, the welfare effect of cherry-picking competition will be marginal, because limited to niches of demand.

In conclusion, direct competition's best playing field are corridors where the demand is high and potentially growing, possibly allowing more than two competitors and some kind of product differentiation. This leads to sustainable price reductions – not price-wars –, but also to the increase of supply and demand. All actions that help these entries

⁹ Guaranteed by the European Union directive 2012 / 34. Moreover, the new entrant "Le Train" has made a similar request to SNCF Réseau. For Tours-Bordeaux Lisea (Vinci), the concessionaire is considering a 20 % discount (CF Ville Rail et Transports N° 660, April 2022).

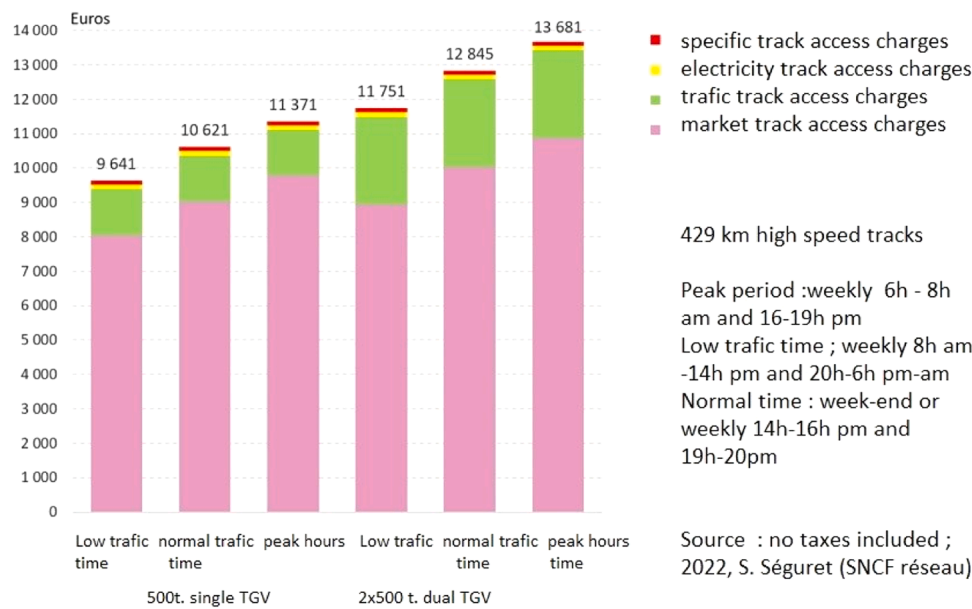


Fig. 6. Rail access charges between Paris and Lyon according to different scenarios (SNCF Réseau).

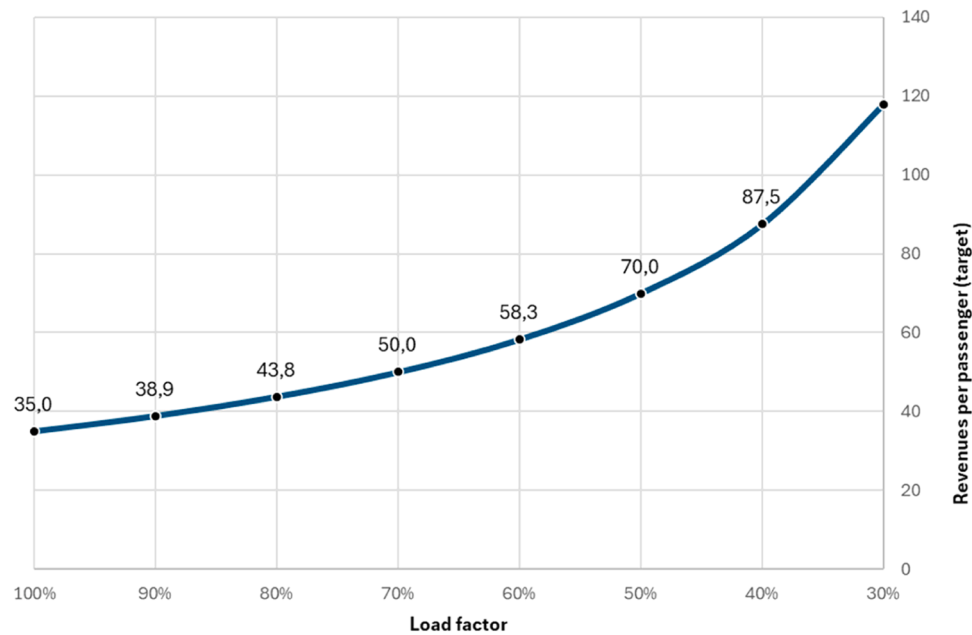


Fig. 7. Estimated Trenitalia break-even point, occupancy rate and revenue per passenger for the second year of the Lyon-Paris line.

should be deployed, from reductions of access charges that will be compensated by additional trains.km, to the promotion of ladder of investment mechanisms. For low-demand corridors direct competition is typically not feasible or structurally unstable. Better would be to stimulate the opening of new unexploited city-pairs.

CRediT authorship contribution statement

Paolo Beria: Writing – review & editing, Writing – original draft, Investigation, Data curation, Conceptualization. **Yves Crozet:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis, Conceptualization. **Laurent Guihery:** Writing – review & editing, Writing – original draft, Investigation, Conceptualization.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. Laurent Guihery (co-author) is Associate Editor of this journal. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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