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Can the ladder of investment approach make on-track competition sustainable in the railway market? A study of asymmetric infrastructure access charges

Nikola Stojadinović^{a*}, Bojan Ristić^b, Dejan Trifunović^b

^aUniversity of Belgrade, Faculty of Transport and Traffic Engineering, Vojvode Stepe 305, Belgrade 11000, Serbia

^bUniversity of Belgrade, Faculty of Economics, Kamenička 6, Belgrade 11000, Serbia

Abstract

The gradual liberalisation of the EU railway market, which began in the early 2000s, has entered its final phase with the formal opening of national markets for commercial passenger transport. However, the level of competition established in some countries is still not sufficient to increase passenger welfare. Based on the previous experience, this phenomenon stems from high barriers to entry for new operators, such as high sunk costs, relatively high infrastructure train access charges (TAC) for commercial passenger traffic, and competition between asymmetric participants, where the incumbent still dominates the market. One of the solutions to improve the conditions for entry is asymmetric market regulation, used in the telecommunications sector. The asymmetric access regulation is based on lower TAC for entrants than for incumbent for a limited period, which is part of the ladder of investment (LOI) approach. In principle, the current EU regulatory framework requires equal and non-discriminatory TAC for all railway operators which provide similar services in a similar market segment with similar infrastructure quality. Any deviation from this principle must be justified. In practice, infrastructure managers (IM) often charge much higher TAC than the marginal cost of using the infrastructure for long-distance passenger traffic because that market can absorb this higher cost. This does not leave much possibility for entry or survival of potential entrants in the passenger market segment. Therefore, this paper will present a duopoly competition model between asymmetric on-track competitors within the commercial passenger transport market segment. We will explain the pros and cons of the introduction of asymmetric access regulation as an essential package of market entry strategy to establish sustainable competition for commercial passenger railway transport services.

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* Corresponding author. Tel.: +381-11-3091-349

E-mail address: n.stojadinovic@sf.bg.ac.rs

1. Introduction

The railway sector reform, which was initiated by the need to solve the accumulated problems faced by national railway companies and their owners and by turning the railway into an effective alternative for transporting passengers and goods, has significantly reshaped relations in this market in Europe. The reform consisted of significant steps towards the liberalisation of access to railway infrastructure, vertical separation of activities and the introduction of contractual relations between governments and railway companies. These changes have created preconditions for replacing the monopoly with direct competition between railway undertakings.

In the last twenty years, competition has been introduced in phases in specific railway transport sectors according to their readiness for intramodal competition. Despite the minor share of rail in the EU passenger transport market of 8% in 2019 (IRG, 2022), market liberalisation for commercial passenger transport services on national networks was postponed for the last stage. The reasons for this are numerous, starting from the high complexity of the organisation of passenger transport services and the dominant volume of passenger traffic on the network (81% of train kilometres were realised by passenger trains in Europe in 2020 (IRG, 2022)), financial aid from public funds to infrastructure manager (IM) and unprofitable segments of passenger railway market, the impact on the welfare of transport users, and resistance of significant stakeholders in the sector.

It has become evident that entry barriers in the passenger market are much higher than in the freight transport market (Bougette et al., 2021). Private long-distance commercial transport operators face high sunk costs related to investments in rolling stock that they cannot easily rent for a particular market. They are also faced with the challenge of hiring train drivers and other staff and access to essential facilities for rolling stock maintenance. Furthermore, there are obstacles to obtaining enough attractive train routes, and they should pay relatively high fees for the use of infrastructure. All these factors increase the risk of successful market entry and thus have discouraging effects on the emergence of new operators in this sector. Those entering the market compete with the incumbent—vertically controlling the entire rail passenger transport system (from local public transport to high-speed trains). This puts competitors in a highly asymmetric relationship and thus makes competition unsustainable for non-incumbents in the long run. In this case, the traditional approach to market regulation with equal conditions for participants (which are not symmetric and will not be of equal strength in a considerable period after entry) does not create favourable conditions for developing sustainable competition.

The basic idea of this paper is to consider the possibility of applying the approach of asymmetric market regulation through the ladder of investment approach (LOI). These relatively new concepts, used in industries with dynamic competition such as telecommunications, air transport and online commerce, were not considered in the railway sector until now. However, train access charges (TAC) have become one of the most significant factors in the cost structure of railway operators. This concept is related to the application of asymmetric TAC that could potentially reduce the entrant's risk of the initial investment, accelerating the convergence of operators' market shares. This approach may facilitate the entry of new operators into the market and increase the number of direct competitors and investments in this market segment. In the paper, we present the discussion about the concepts of asymmetric TAC regulation and the ladder of investment approach with a review of the relevant literature. The effects of this policy and the possibilities for its application as a new instrument of market regulation are also considered.

The paper consists of the following chapters. Chapter 2 provides an overview of current infrastructure charges for commercial passenger transport. Chapter 3 deals with the idea of asymmetric market regulation and the “ladder of investment” approach. In Chapter 4, we discuss a possible way to apply asymmetric TAC for the use of railway infrastructure and measure the effects of this policy. Concluding remarks are given in the last chapter.

2. Background – Setting up train access charges

Liberalisation of access to railway infrastructure requires introducing a system of charges that would regulate the relations between the IM and railway operators. Although Directive 91/440/EEC laid the groundwork for open access to railway infrastructure, the first rules for levying charges for the use of railway infrastructure were officially established at the EU level by adopting the 2001/14/EC. However, the Directive 2001/14/EC has set a reasonably broad legal framework for each member to choose its system. Consequently, the choice of economic principles and

model of charges, the way of covering the costs of IMs, and the pricing policy were left almost entirely to member states.

2.1. *Conflicting objectives in determining the level of charges*

For the rail passenger transport service to be attractive and able to compete with air and road traffic on medium and long distances, high-quality infrastructure and rolling stock are necessary preconditions. The maintenance and modernisation of the existing railway network and its capacity expansion require substantial financial resources. Although Directive 2001/14/EC recommended that TAC should be based on the marginal cost of IMs, it did not prevent the EU Member States from deciding that the market should bear a large part of the costs of IMs. Thus, the principle of determining the level of TAC based on covering the majority of the expenses of IMs has been widespread since the 2000s among EU countries (especially in Germany, Italy, France and new EU members; ECMT, 2005, Crozet and Chassagne, 2013 and Link, 2018). The level of TAC depends on the assessment of the profitability of each type of transport service.

IMs determine the markup level using the Ramsey pricing principle, where price elasticity is estimated based on the operator's revenue. In practice, in the larger markets, the market segment of commercial long-distance and passenger transport is often burdened with TAC that is significantly higher than marginal costs because it is estimated that this market can bear the higher cost. Consequently, the determination of high TAC does not leave much room for a new operator to enter this market segment on a larger scale and at the optimal time¹, which, together with the network effects of the service, significantly reduces the potential profitability of entrants.

2.2. *Comparison of the level of TAC in EU countries*

In the market of commercial rail passenger transport services in long-distance transport, the conflicting objectives for sustainable financing of high-quality railway infrastructure on one side and creating conditions for the development of competition on the other side are clearly emphasised. Considering the structure of TAC revenues, most IMs depend predominantly on passenger traffic (in 19 of the 28 EU countries, together with Norway, Switzerland and Great Britain, passenger traffic contributed at least 65% of IM's total revenue (IRG, 2022)).

To analyse the level of TAC for commercial passenger traffic, it is necessary to observe the structure given in the Network Statements in each country. TAC usually consists of one or two parts, the mandatory part according to direct costs (consists of components related to the cost of the capacity reservation, infrastructure maintenance, traffic regulation and use of catenary) and the part representing markup. The TAC for high-speed trains and conventional trains in long-distance passenger transport were analysed separately when reviewing the relationship between these two parts. Figure 1 shows the calculated TAC levels for the minimum service package for a typical conventional passenger train in national long-distance transport (8-coaches intercity train, total mass 500 t, travelling 300 km between the two largest cities on weekdays on the electrified line of the highest quality for conventional traffic, with a maximum speed of up to 190 km/h) which is not under the contract of public service obligation (PSO). Countries that do not have commercial passenger transport services (all passenger transport by rail takes place under a PSO, i.e., without on-track competition) and relatively small countries without the possibility of organising long-distance transportation on the national network are not considered.

The chart explicitly indicates the levels of TAC for direct costs and the minimum and maximum amount of markup. TAC based on direct costs are generally below 2 euros per train kilometre (with the exceptions of Greece and Latvia). In countries with TAC higher than 2 euros per train kilometre, the share of markups plays a significant role in price formation. A fixed amount of markups for this market segment is used in France (3.2) and Italy (3.4). In contrast, the markup level varies significantly in Germany (between 4.2 and 8.6 EUR per train-km) and Belgium (between 2.1 to 14.7 EUR per train-km). In countries with the variable markup, the principles of its variation depending on the average

¹ (2004/C 31/03) Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings.

speed of the train, the intensity of traffic on the track and the time of train traffic (regular hours to high peak hours). Thus, the markup for commercial conventional long-distance traffic is from 1.3 to as much as 6.7 times higher than the TAC based on direct costs. Sweden is the only country where the markup is less than the direct costs and where the total TAC is less than 2 EUR per train-km. Lower-level TAC, better infrastructure, and sufficiently available capacity that is not under the PSO contract enable on-track competition since these conditions positively affect entry decisions of new operators that will compete with incumbents. Such a situation is in the Czech Republic (1.19 EUR per train-km), Slovakia (1.73 EUR per train-km) and Sweden (1.89 EUR per train-km), while Austria belongs to the group of countries with a slightly higher TAC (2.32 EUR per train-km).

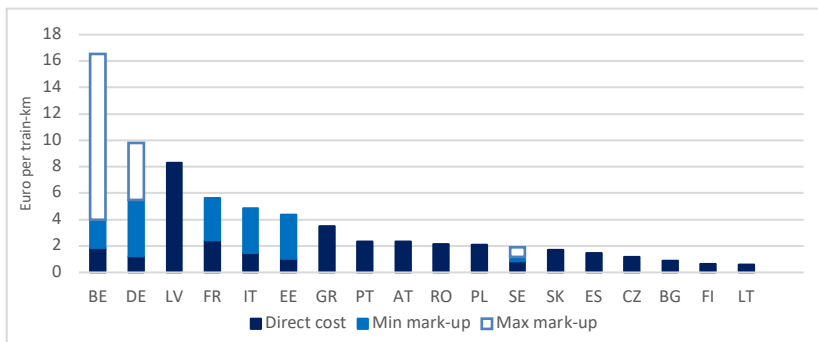


Fig. 1. Amount of TAC for MAP according to the EU Network Statement and the ratio between direct costs and markup for conventional non-PSO long-distance passenger trains in 2021²

With HSR, the markup in TAC is an unavoidable factor in determining the final cost for infrastructure usage for this market segment. In all countries with high-speed train services, markup significantly exceeds the part based on direct costs (Figure 2). The amount of the markup varies, and the least is in Italy (from 5.9 to 7.3 EUR per train-km). In other countries, TAC for the minimal access package (MAP) for HSR is significantly higher—from 14.4 in Germany to as much as 32.1 EUR per train-km in France. Due to the lack of on-track competition in these countries, IMs resorted to markup differentiation depending on the intensity of traffic, the time of day when the traffic takes place, the train's capacity in the number of seats etc. (Link, 2018). According to Sánchez Borrás (2009), markups seem to be a mix of two different concepts aiming at the coverage of capital costs of HSR and exploiting the commercial position of HSR.

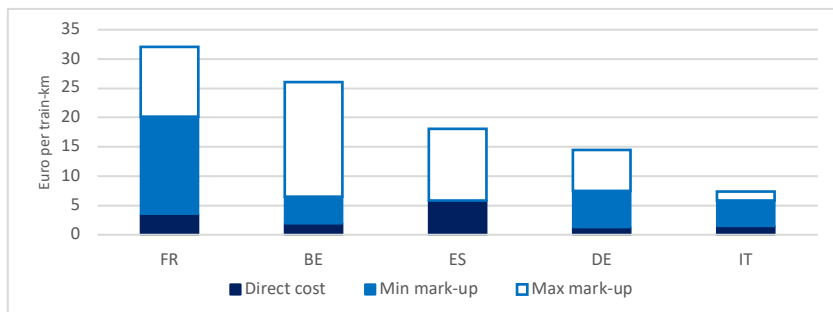


Fig. 2. Amount of TAC for MAP according to the EU Network Statement and the ratio between direct costs and markup for high-speed trains in 2021³

² Network statements of the IMs of the EU member states for 2021, authors' calculations.

³ Ibid.

Although they represent the most important European markets for commercial rail passenger transport in Europe (with more than 30 million mileage per year), where incumbents and users are willing to pay such high TAC, such high fees enable just one operator at a time. In other words, the markup is inevitable for the use of HSR infrastructure. Still, its level needs to be reasonable to attract a more extensive traffic volume and encourage entry into the market. Italy is the only one of these countries that have embarked on this path with noticeable results—the private HSR operator has a significant market share. In 2014, lower TAC (from 12.8 EUR per train-km to 8.2) allowed NTV to obtain positive profits (Desmaris and Croccolo, 2018).

Maintaining high TAC is not a suitable option from the standpoint of competition policy because it lowers both consumers' and producers' welfare (Ristić et al., 2022). Hence, if the objective is to foster effective on-track competition, TAC should tend towards the marginal cost of using the infrastructure. However, reducing infrastructure charges to the marginal costs (for conventional trains) and reduction of markup (for HSR trains) would inevitably increase government subsidies to cover the large portion of IM's expenses⁴.

3. On track competition in the EU and asymmetric regulation

The market share of entrants is still very low, and in many EU countries, only incumbents operate in the passenger railway market. Competition in this market segment is limited to the competition of two asymmetric railway undertakings (incumbent and entrant) on 1 to 2 routes between the largest cities in the national network. In general, the transport of passengers by rail is a low-profit branch of transportation, and a high part of the services provided is subsidised through PSO. Therefore, this market, organised under the current conditions and levels of charges, is not attractive for private operators. There is a reasonable suspicion that there will never be an increase in competition and profits in this market segment. Moreover, it may remain limited and stagnate due to low-profit rates and high investment risks.

3.1. *The asymmetric access regulation policy*

One possibility to attract more entrants is to use asymmetric regulation, which represents the introduction of different obligations to competitors by the size of their market share (Montero, 2019). After considering competitive advantages inherited by the incumbent, asymmetric regulation implies introducing specific measures that will facilitate entry. These measures should be limited in time and gradually reduced during the transition period of convergence of market shares. This policy has already been applied in telecommunications, in which, unlike rail transport, there is no vertical separation between the IM and the service provider. Asymmetric access regulation in telecommunications has been applied in many European countries: Austria, Belgium, Denmark, Finland, Germany, Hungary, Ireland, Italy, Netherlands, Switzerland, and the UK. According to de Bijl and Peitz (2004) and Peitz (2005), this policy provides more significant incentives for entry and increases consumer' surplus while slightly reducing total welfare. Sidak et al. (2017) claim that asymmetric access regulation might reduce the incentive for less efficient entrants to reduce their costs. Furthermore, by comparing the data from countries using symmetric and asymmetric regulation, they find that with asymmetric access regulation, entrants gain a slightly higher market share than with symmetric access regulation.

Although telecommunications and railways both have network effects, the results from the former industry cannot be directly extrapolated to the latter sector. The specificity of telecommunications is that the competition takes place on several networks owned by vertically integrated competitors, allowing access to be paid from one operator to another for access to its network. In this sector, asymmetric regulation means that one network imposes higher obligations for incumbents than for other networks. Unlike telecommunications, all railway traffic takes place on a single unrivalled railway network, which has been declared a natural monopoly, vertically separated from other

⁴ During the COVID-19 pandemic, the most significant decline in revenue. Government aid was felt by non-PSO operators, so that government aid mainly reflected in covering IM losses and writing off RU debts related to TAC. At that time, many EU countries abolished the payment of some charges, such as mark-ups for non-PSO passenger traffic (Austria, Germany and Spain) or a 50-90% reduction in MAP charges (Slovakia), which required substantial government subsidies (IRG-rail, 2022).

railway operators. This considerably different setup imposes the need to consider the effects of asymmetric access regulation on on-track competition in the passenger railway market.

The idea of introducing asymmetric regulation in the on-track competition was considered by Montero (2019), who argues that asymmetric regulation of railway passenger transport should be based on asymmetric TAC. The asymmetric access regulation would favour entrants for a limited period and require the incumbent to pay a higher TAC for using infrastructure than the entrant. After the period of entry incentives for entrant expires, both operators should pay the same level of TAC. By bearing in mind that TAC for the use of infrastructure is provided to cover only direct costs of IM, asymmetric TAC would refer to determining the amount of markup for entrants. The idea of introducing a discount on the TAC in the form of zero markups for entrants as an incentive to induce entry is faced with two problems:

- Legal – As railway infrastructure has been declared a natural monopoly, access to infrastructure is based on the principle of non-discrimination. Directive 2012/34/EU does not explicitly allow differentiation of TAC for certain operators. In this regard, discounts are used to launch new services and use infrastructure with low-capacity utilisation. In both cases, the introduction of a discount on TAC must be justified by an increase in the revenue of the IM after a certain period. Therefore, this type of discount could be judged as illegal state aid.
- Economic – asymmetric regulation with preferential prices for access to infrastructure for new operators can attract opportunistic investors and inefficient competitors. Their existence on the market relies on protective measures and government-provided incentives. In addition, monitoring the performance of such competitors over time would require higher complexity of regulatory instruments to implement this type of regulation. Moreover, it is estimated that this would require more resources than regulating monopolies (Crandall et al., 2002).

Concerning the legal part of the problem, the EU knew how to adjust its regulatory framework based on previous experience from earlier stages of railway market liberalisation. The EU legislation imposes a non-discriminatory approach for TAC. Still, non-discriminatory access to infrastructure does not mean that TAC levels will be identical for each operator in any situation. On the contrary, a difference in TAC can be introduced if there are objective reasons. Given that this is a sector-specific regulation, it is not unrealistic to expect the regulatory framework to be adjusted to provide more significant incentives to entrants. The economic part of the problem is fundamental in the case of choosing to apply asymmetric market regulation. In addition to incentives that reduce the risk of entering the market, regulators, on the other hand, must have sufficiently strong measures that should induce the entrant to increase efficiency and maintain the dynamics of market expansion and investments. The entry of opportunistic and inefficient operators can prevent new serious entrants from entering the market. One of the available mechanisms is to use the (LOI) approach to apply asymmetric TAC in the transition period.

3.2. *The ladder of investment approach*

The LOI approach is based on a lower TAC for entrants, but their level should be gradually increased in several steps toward the incumbent's level. The first level of TAC aims to attract entry, and after a particular time, the entrant climbs the next ladder with higher TAC (Bourreau, et al., 2010). In the first stage, the entrant should invest in rolling stock, hire enough train drivers, and establish a regular frequency of its services. Bougette et al. (2021) propose that the entrant pay lower TAC than the incumbent for using infrastructure under the LOI approach and that regulator or competent authority should strictly respect the timing of moving to a higher ladder. With the LOI approach, the entrant gradually acquires a market share. Since passengers are initially biased towards the incumbent's services, this approach also increases their willingness to pay for entrant's services. Due to the incumbent's established brand name, passengers also have psychological switching costs to use the newcomer's services (Fröidh and Byström, 2013).

The level of TAC in the following step could depend on the entrant's current market share, but this policy might be inconsistent with a certain level of steps announced in advance in the LOI approach. There are two other possibilities consistent with the application of the LOI approach, according to Cave (2006). TAC is continuously

increased towards the incumbent's level in the first approach. There is a discrete increase of TAC in the second approach at a predetermined time.

LOI should also facilitate an exit strategy for the entrant. In a short period after entry, a newcomer faces uncertainty concerning the demand for its services. Suppose in the first stage of the LOI approach, the entrant realises that entry will not be profitable in the future. In that case, it may exit the industry with lower exit costs when rolling stock is also subject to LOI asymmetric regulation. Otherwise, if the entrant perceives future profitability, it will continue to invest in the rolling stock. Another advantage of the LOI approach is the reduction of risk premium demanded by banks who finance entrant's acquisition of rolling stock.

A critical issue in the LOI approach is that the timing of each step should depend on the time of entry. Hence, if there are two entrants, which is not very likely in on track-competition (the only case is in the Czech Republic), the second entrant should start from the first ladder, even though the first entrant might have already climbed to the second ladder (Avenali et al., 2010). The credibility of the competent authority is also essential since it must stick to the previously announced timing of moving to a higher ladder. If the competent authority is willing to prolong the duration of a step, fearing the entrant's potential exit, this approach loses its effectiveness in inducing entrants to compete with incumbents. The lack of credibility in applying the LOI approach might also attract speculative entry.

4. Proposed application of LOI approach for determining the dynamics of markup increase

LOI is a way to "operationalise" the application of asymmetric TAC as an incentive for entrants in the transition period. Entrants would initially receive discounts on TAC (or, more precisely, write-off of the markup) as an incentive measure in the light of "positive discrimination". This approach aims to facilitate a sufficiently large market entry that would not incur huge costs for the entrant, accelerating the convergence of entrant and incumbent market shares over time. To increase market share and maintain efficiency, the entrant should enter a contractual relationship with the government that grants these discounts. The contract should specify the number of "steps" from the minimum to the total amount of the TAC (the amount of markup), the parameters that the entrant must meet in each period and the period to reach them. For example, in the first phase, the entrant does not pay the markup; in the second, it pays 33% of the markup; in the third, 66%; and in the fourth, it pays the total amount of the markup. Each phase can vary between 1 and 3 years, but altogether, the transition period of incentives should not last between 5 to 10 years.

The indicators that should measure the progress defined in the long-term contract and those achievements would be directly related to the gradual increase of the markup. These targets that entrant should reach over time would be associated, for example, with the number of realised passenger kilometres, the load factor of capacity use, cost efficiency (increase in profit) or expanding the service network by increasing the frequency of services or opening new lines. This set of parameters would be linked in the form of key performance indicators, through which the contract for the provision of incentives would be managed. A similar mechanism exists in contracts for the provision of PSO. In the case of on-track competition, the entrant would have complete freedom in determining prices for provided services. At the same time, the initial number of departures and frequency on the first line would be the subject of negotiations between the competent authority appointed by the government and the entrant. In the case of non-fulfilment of the planned milestones (unless the entrant could not justifiably fulfil them), the TAC would increase further, forcing the inefficient entrant to exit the market and leave the place to efficient entrants.

From the public budget perspective, the government's interest is related to the gradual reduction of subsidies for entrant's incentives and the reduction of the number of lines organised and financed under PSO contracts (i.e., non-profit services). The benefits of this approach and its alternatives should be measured through the level of subsidies for incentives, entrant's profit and market share, consumers' surplus, and total welfare. The effects of LOI variants should be compared with other alternatives, i.e., symmetrical reduction of TAC for all market participants and the current situation of relatively high TAC for commercial long-distance rail transport services.

5. Conclusions

TAC represents a significant factor in the railway operator's decision to enter a specific market segment. For conventional traffic of long-distance commercial passenger transport services, the TAC level is generally up to 2 euros per train kilometre. However, in the EU countries with a larger volume of passenger transport, there is typically a

mark-up that can be several times larger than the marginal cost. For HSR, the markup is an indispensable element and IMs use it to cover capital costs. Moreover, this market segment can bear this markup due to its high intermodal competitiveness. A high level of TAC reduces the attractiveness of this market segment to potential competitors who perceive them as an obstacle to achieving profitable entry. This creates a high investment risk for entrants. As the evidence for this claim, on-track competition exists between incumbents and entrants in only six countries in the EU on one or two most attractive lines. The two competitors are highly asymmetric in terms of their market shares.

One way to mitigate these risks and increase the attractiveness of entry is to introduce a mechanism of asymmetric TAC based on competitors' market shares. The idea for this policy stems from the telecommunications sector and partly from air traffic after its liberalisation in the USA and the EU. The application of asymmetric TAC could be achieved through the LOI concept, where IMs gradually and in several steps increase the level of markup for entrants as entrants increase their market share and expand the network and frequency of their services. When entrants reach considerable market share, the markup should be the same for both operators. The introduction of this regulation mechanism in the EU faces two challenges. The first is legal since the EU legislation considers asymmetric TAC an illegal form of state aid. The second is its economic nature because this policy can attract inefficient rail operators. Introducing this policy requires the engagement of regulators to monitor entrants' progress through the KPI system well defined in a long-term contract. This policy also involves budget subsidies that would compensate for the loss of IMs revenue due to the lower markup for entrants in the transitional period. The expected effects of this policy would be an increase in passengers' surplus, entrant's profit and market share.

References

- Avenali, A., Matteucci, G., Reverberi, P., 2010. Dynamic Access Pricing and Investment in Alternative Infrastructures. *International Journal of Industrial Organization* 28.2, 167-175.
- Bougette, P., Gautier, A., Marty, F., 2021. Which Access to Which Assets for an Effective Liberalization of the Railway Sector? *Competition and Regulation in Network Industries* 22.2, 87-110.
- Bourreau, M., Doğan, P., Manant, M., 2010. A Critical Review of the “Ladder of Investment” Approach. *Telecommunications Policy* 34.11, 683-696.
- Cave, M., 2006. Encouraging Infrastructure Competition via the Ladder of Investment. *Telecommunications Policy* 30.3-4, 223-237.
- Crandall, R. W., Sidak, J. G., Singer, H. J., 2002. The Empirical Case against Asymmetrical regulation of Broadband Internet Access. *Berkley Technology Law Journal* 17.3, 953-987.
- Crozet, Y., Chassagne, F., 2013. Rail access charges in France: Beyond the opposition between competition and financing. *Research in Transportation Economics* 39.1, 247-254.
- De Bijl, P., and Peitz, M., 2004. Dynamic Regulation and Entry in Telecommunications Market: A Policy Framework. *Information Economics and Policy* 16, 411-437.
- Desmaris, C., Croccolo, F., 2018. The HSR competition in Italy: How are the regulatory design and practices concerned? *Research in Transport Economics* 69, 290-299.
- ECMT, 2005. *Railway Reform and Charges for the Use of Infrastructure*. OECD Publishing, Paris.
- Fröidh, O., Byström, C., 2013. Competition on the Tracks—Passengers' Response to Deregulation of Interregional Rail Services. *Transportation Research part A: Policy and Practice* 56, 1-10.
- IRG-rail, 2022. *10th Annual Market Monitoring Report*.
- Link, H., 2018. *Track access charges: Reconciling conflicting objectives, Case Study – Germany*. Centre on Regulation in Europe (CERRE).
- Montero, J. J., 2019. Asymmetric Regulation for Competition in European Railways? *Competition and Regulation in Network Industries* 20.2, 184-201.
- Peitz, M., 2005. Asymmetric Regulation of Access and Price Discrimination in Telecommunications. *Journal of Regulatory Economics* 28.3, 327-343.
- Ristić, B., Stojadinović, N., Trifunović D., 2022. Conditions for effective on-track competition in the European passenger railway market: A yardstick for regulations. *Transport Policy* 119, 1-15.
- Sánchez Borràs, M., 2009. *Impact of rail infrastructure charging systems implemented in Europe on the competitiveness of high-speed services*. PhD thesis. Universitat Politècnica de Catalunya.
- Sidak, J. G., Vassallo, A. P., Sabetti, L., 2017. Did Asymmetric Mobile Termination Rates Help Entrants Gain Market Share. *The Criterion Journal on Innovation* 2, 701-722.