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On the *ability to pay* of railway freight transport demand

Research contract nr. D73C23000590005 between the Department of Economics of the University of Genoa and the Department of Architecture and Urban Studies of Milan Politecnico.

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Scope of the work

The present report is part of a broader research contract that Rete Ferroviaria Italiana (RFI) commissioned to the Politecnico di Milano (POLIMI) to estimate the elasticities of demand for rail transport services to modifications in the infrastructure access charge (TAC – track access charge).
The University of Genoa's contribution focuses on freight traffic and is aimed at carrying out:

- The estimation of elasticity of demand, expressed in train-km and tonnes-km, to changes in the TAC, expressed in € per transported tonne, that Railway Undertakings (RUs) pay to RFI for accessing the rail network;
- The estimation of the sensitivity of freight RUs to changes in the TAC through models developed ad-hoc starting from the econometric approach applied to the traffic data - circulated or scheduled - provided by RFI, also through the analysis of possible heterogeneous effects on the basis of some service and network characteristics (agreed with RFI).

In addition, the research team assisted RFI and POLIMI in preparing and conducting an information seminar with the RUs (held in Milan), which led to a direct survey aimed at investigating the determinants of the choice of train path by the RUs. Furthermore, an analysis of the data provided by RFI was carried out to describe the trend of rail freight transport during the period considered by the contract (2018-2022). Finally, the University of Genoa collaborated with the Politecnico di Milano and IUAV to model the elasticity of all RFI's traffic revenues to the TAC.

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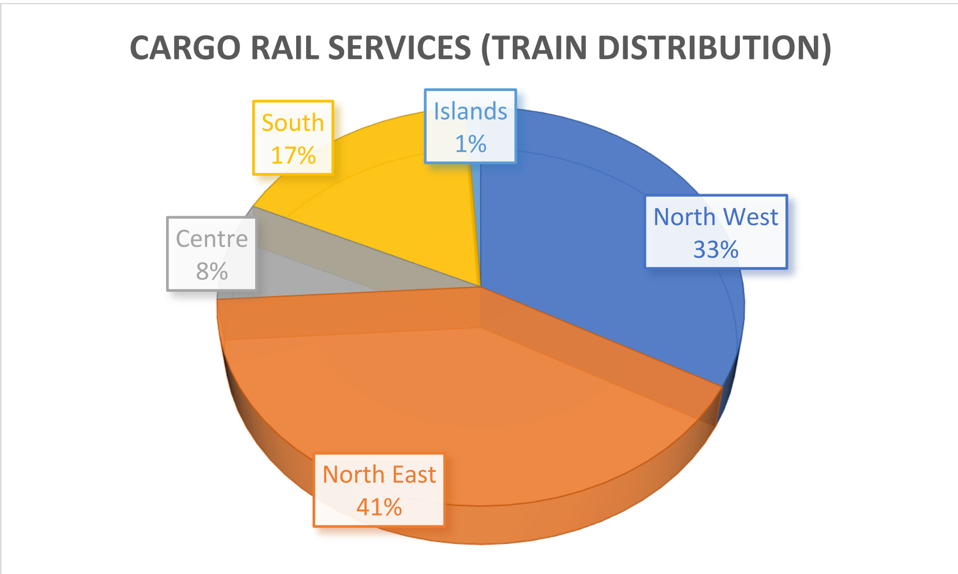
The access charge and the Italian rail market

After the liberalization of the market occurred at the end of the '90s (EU Directive 95/19/CE), a separation between the rail infrastructure manager (i.e. RFI) and the rail service provider occurred, with the incumbent (i.e. Ferrovie dello Stato) that created controlled subsidiaries for both the passenger and rail sector (i.e. Trenitalia for the passenger market and, starting from 2016, Mercitalia Rail for the cargo business). Such de-verticalisation process allowed to introduce competition both for and within the market (Musso and Ferrari, 2002) and this possibility was particularly successful for the high-speed rail segment and for the cargo rail market. The beneficial impact of competition allowed to increase the tonnes-km produced over the last 20 years (with some negative fluctuations occurring in connection with the 2008 financial crisis) and recording a better performance than several other European rail systems (e.g. France) even if with lower rate of growth in respect with main Central European countries (e.g. Germany and Austria).

Concerning the Italian cargo rail market, currently most of the trains are produced in the North of Italy. Such region is characterized by the presence of main industrial areas and logistics hubs that act as either origin or destination of the related rail services.

Figure 1: Cargo train distribution

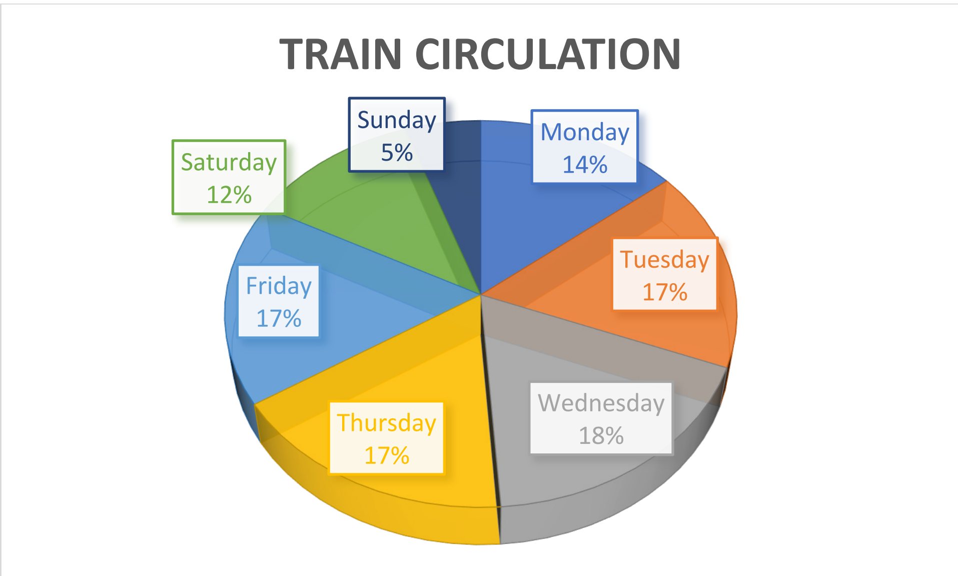


Source: Own elaboration on ISTAT data

Private rail companies are mainly represented by two associations: FerCargo (comprising 19 rail operators) and FerMerci (representing stakeholders linked to the cargo rail logistics). In accordance with annual reports published by both associations, currently about 20 operators can be listed as fully operative – but some of them linked through shareholding links – with a difference in terms of market share.this market concentration is linked to the differentiation in terms of company size as well as on different strategies in terms of either geographical scope of operation or market served. Using market concentration indexes to assess the level of competition, the Herfindhal-Hirschman Index[1] has always been above 2000 (i.e. moderate concentration) even though with a tendency to a reduction in value (in the period 2018-2022 a 10% reduction can be observed).

Considering service characteristics, it is important to highlight how in 2022 Italian cargo trains have mainly circulated during weekdays, with the period Tuesday-Friday accounting for about 70% of the performed trains. Weekends register lower performance with Sunday accounting for only 5% of the total. This latter aspect – in accordance with information published by relevant association reports – can be linked to the opening times of main rail terminals as well as the different labor constraints and costs, thus affecting the capability of the companies to produce trains within that timeframe.

Figure 2: Train circulation pattern



Source: Own elaboration on RFI data

[1] https://www.justice.gov/atr/herfindahl-hirschman-index

Average train distance covered on RFI managed network was 246 km with only 5% of the trains operated in services covering distances above 800 km (and less than 1% above 1000 km) and about 25% of train operating services covering distances shorter than 100 km. Considering train mass, average weight is of about 1000 tonnes but with high variability depending on route, company, and other service characteristics.

The access charge

Whenever a liberalization occurs, regulators need to define rules for competition and market access. In current economic literature, most of the research has focused on the impact of rail liberalization on passenger flows, the role of different costing criteria on the capability for operators to develop sustainable rail services, and the actual impact of liberalization processes on rail investments and service performance. Using the scientific database SCOPUS is possible to highlight about 80 papers – published starting from mid '90s – discussing the track access charge (TAC) and its impact on rail finance, service performance, and capability to be used for attracting new demand. Most of the papers are focused on specific national case studies, in accordance with market trends and the booming of Asian markets (particularly in China, India, and Japan). First papers on access charges and regulatory methods focused on the British liberalization (e.g. Dodgsonx, 1994) providing elements for both the passenger and cargo markets. In the year 2000, other main markets have been introducing different approaches and scholars have been focusing in evaluating the effectiveness of the related regulatory experiences (e.g. Crozet and Chassagne, 2013, in France; Borjesson et al., 2021, in Sweden; Heike, 2012, in Germany). Only recently scholars have discussed the possibility to fine-tuning the TAC paid by relevant railway undertakings (RUs) to solve specific infrastructure management challenges (e.g. Armstrong and Preston, 2017, for the British case study) or as a way to pass incentive to users (e.g. Marzano et al., 2018, for the South of Italy market).

Considering such body of literature, many authors have discussed tools for improving the TAC estimation methods (e.g. Borjesson et al, 2021; Marzano et al., 2018; Armstrong and Preston, 2017; Crozet and Chassagne, 2013; Link, 2012; Gibson et al., 2002; Dodgsonx, 1994). It is worth noticing that most EU countries seem to adopt slightly different solutions and ongoing discussions are often concentrated on similar – but not equal – approaches, summing-up differently a mix of cost, infrastructure performance, utilization and capacity rates, and demand characteristics. The different approaches are also linked to the several network characteristics and organizational models adopted for managing (and splitting) the access of passenger and cargo trains: on the one hand Countries that have specific patterns for passengers and cargo could even almost separate the two markets, allowing regulators for differentiated solutions that can promote more easily effective solutions; on the other hand, Countries that have most of the network shared between passengers and cargo services had to deal with a hierarchization of the access also embedded in the related TACs. Similarly, different approaches have been taken by regulators where private – or partially private – networks are present due to the related constraints in terms of network investment and managing controls.

Despite the differences, most research and policy papers seem to point out the need for better understanding the role of specific nodes within the transport network (e.g. junctions, logistics hubs) given their impact on the actual and perceived performance of the RUs as well as the differentiated needs of different demand segments in terms of both ability to pay and performance needs. While “traditional” access charge schemes seem to be based on a fee mostly linked to cost generation factors and infrastructure characteristics, starting from the ‘90s RailTrack, now replaced by NetworkRail – the UK rail infrastructure manager –, have tried to promote a model for linking access charges to specific abilities to pay of different industries and then differentiating the TAC in respect to the industrial sector. Such approach can be considered as the main attempt to directly link TACs to demand characteristics. Despite the potential value in recognizing the key role of demand segmentations for structuring effective pricing schemes (e.g. for maximizing infrastructure utilization as well as improving the modal shift), the high computational costs and the need for frequent updates of the demand model, discouraged many countries to follow the British system. More recently, researchers seem to propose a mixed approach in which rail characteristics and performance are the main factors for the calibration of the access charge, together with some general market considerations for differentiating main market segments or for introducing incentives so to align railway undertakings’ strategies to main national policies.

Within this heterogenous framework, the Italian rail access charge calculation approach is currently published annually by RFI within its “Prospetto Informativo della Rete” (PIR). The document not only includes the TAC rates and the related calculation method but also all main rules (i.e. infrastructure access procedure, capacity allocation, booking rules, contract characteristics) to be followed by both passenger and cargo RUs for accessing the infrastructure and performing the service. One of the key aspects to be underlined is that within the slot booking process (i.e. capacity allocation), the published procedure guarantees a high-degree of flexibility to rail operators for cancelling reserved slots. The official booking process starts 15 months in advance with respect to the publication date of the rail schedule and this could create issues for cargo rail companies due to either market uncertainty or the possibility to sign contracts without specific details on the timeframe of different services. Because of this, RFI guarantees the possibility to cancel the reservation with little or no penalty fee if notice is given at least a month in advance of the scheduled departure. Such element generates high discrepancies between planned trains originally published on the system schedule and actual utilization rate of the infrastructure. In accordance with the literature, this practice is common and often necessary but companies can use such flexibility to prevent competitors to book slots thus creating barriers to competition and infrastructure underutilization.

PIR can be then considered the main reference source for the rail market in Italy and its content is reviewed by the Italian Transport Regulation Authority (ART), including the published TAC and related computations. Despite this, it is relevant to highlight that in the period of study (i.e. from 2018 onwards) several deviations from the published TAC has been granted thanks to ad-hoc incentives planned by both the National and some regional governments. Such incentives created an unusual situation in which the full TAC has only been paid for the minority part of the studied period.

In accordance with PIR2024, the access charge is calculated as the sum of two components: A and B.

The Component A represents the cost generated by the rail services to the infrastructure manager (i.e. maintenance and energy related costs) and it is calculated as km ran by the train multiplied by three different factors representing the cost generators (i.e. train weight, speed, and power supply). Given the nature of the component A, it is justified by the utilization costs generated and it is directly proportional to the performance of service (i.e. speed), the train characteristics (i.e. power supply), and the amount of cargo transported (i.e. weight).

In 2021, the component A value was about 35mln euro for the whole cargo rail sector.

Component B aims at incorporating the ability to pay of different railway undertakings and the related clients. Given the computational difficulties highlighted above, the current Italian system foreseen a segmentation in different classes that establish specific coefficients to be used for evaluating the €/km fare applicable for the specific service. The segmentation creates levels and sublevels in order to identify the service characteristics to which a specific coefficient (called "binomio", i.e. "binomial") is quantified. The cargo sector is therefore considered a macro-segment for which four subcategories (i.e. binomials) are identified: NIGHT trains (identified as "Night"), INTERNATIONAL trains (identified as "Jo.Int"), ordinary NATIONAL trains (identified as "Na.Da.Base"), and NATIONAL trains considered as outliers (identified as

"Na.Da.Top") that are using the network either for short (i.e. below 100km) or long (i.e. above 800km) distances. Night trains are defined as such if they are operated in the period 22-06 for most of the trip duration. A Fifth sub-categorisation (identified as "Promo") is linked to special rates included in a separated catalogue. Component B factors vary substantially from 2,415 €/km of the JO.INT to the 1,209 €/km of the Na.Da.Top and to 0,961 €/km of the NIGHT sub-category showing differentiated abilities to pay and an indirect incentive to use night slots. The component B reflects the market characteristics and the value that rail cargo users recognize to different service combinations once they have chosen the rail solution.

In 2021, Component B was about 85 mln euro.

Given the above-mentioned value, Component B over the years have constantly counted about 70% of the overall access charge billed by the RFI to the cargo RUs.

Table 1 sums up the quantitative value of the single TAC components.

Table 1: Cargo TAC, composition summary

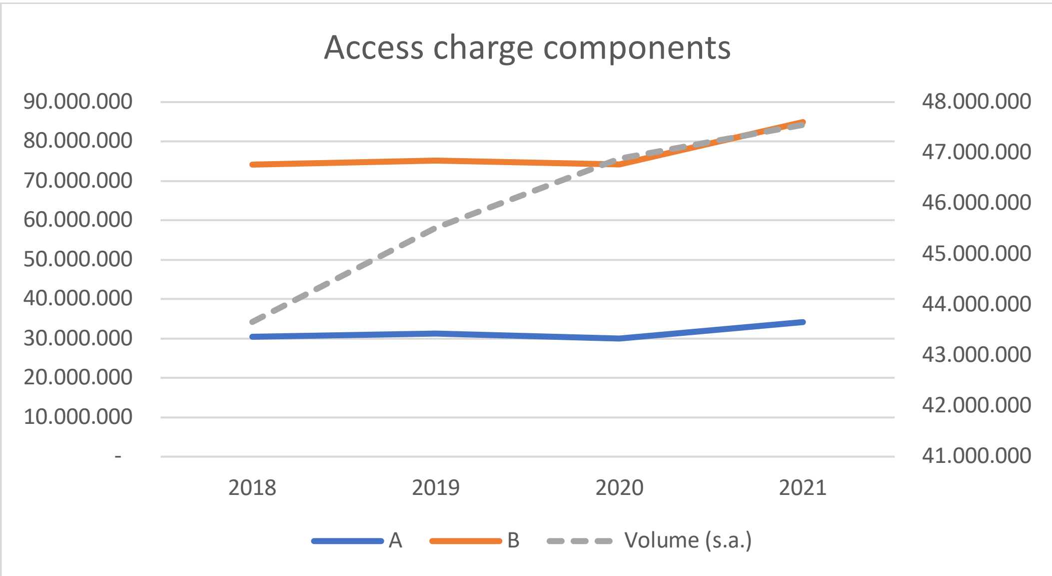
Component A	
Weight Factor (€/km)	
0 - 500 t	0,133
500 - 1000 t	0,387
1000 - 1500 t	0,641
>1500 t	0,896
Speed Factor (€/km)	
0 - 100 km/h	0,122
100 - 150 km/h	0,201
> 150 km/h	1,1
Energy Supply factor (€/km)	
Electric I	0,024
Elecric II (2 pant, and max speed >250km/h)	0,048
Diesel	0
***Cargo - Component B** (€/km)*	
JO.INT.	2,415
NA.DA. Top	2,033
NA.DA. Base	1,209
Night	0,961

Source: Own elaboration on PIR2024 data

At the top of components A and B, some specific extra-charges could also be applicable if certain extra-services are needed (e.g. transit to border stations).

Looking at the components' trends a correlation between the two can be highlighted, as also visually shown in Figure 3. This connection is present despite the two components being linked to different elements. Considering rail volumes – calculated in tonnes-km –, the cargo quantity transported by rail seems independent from the components' trend apart from the last period of reference. This counterintuitive differentiated trend is due to the discounts and incentive policies that have greatly impacted the amount of TAC collected in respect with the published charges: since 2018 the component B actually billed has been substantially reduced so to incorporate discounts and incentives. In 2020, for instance, about 80% of trains paid a reduced Component B and about 25% had the Component B zeroed. Substantial differences can be observed in 2022, creating the spike shown in Figure 3.

Figure 3: Access charge trends



Source: Own elaboration on RFI data

As part of the ongoing incentive schemes, starting from 2016 (DM 61/2016) a series of discount factors have been introduced with the aim to achieve national goals in terms of modal shift at either national or regional level. The magnitude of such discounts varies substantially from 1,44 €/KM of the so-called "Eco-bonus" – applicable to all national cargo trains – to 1,30 €/km of the special contribution dedicated to train operated on the South Italy rail infrastructure. Other scope related incentives (e.g. ferro-bonus for shifting cargo from road to rail) or temporary measures (e.g. law decrees n.34/20, 73/21, and 4/22; law n.178/20 either zero or substantially reduced the Component B in order to cope with the pandemic impact on logistics) have also been present, impacting both TAC actual value and the RUs' competitive behaviour.

Given the situation described above, on the one hand the mechanism for determining the access fee is simple and well defined by the PIR; on the other hand, the variety of discount factors applicable and the operators' behavior in respect with the capacity allocation process – i.e. possibility to easily cancel the "purchased" slot, discount of TAC as incentive tool – could possibly create distortions of the railway undertakings' behaviors as well as to their capability of properly relate their ability to pay into track access charge.

The TAC elasticity of demand

Introduction

The analysis that follows focuses on the rail cargo market and the elasticity of RUs to TAC changes. In respect to the passenger market, the cargo market is characterised by a variety of operators, with different size, organisational structure, equipment ownership rate, market served, and geographical scope. Similarly, the demand for transport is generally characterised by different drivers (e.g. value for time and route is generally considered different and depending on specific cargo needs) and subject to different rate of substitution in respect with alternative logistics services. As such, companies' behaviour is not aligned with what can be expected for passenger RUs and some relevant data are not directly accessible as for the case of the passenger market. Given the above-mentioned framework, the chosen methodological approach is different from the one used for passengers: for the cargo market an econometric estimation of the different abilities to pay seemed more consistent with the data and the overall market characteristics. In order to produce robust estimations, several statistical tests have been performed, while data – shared by RFI and considering all trains circulated in between 2018 and 2022 – have been used. Preliminary results have also been discussed with RUs through an ad-hoc seminar that took place in Milan and the beginning of 2023.

Data

The initial database contains annual data on gross tonne-kilometres circulated from 2018 to 2021. In particular, for each unit, the database provides information on the tonne-kilometres carried, the TAC paid by the RU (separated into total, component A and component B) and the kilometres travelled.[2] Each observation is classified according to: year, origin-destination pair[3], freight segment, weight class, operating speed, type of traction, RU, type of line (HS/HC or conventional), and line category according to ART classification. Furthermore, a set of dichotomous variables indicate if the route is classified as international, if trains on the route are combined and/or are carrying dangerous goods. Starting from this set of information, it was possible to compute the gross tonnes carried and, as a consequence, the TAC (summing-up both component A and component B) per gross tonne for each unit of observation.

[2] It should be noted that the kilometres travelled refer to the sum of the kilometres travelled by all trains. On the other hand, the database does not contain information on the number of trains; therefore, the length of the route cannot be determined.

[3] Notice that origin-destination is defined without distinction of direction, so a service operated with origin A and destination B, is treated exactly the same as a service with origin B and destination A.

Then, the initial database has been rearranged in order to observe the total value of tonne-kilometres moved by a specific RU, on a specific route (origin-destination) in a specific year, and the corresponding average TAC (€/tonne for both component A and component B) paid by the RU. Table 1 reports corresponding basic descriptive statistics for main variables.

Table 2 - Descriptive Statistics

Variables	*Obs.*	*Mean*	*SD*
Tonne-km ('000)	18777	10,107.8	52,317.13
Tonnes		6,729.713	10,358.02
Average TAC per tonne (Component A)		0.0007992	0.0003747
Average TAC per tonne (Component B)		0.0022694	0.0024316
Average TAC (Component A)		0.5824403	0.1947353
Average TAC (Component B)		2.258206	0.625344
Combines services (1=YES, 0=otherwise)		0.174641	0.3385579
Dangerous goods (1=YES, 0=otherwise)		0.0693445	0.2278581

In a second stage of analysis, information on second-level freight binomials (JO.INT, NA.DA.Top, NA.DA.Base, and NIGHT) are exploited to observe the tonne-kilometres moved by a specific railway company, on a specific route (origin-destination), in a specific year, and on a specific binomial.

Methodology

To analyse the elasticity of demand for freight transport, a linear panel model is considered in which tonne-kilometres are a function of the TAC (considering only component B):

$$lnTonneKm_{i,t} = \varphi_i + \varphi_t + \beta_1\, lnTACBTonne_{i,t} + \gamma X_{i,t} + \epsilon_{i,t}, \qquad (1)$$

where i represents the cross-section, i.e. a specific RU on a specific route, with $i = 1, \dots, N$, and t is the index for the time dimension, i.e. year, with $t = 2018, 2019, 2020, 2021$. The dependent variable, $lnTonnKm_{i,t}$, represents total tonne-kilometres moved by a specific RU on a specific route at time t, while the main explanatory variable, $lnTACBTonne_{i,t}$, indicates the TAC (component B) per tonne that on average each RU pays on a specific route at time t. Finally, $X_{i,t}$ represents the set of control variables, i.e. the percentage of combined traffic, and the percentage of traffic

with dangerous goods.[4] The model is estimated including unit specific effects, φ_i, that should help to account for omitted specific time-invariant factors whose omission might bias coefficient estimate, and also time fixed effects, φ_t, that should remove changes in the economic environment that have the same effect on all units (Wooldrige, 2021).
Furthermore, to exploit information on second-level freight binomials on the basis of which the unit TAC of component B is structured, the following model is estimated.[5]

$$lnTonneKm_{i,t} = \varphi_i + \varphi_t + \beta_1\, lnTACBTonn_{i,t} + \beta_2\, lnTariffBTonn_{i,t} * binomial + \beta_3 binomial + \gamma X_{i,t} + \epsilon_{i,t} \quad (2)$$

where i represents the cross-section, i.e. a specific RU on a specific route on a specific binomial, with $i = 1, \ldots, N$, t is the index for the time dimension, i.e. year, with $t = 2018, 2019, 2020, 2021$, and $binomial$ represents a categorical variable that denote different market segments, i.e. JO.INT, NA.DA Top, NA.DA Base, NIGHT.

Results and Discussion

Table 3 shows results from *Ordinary Least Squares* (OLS) estimates of Equation 1. In column (1) it is presented the first basic specification, where only unit and time fixed effects are included in the model, while in subsequent columns different control variables are alternatively included. More specifically, in column (2) the model is estimated including the average TAC (component A) per tonne, while in column (3) the percentage of combined service is added and in column (4) the percentage of traffic with dangerous goods is also included. Finally, in column (5) the estimated model takes all controls into account. The coefficient of $lnTACBTonne$ ranges from -0.12 and -0.32 and it is always negatively significant at the 1% level. By considering the most complete specification in column (5), results show that a variation of 1% in the TAC leads to a variation in the opposite direction of the tonne-kilometres of about 0.12%.

Table 3 - Relationship between TAC (€/tonne) component B and gross Tonne-kilometres Transported.

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
	Dependent Variable: lnTonneKM				
lnTACBTonne	-0.315*** (0.0191)	-0.122*** (0.0199)	-0.310*** (0.0190)	-0.311*** (0.0190)	-0.116*** (0.0198)
Year FE	√	√	√	√	√
Unit FE	√	√	√	√	√
lnTACTonne A		√			√

[4] It is worth recalling that no information is available at train level. The percentage of combined service is therefore obtained by averaging the relevant dummy variable when the database has been aggregated at RU and route level. The same applies to the percentage of traffic with dangerous goods.
[5] Recall that the value of component B is given by $UnitaryToll_B * Kilometers$.

Combined Service			√		√
Dangerous Goods				√	√
Obs.	18,777	18,777	18,777	18,777	18,777
R-Squared	0.063	0.108	0.065	0.066	0.112
Number of panelID	10,548	10,548	10,548	10,548	10,548

Notes: All specifications are estimated via OLS. The dependent variable, $lnTonneKm$, represents tonne-kilometres that a specific RU transport on a specific route i at time t, while $lnTACBTonne_{i,t}$, indicates the TAC (component B) per tonne that on average a specific RU pays on a specific route at time t. The set of control variables includes unit and time fixed effects; *TAC Tonne A,* a variable that accounts for the average TAC per tonne; *Dangerous Goods Traffic* that reflects the percentage of traffic with dangerous goods; and *Combined Service* that represents the percentage of combined service. Robust standard errors clustered at unit level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Results from estimates of Equation (2) are shown in Table 4. In each column the coefficient of the interacted terms refers to the slope of $TACBTonne$ for a specific binomial. In the first specification in column (1) unit and time fixed effects are included, while from columns (2) to (4) other controls are progressively added to the model: average TAC per tonne (component A), percentage of combined service and percentage of traffic with dangerous goods.[6] In particular, considering results in column (4), a 1% increase (decrease) in the TAC might lead to an increase (decrease) of the total tonne-kilometres of about 0.22% for binomial NADA Base, of 0.17% for binomial NADA top, of 0.14% for binomial JO.INT, of 0.11% for binomial NIGHT.

Table 4 - Relationship between TAC (€/tonne) component B and gross Tonne-kilometres Transported: Heterogeneous Effects

	(1) OLS	(2) OLS	(3) OLS	(4) OLS
Dependent Variable: lnTonneKM				
*lnTACBTonne * Jo.Int*	-0.319***	-0.143***	-0.140***	-0.140***
	(0.0331)	(0.0314)	(0.0314)	(0.0313)
*lnTACBTonne * NADA Base*	-0.404***	-0.223***	-0.221***	-0.223***
	(0.0302)	(0.0302)	(0.0301)	(0.0301)
*lnTACBTonne * NADA TOP*	-0.326***	-0.181***	-0.178***	-0.177***
	(0.0226)	(0.0232)	(0.231)	(0.0231)
*lnTACBTonne * Night*	-0.298***	-0.119***	-0.115***	-0.113***
	(0.0299)	(0.0302)	(0.0302)	(0.0301)
Year FE	√	√	√	√
Unit FE	√	√	√	√
lnTAC Tonne A		√	√	√
Combined Service			√	√
Dangerous Goods				√

[6] Note that the binomial fixed effects that are necessary for the computation of the interaction terms between the TAC and the variable *binomial* are omitted due to collinearity with the unit and time fixed effects.

Obs.	26,597	26,597	26,597	26,597
R-Squared	0.065	0.098	0.099	0.101
Number of panel ID	15,614	15,614	15,614	15,614

Notes: All specifications are estimated via OLS. The dependent variable, $lnTonneKm$, represents tonne-kilometres that a specific RU transport on a specific route i at time t, on a specific binomial while $lnTACBTonne_{i,t}$, indicates the TAC (component B) per tonne that on average a specific RU pays on a specific route at time t on a specific binomial. The term $lnTariffBTonne_{i,t}$, is interacted with the categorical variable *binomials* that reflects different market segments: JO.INT, NA.DA Top, NA.DA Base, NIGHT .The set of control variables includes unit and time fixed effects; *TAC Tonne A,* a variable that accounts for the average TAC per tonne; *Dangerous Goods Traffic* that reflects the percentage of traffic with dangerous goods; and *Combined Service* that represents the percentage of combined service. Robust standard errors clustered at unit level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Heterogeneous Effects

Data

The database used to analyse possible heterogeneous effects with respect to different network or traffic characteristics contains information on each individual train circulated on the railway network in the period 2018-2022. For each train it is known the origin and destination, date and time of departure, railway undertaking, average weight, category, TAC (with the specification of both component A and component B), kilometres travelled, commercial speed, and kilometres travelled by dangerous goods. Furthermore, other information on route and/or network characteristics are included to this database. In particular, two dichotomous variables are included to indicate whether a train is combined or conventional and whether a train travels mostly during the day or at night. Furthermore, it is considered whether the train travels on a high-performing line or not, whether the origin and/or destination coincides with a port or an intermodal node, and the day in which the trains start and end their trips (weekday/festive).

It is worth noting that the database covers a fairly limited period of time and the only change in TAC recorded over the period is that related to the lowering or cancellation of part of the TAC as a result of the temporary measures applied due to the COVID-19 pandemic. In addition, in the years analysed, there is no phenomenon of the opposite sign, i.e. a large increase in TAC or in its components.

The database is reorganised so that the total train-kilometres circulated on each route can be observed in each year.[7] Accordingly, after calculating the trains-kilometres of each individual train, these are aggregated at route level, and also the kilometres travelled by dangerous goods and the TAC paid (summing-up both component A and component B) are aggregated at the same level. The kilometre length of each route, on the other hand, is calculated as the average of the kilometres travelled by each train on a specific route.[8] Also other variables related to individual trains are aggregated at route level by computing the average value.[9] Finally, in order to conduct the analysis, the overall TAC (and its component A and component B) per train and per tonne is computed. Table 5 shows the relevant descriptive statistics.

[7] Note that in this case the route is sensitive to the difference between origin and destination, so that a route from A to B differs from a route from B to A.

[8] The kilometres travelled, although very similar, are not identical for all trains on the same route.

[9] Note that we only sample routes with 100% day or 100% night trains and only routes with 100% combined or 100% conventional service. We therefore exclude routes with mixed scenarios.

Table 5 - Descriptive Statistics

Variables	*Obs.*	*Mean*	*SD*	*Min*	*Max*
Average TAC per train (A+B)	20801	494.91	473.60	0.25	4353.74
Average TAC per tonne (A+B)		0.73	0.86	0.00	19.68
Total Train-KM		2,066.24	9,109.38	1.00	273,112.1
Total Trains		8.60	32.65	1.00	631
Total Tonne-KM		1,851.28	9,077.96	0.16	313,457.1
Total Tonnes		7,189.23	32,473.59	18.00	1,064,437
Train Time (1=Night, 0=Day))		0.13	0.34	0	1.00
Quality (1=high performing network, 0=otherwise)		0.12	0.33	0	1.00
Combined Service (1=YES, 0=otherwise)		0.16	0.37	0	1.00
Commercial Speed (1=speed<=50km/h, 2=90km/h>=speed>50km/h, 3=speed>90km/h)		1.67	0.49	1.00	3.00
Port (1=YES, 0= otherwise)		0.16	0.37	0	1.00
Route Length		282.506	243.04	1.00	1,513.54
Dangerous goods (1=YES, 0=otherwise)		0.06	0.24	0.	1.00
Weekdays (1=weekday, 2=festive, 3=mixed)		1.94	0.35	1.00	3.00

Methodology

The model used is a linear regression model with interaction terms that allow to observe whether heterogeneous effects exist with respect to certain dimensions. The model can be expressed as follows:

$$\begin{aligned} lnTrainKm_{i,t} &= \varphi_i + \varphi_t + \beta_1\, lnTACABTrain_{i,t} + \beta_2\, lnTACABTrain_{i,t} * Z_i \\ &\quad + \beta_3 Z_i + \gamma X_{i,t} + \epsilon_{i,t} \end{aligned} \tag{3}$$

where $lnTrainKm$ represents train-kilometres circulated on path i at time t, with *t=2018,2019,2020,2021,2022*, while the main explanatory variable, $lnTACABTrain_{i,t}$, indicates the real TAC (component A and B) per train that on average each RU pays on

a specific route at time t[10]. Z_i represents alternatively different categorical variables accounting for one or more of the following characteristics: the length of the route, the network quality (1=high performing line, 0 otherwise), type of service (combined or conventional), the presence of a port or an intermodal node at the origin and/or destination of the route, train time (travelling predominantly at night or during the day).[11] Finally, $X_{i,t}$ represents the set of control variables.
It is worth noting that despite the inclusion of fixed effects and a complete set of controls, the model presented cannot lead to a causal interpretation of the results, and therefore results further presented should be interpreted as correlations between the TAC and the demand for freight transport.

Results and Discussion

Table 6 shows results obtained by estimating Equation 3. In particular, in columns (1) and (2) it is explored the presence of heterogeneous effects according to the route length: the dummy variable $Lenght\ Dummy$ is interacted with the main explanatory variable, $lnTACABTrain$. Results in column (1) show that for routes between 100 km and 800 km[12] a 1% increase (decrease) in the TAC (€/train) corresponds to a decrease (increase) in train-kilometres of about 0.16%, while for routes of less than 100 km or more than 800 km the same variation in the TAC leads to an opposite change in train-kilometres of about 0.3%. Indeed, the difference in the coefficient magnitude is equal to -0.134 and it is significant al 1% level. These findings are confirmed in column (2) where the full set of controls is accounted for. In particular, the model is estimated considering, in addition to the total tonnes transported and the length of the route (both with a dummy both with a continuous variable), other relevant characteristics, i.e. the presence or the absence of trains with dangerous goods, the type of service (conventional or combined), the time slot in which the train travelled (mostly during the day or at night), the commercial speed, and the day in which the trains on the route started and ended the trip (weekday/festive). Also in this case, the variation of 1% in the TAC (€/train) leads to an opposite sign variation in the train-kilometres and the variation is higher (of about 0.13%) in the case of routes of less than 100 km or more than 800 km.
Furthermore, in columns (3) and (4) the term $lnTollABTrain$ is interacted with $Train\ Time$, a dummy variable which takes value 1 if trains on a route travel mostly at night, and 0 otherwise. Results in column (3) show that when trains travel mostly at night a variation of 1% in the TAC (€/train) leads to a an opposite sign variation in

[10] The term "real" refers to the fact that $lnTACABTrain_{i,t}$ is adjusted for inflation. In particular, the base year selected is 2022.
[11] Travelling predominantly at night means ≥51% route in the 22-06 slot.
[12] Tests on different length range have been performed but no evidence of a different pattern in respect with current regulatory boundaries have been found. In particular, most national trains have value around the average (i.e. 240km) with the tails (i.e. <100 and >800) representing specific train patterns (i.e. connecting border stations and or specific logistics hubs, North-South long distance connections).

lnTACABTrain of about 0.18%, and for train travelling mostly during the day the variation is only slightly higher (about -0.20%). The difference between the two coefficients equals to about 0.03 is statistically significant at 10% level. These results are also confirmed after including the full set of control variables (column (4)).
In columns (5) and (6) the main independent variable is interacted with the dummy variable *Quality* which takes value 1 when the line is considered high-performing and 0 otherwise. Results show that the elasticity is higher in the case of high-performance lines: indeed, in both specifications a 1% increase (decrease) in the TAC per train leads to a 0.28% decrease (increase) train-kilometres, i.e. 0.10% more than in the case of non-performing lines.
In columns (7) and (8) possible heterogeneous effects according to the type of service are investigated. Indeed, the interaction is constructed using the dummy *Combined Service* which takes value 1 in presence of combined service, and 0 in presence of conventional service. Results from this analysis show that a 1% increase (decrease) in the TAC per train leads to a 0.19 %-0.20% decrease (increase) of train-kilometres in the case of conventional traffic, while the variation decrease of about 0.04% for routes with combined service.
The last heterogeneous effect is explored in columns (9) and (10) where the interaction accounts for the dummy variable *Port* which takes value 1 if at the origin and/or destination of the route there is a port or an intermodal node. In this case the difference between the two coefficients is very small and not statistically significant.
Overall, the results show that for very short (<100 km) or very long (>800 km) routes, the elasticity of *lnTrainKm* to the access charge per train is higher than for routes between 100 and 800 km in length, and this is probably due to the fact that the former experience stronger competition from other modes of transport. In addition, routes on which night trains run are less sensitive to TAC variations than those on which trains run in the daytime slot, and this can be explained both by the fact that night trains under the current tariff structure are those that pay a lower unit TAC (B component) and by the fact that night trains are basically tied to terminal opening times, effectively reducing the impact of the TAC component. Moreover, the elasticity of train-kilometres to the access charge appears to be higher for trains using high-performing lines, and this can be interpreted in light of the fact that a price decrease would have a greater impact on increasing train-kilometres on routes that are considered qualitatively better. Furthermore, the lower elasticity associated with combined trains can be attributed to the greater complexity of combined transport, and thus a slower response to changes in the TAC. Finally, it is worth noting that all results are confirmed when it is used as main dependent variable the TAC per train not adjusted for inflation.

Table 6 - Relationship between TAC (€/train) and Train-kilometres Circulated: Heterogeneous Effects – Length, Train Time, Quality of the Network, Type of Service, and Presence of Ports

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) OLS
	Dependent Variable: *lnTrainKM*									
lnTACABTrain	-0.159***	-0.170***	-0.207***	-0.203***	-0.179***	-0.190***	-0.194***	-0.206***	-0.191***	-0.201***
	(0.0101)	(0.0102)	(0.0103)	(0.0103)	(0.0104)	(0.0105)	(0.0102)	(0.0103	(0.0108)	(0.0109)
*lnTACABTrain*Length Dummy=1*	-0.134***	-0.127***								
	(0.0184)	(0.0183)								
*lnTACABTrain*Train Time=1*			0.025*	0.0258*						
			(0.0145)	(0.0145)						
*lnTACABTrain*Quality=1*					-0.103***	-0.091***				
					(0.0272)	(0.0271)				
*lnTACABTrain*Combined Service=1*							0.0398***	0.0388***		
							(0.0131)	(0.0130)		
*lnTACABTrain*Port=1*									-0.00802	-0.0039
									(0.0199)	(0.02)
Year FE	√	√	√	√	√	√	√	√	√	√
Unit FE	√	√	√	√	√	√	√	√	√	√
Route Length	√	√	√	√	√	√	√	√	√	√
Ln Total Tonnes	√	√	√	√	√	√	√	√	√	√
Lenght Dummy	√	√								
Dangerous Goods		√		√		√		√		√
Combined Services		√		√		√		√		√
Train Time (day/night)		√		√		√		√		√
Commercial Speed		√		√		√		√		√
Weekday/Festive		√		√		√		√		√
Obs.	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801
R-squared	0.757	0.763	0.757	0.761	0.756	0.761	0.758	0.761	0.755	0.760
Number of Panel ID	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332

Notes: All specifications are estimated via OLS. The dependent variable, $lnTrainKm$, represents train-kilometres circulated on path i at time t, while $lnTACABTrain_{i,t}$, indicates the TAC (component A and B) per train that on average each RU pays on a specific route at time t. The interaction term in columns (1) and (2) is constructed using the variable $Lenght\ Dummy$, which equals 1 if route <100km or >800km, 0 otherwise; in columns (3) and (4) the explanatory variable is interacted with *Train Time*, which indicates if trains on a route travel mostly at night (=1) or during the day (=0); in columns (5) and (6) it is interacted with the dummy variable *Quality* which takes value 1 when the line is considered high-performing and 0 otherwise; in columns (7) and (8) the interaction is constructed using the dummy *Combined Service* which takes value 1 in presence of combined service, and 0 in presence of conventional service; and in columns (9) and (10) the interaction accounts for the dummy variable *Port* which takes value 1 if at the origin and/or destination of the route there is a port or an intermodal node. The set of control variables includes: *Route Length,* a continuous measure of the route length expressed in kilometres; *Total Tonnes*, representing toral gross tonnes transported on a route, *Dangerous Goods Traffic*, a dichotomous variables which indicates if trains on a route carry dangerous goods (1= yes, 0 otherwise); *Combined Service; Commercial Speed* which is a categorical variable (1 if speed $\leq 50\ km/h$, 2 if speed $> 50\ and < 90 km/h$, 3 if speed $\geq 90\ km/h$; *Weekday/Festive*, a categorical variable that if the majority of trains on the route started and ended the trip on a weekday takes value 1, on a festive day takes value 2, while it takes value 3 when the majority started on a weekday (festive day) and ended the tip on a festive day (weekday). All specifications are estimated including unit and time fixed effects. *Quality* and *Port* variables are omitted from the list of controls for collinearity with fixed effects. Robust standard errors clustered at route level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

The model is also estimated using as dependent variable total tonne-kilometres and as main explanatory variable the TAC per tonne. Overall results show that the elasticity of demand expressed in tonne-kilometres shows higher values than demand expressed in train-kilometres. This reflects the complexity of the organisation of rail transport and the different loading capacity of trains compared to the traffic units used by competing modes of transport. Results on the heterogeneous effects with respect to different route length and different quality of network are confirmed, it is not detected any other statistical difference in other cases.[13]

The second part of the analysis is devoted to the inspection of additional heterogeneous effects that may affect the category of trains with a length of more than 100 km and less than 800 km.

Four dummy variables are constructed by combining information on two characteristics, i.e. line quality and service type: *Conventional Standard* takes value 1 if *Combined Service=0* and *Quality=0*, 0 otherwise; *Combined Standard* takes value 1 if *Combined Service =1* and *Quality=0*, 0 otherwise; *Conventional Top* takes value 1 if *Combined Service =0* and *Quality=1*, 0 otherwise; and *Combined Top* takes value 1 if *Combined Service =1* and *Quality=1*, 0 otherwise. Then, the term $lnTonnABTrain$ is interacted with a categorical variable that takes into account the type of route as defined above and assumes the corresponding four possible values, (1=*Conventional Standard*, 2= *Combined Standard*, 3= *Conventional Top*, 4= *Combined Top*).

Results from this analysis are shown in Table 7, where it is possible to observe the slope of $lnTACABTrain$ for *Conventional Standard*, *Combined Standard*, *Conventional Top*, *Combined Top.* All coefficients are negative and statistically significant. The magnitude of coefficients slightly differs across different categories, showing that for the category *Combined Top* a variation of 1% in $lnTACABTrain$ leads to an opposite sign variation in train-kilometres of about 0.17%-0.20%, while the same variation leads to an opposite sign variation in train-kilometres of about 0.12%-0.13% in the case of the category *Conventional Top.*

[13] Results from this analysis are reported in Appendix.

In general, results confirm a low value of elasticity of demand for routes between 100 and 800 km, reflecting the higher competitiveness of rail transport compared to other modes of transport. The different coefficients associated with the four categories considered reflect the ability to pay of the different categories. Conventional traffic predominantly used by low-unit-value goods categories has a lower elasticity when using high-performing lines, conversely, combined traffic has a higher elasticity on the latter.

Table 7 - Relationship between TAC (€/train) and Train-kilometres Circulated: Heterogeneous Effects – Conventional Standard, Combined Standard, Conventional Standard, Combined Top.

	(1) OLS	(2) OLS
Dependent Variable: *lnTrainKM*		
*lnTACABTrain*Conventional Standard*	-0.151***	-0.161***
	(0.0112)	(0.0113)
*lnTACABTrain*Combined Standard*	-0.135***	-0.146***
	(0.0221)	(0.0220)
*lnTACABTrain*Conventional TOP*	-0.119***	-0.128***
	(0.0333)	(0.0338)
*lnTACABTrain*Combined TOP*	-0.174*	-0.198**
	(0.0945)	(0.0945)
Year FE	√	√
Unit FE	√	√
Route Length	√	√
Ln Total Tonnes	√	√
Dangerous Goods		√
Combined Services		√
Train Time (day/night)		√
Commercial Speed		√
Weekday/Festive		√
Obs.	14,472	14,472
R-squared	0.797	0.798
Number of Panel ID	8,787	8,787

Notes: All specifications are estimated via OLS. The sample contains only routes wight length >100 km and <800km. The dependent variable, $lnTrainKm$, represents train-kilometres circulated on path i at time t, while $lnTACABTrain_{i,t}$, indicates the TAC (component A and B) per train that on average each RU pays on a specific route at time t. The term $lnTACABTrain_{i,t}$, is interacted with a categorical variable that reflects different combinations of two separate characteristics: quality of the network and type of traffic (combined or conventional). The set of control variables includes: *Route Length,* a continuous measure of the route length expressed in kilometres; *Total Tonnes*, representing toral gross tonnes transported on a route, *Dangerous Goods Traffic*, a dichotomous variables which indicates if trains on a route carry dangerous goods (1= yes, 0 otherwise); *Combined Service*, which takes value 1 in presence of combined service, and 0 in presence of conventional service*; Commercial Speed* which is a categorical variable (1 if speed $\leq 50\ km/h$, 2 if speed $> 50\ and < 90 km/h$, 3 if speed $\geq 90\ km/h$; *Weekday/Festive*, a categorical variable that if the majority of trains on the route started and ended the trip on a weekday takes value 1, on a festive day takes value 2, while it takes value 3 when the majority started on a weekday (festive day) and ended the tip on a festive day (weekday). All specifications are estimated including unit and time fixed effects. Robust standard errors clustered at route level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Also in this case, results are confirmed when using a dependent variable not adjusted for inflation. Moreover, the analysis is replicated by using as dependent variable total tonne-kilometres and as main explanatory variable the TAC per tonne and results from this analysis are presented in Appendix.
The last part of the analysis is devoted to analysing possible heterogeneity associated to geographic areas. In particular, in Table 8 the coefficient $lnTACABTrain$ is interacted with a categorical variable that takes into account all possible origin-destination pairs considering Italian NUTS-1 regions.[14]
In the North of the country, routes with origin-destination in the same NUTS-1 regions are basically trains with a rather low average distance which therefore suffer greatly from road competition, and this explains the relatively high coefficients. In the rest of Italy, this is not confirmed probably due to the topography of the infrastructure network which favours North-South (and vice versa) and not transversal routes. Furthermore, on the North-West South routes the rather high value of elasticity is probably due to the existence of an additional transport alternative represented by combined maritime transport. Finally, trains with a foreign origin or destination generally have a lower elasticity with the exception of the North-Eastern case.

Eventually, a test comparing general elasticity – i.e. not considering neither train or network categories nor binomials and other factors – for train-km and tonne-km to variations of TAC (considering both component A and B) has been developed, in order to determine if considering different unit of measures could generate different point of view. It is interesting to highlight that results show a lower value for train-km (i.e. -0,156) than for tonne-km (i.e. -0,431). This difference can be justified by the major difficulties to add new trains in respect to the possibility to vary the amount of cargo on board of single trains as well as to the contractual obligations of RUs that often relate to tonnes and shipments rather than to the number of trains specifically.

[14] Note that for the purpose of this analysis each origin-destination pair is undirected, e.g. routes with origin in the South and destination in the North are considered equal to those with origin in the North and destination in the South.

Table 8 - Relationship between TAC (€/train) and Train-kilometres Circulated: Heterogeneous Effects – Origin-Destination Geographic Area

	(1) OLS	(2) OLS
Dependent Variable: *lnTrainKM*		
*lnTACABTrain*North-west Norht-west*	-0.241***	-0.242***
	(0.0236)	(0.0235)
lnTACABTrain North-west North-east*	-0.207***	-0.216***
	(0.0183)	(0.0183)
lnTACABTrain North-west Centre*	-0.137***	-0.153***
	(0.0275)	(0.0271)
lnTACABTrain North-west South*	-0.251***	-0.263***
	(0.0607)	(0.0613)
lnTACABTrain North-west Foreign Country*	-0.128***	-0.138***
	(0.0330)	(0.0330)
*lnTACABTrain*North-east Norht-east*	-0.275***	-0.276***
	(0.0219)	(0.0219)
lnTACABTrain North-east Centre*	-0.132***	-0.159***
	(0.0223)	(0.0230)
lnTACABTrain Centre Centre*	-0.157***	-0.177***
	(0.0454)	(0.0483)
lnTACABTrain North-east South*	-0.106***	-0.119***
	(0.0332)	(0.0317)
lnTACABTrain North-east Foreign Country*	-0.214***	-0.221***
	(0.0273)	(0.0276)
lnTACABTrain Centre South*	-0.157***	-0.172***
	(0.0374)	(0.0391)
lnTACABTrain Centre Foreign Country*	-0.0043	-0.0626
	(0.0420)	(0.0403)
lnTACABTrain South South*	-0.146***	-0.160***
	(0.0385)	(0.0387)
lnTACABTrain South Foreign Country*	0.0097*	0.0988*
	(0.0582)	(0.0599)
lnTACABTrain Foreign Country Foreign Country*	-0.00236	-0.0459
	(0.0810)	(0.0803)
Year FE	√	√
Unit FE	√	√
Route Length	√	√
Ln Total Tonnes	√	√
Dangerous Goods		√
Combined Services		√
Train Time (day/night)		√
Commercial Speed		√
Weekday/Festive		√
Obs.	20,801	20,801
R-squared	0.757	0.762
Number of Panel ID	13,132	13,132

Notes: All specifications are estimated via OLS. The dependent variable, $lnTrainKm$, represents train-kilometres circulated on path i at time t, while $lnTACABTrain_{i,t}$, indicates the TAC (component A and B) per train that on average each RU pays on a specific route at time t. The term $lnTACABTrain_{i,t}$, is interacted with

15 possible origin-destination pairs. The set of control variables includes: *Route Length,* a continuous measure of the route length expressed in kilometres; *Total Tonnes*, representing toral gross tonnes transported on a route, *Dangerous Goods Traffic*, a dichotomous variables which indicates if trains on a route carry dangerous goods (1= yes, 0 otherwise); *Combined Service*, which takes value 1 in presence of combined service, and 0 in presence of conventional service; *Commercial Speed* which is a categorical variable (1 if speed $\leq 50\ km/h$, 2 if speed $> 50\ and < 90 km/h$, 3 if speed $\geq 90\ km/h$; *Weekday/Festive*, a categorical variable that if the majority of trains on the route started and ended the trip on a weekday takes value 1, on a festive day takes value 2, while it takes value 3 when the majority started on a weekday (festive day) and ended the tip on a festive day (weekday). All specifications are estimated including unit and time fixed effects. *Area dummies* are omitted from the list of controls for collinearity with unit and time fixed effects. Robust standard errors clustered at route level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Analysis of the balance sheets of railway undertakings

Introduction

This section aims to provide a summary of the main balance sheet ratios of railway undertakings (RUs) that have operated on the Italian railway network in recent years. Specific statistics are here not shown but are available from the authors' of the report. The rationale for presenting the following summary of the financial assessment is linked to the fact that a better knowledge of company performance and of the items that define the cost of production contributes to a better understanding of the spending capacity (ability to pay) of these companies with respect to the TACs paid for access to the infrastructure and of their end customers with respect to the cost of rail freight transport.
For each company, consolidated financial statements were considered for a 9-year time window, from 2013 to 2021, using data retrieved through the Aida - Bureau van Dijk database: 22 companies have then been considered but for three of them some years were missing from the database

Table 9 presents aggregated data on the profits made by RUs. From the historical analysis of the data, it can be seen that in 2020 and 2021 the percentage of companies making a loss increased considerably compared to previous years.

Table 9 - RUs' profits

	2021	2020	2019	2018	2017	2016	2015	2014	2013
Companies making profits (%)	70%	64%	82%	81%	90%	100%	79%	84%	68%
Companies making a loss (%)	30%	36%	18%	19%	10%	0%	21%	16%	32%

The effect caused by the pandemic, which doubled the number of RUs reporting a loss in 2020 compared to the previous year, is evident. In 2021, there is a slight reduction in this percentage, but not yet able to return to previous values.

The RUs considered

On the basis of the balance sheets collected in the AIDA database, it is possible to classify the RUs on the basis of the sales revenues recorded in the balance sheets for the year 2021 .

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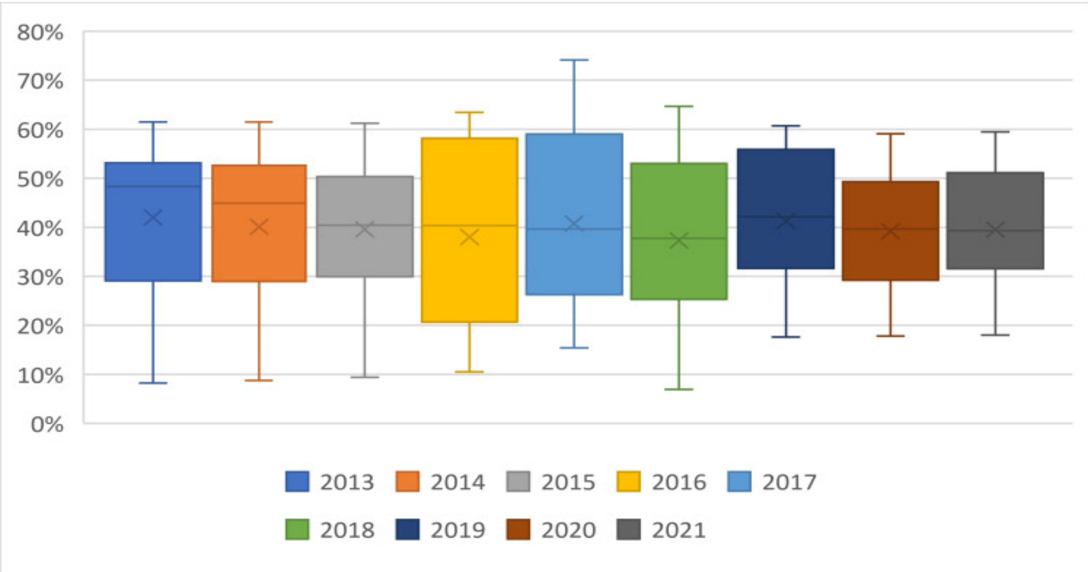
Analysis of the cost of production

The cost of production of the RUs can be broken down into the main items concerning expenses for raw materials and consumables, services, use of third-party assets, depreciation, and personnel costs.

The TAC - understood as the sum of components A and B - paid by the RUs to RFI is included in the balance sheet under the item "cost of services", which in turn, ontributes to the RU's cost of production.

Figure 6 – Distribution of the ratio cost for services and cost of production for the period 2013-2021



Source: Elaboration from AIDA - Bureau van Dijk data

The "cost of service" component turns out to have a rather variable weight depending on the RUs as shown in Figure 6 where for each of the years 2013-2021 the distribution of the percentage share of the cost of services in relation to the cost of production of the RUs (whose balance sheet was retrieved from the AIDA database) is shown.

While the average value for the sample is always between 40 and 50 per cent of the value of the cost of production in the various years considered, for some companies the expenditure on services may even exceed 60 per cent, while for others it drops as low as 10 per cent. In the years 2020 and 2021, the average for the RUs considered shows a reduction compared to the value of the previous year, as a consequence of the incentive measures that led to the reduction and zeroing of the network access charge.

The effect of the discounts on the part B of the TAC is evident: for all the RUs in the sample the access charge (i.e. the sum of the A and B components) stands at a percentage value of less than 10% of the production cost.

This means that, given the percentage ratios in 2021, a 10% change in the TAC would only have an impact of 1% on the RU's cost of production.

On the other hand, the absolute values of the cost of production and the cost of services for the three-year period 2019-2021 show both the absolute values derived from the balance sheets and the value per train-km performed in the year (on the national rail network only, therefore excluding foreign routes[15]). The latter are very much affected by the specificities of individual companies – as the ratio of "long" to "short" trains, the weight of international trains, etc. - and the role that distance, i.e. the length of the routes served, plays in their determination is evident. It is therefore considered more meaningful to check the variations of costs per train-km over time for each individual RU. As far as the cost per service, which includes the TAC, is concerned, it is lower in 2021 for all RUs than in 2019.

Profitability analysis

EBITDA or gross operating margin (MOL, in Italian) represents the profit for the year before taxes, depreciation and amortisation and is the indicator normally used to assess the operating performance of a company. In particular, EBITDA measures a company's ability to generate profits through its core business.

The data shows that there is only one RU whose EBITDA/sales ratio is negative. Focusing on the three-year period 2019-2021, characterised by the Covid-19 pandemic, it is worth noting that for 7 RUs in the sample, the EBITDA recorded in 2021 was higher than that recorded in 2019.

Main profitability ratios

The profitability of the companies is usually summarised by means of appropriate indices. Among those most representative of the relationship between RUs and RFI are the following:

- ROA, return on assets;

[15] This means that in case of international rail services, the part of the voyage spent on the foreign railway networks is not considered, thus the values in terms of train-km are overestimated.

- ROE, return on equity;

- ROI, return on investment

- ROS, return on sales.

Return On Sales (ROS)expresses the ability of companies to charge profitable prices relative to production costs. In general, a deterioration in the performance of the RUs is observed the last surveyed years as a result of the pandemic; in fact, while there were only 3 RUs with a negative index in 2019, in 2020 and 2021 this number rises to 6.

The Return On Assets (ROA) expresses the ability of the RU to generate an income stream from the conduct of its core business and is to be compared with the interest rate paid on debt capital. The data shown in the table highlight that 5 RUs in the sample recorded in 2021 a negative value of ROA (they were 6 in the previous year). The median value for 2021 is equal to 2.12% a little bit lower than the median value of the cost of capital (2.18%).

The Return On Investment (ROI) shows a decline coinciding with the pandemic period and a recovery in 2021, although 4 RUs still record a negative ratio. The median value in 2021 is 5.1%, still higher than the inflation rate recorded in the same year.

Finally, the return on equity (ROE) ratio expresses the return for the venture capital holders of the company. In 2021, only 3 RUs recorded a negative ratio, but it should be noted that the figure is not available for 4 RUs that recorded a negative ratio in 2020. The median value is 3.8% in 2020 and 5.2% in 2021, thus recovering.

Solvency of RUs

An important characteristic for the evaluation of a company is its solvency, i.e. its ability to meet its liabilities.

Among the ratios used for this kind of analysis, the debt-equity ratio shows the weight of financial debt compared to the company's durable resources: i.e. capital, reserves and retained earnings. The greater the weight of financial debt in relation to the company's equity, the greater the risk of the financial structure.

With few exceptions, no relevant problems can be detected with regard to the solvency of the RUs.

Fixed asset to equity capital margin, which indicates the ability to cover investments with equity capital, also shows for the sampled companies a worsening trend as a result of the Covid pandemic.

The direct surveys

During the meeting held on 15 February 2023 at the "Piccini" room at the station of Milano Greco Pirelli, during which RFI illustrated to the RUs the purpose of the work commissioned to the Universities, in the presence of some ART officials, the University of Genoa illustrated the econometric model on the basis of which the first estimates were made (already discussed in previous chapters).

During the discussion that followed the presentation, the need emerged for a deeper understanding of the characteristics that have the greatest impact on the RUs' determination of the scheduled timetable, as well as of the causes that lead them not to carry out all the paths in the scheduled timetable or to request the introduction of new paths in the timetable.

In the days that followed, two surveys were produced in agreement with RFI:

- a questionnaire[16] consisting of 23 questions aimed at highlighting the critical aspects of the demand determination process and the ability of the current binomials to capture any differentiation in demand;
- a pairwise comparison of 10 attributes considered relevant for the determination of path demand.

All freight RUs that operated on the national network in at least one of the years covered by the survey were invited to take part in both surveys and asked to return their responses within 3-4 weeks of submission (which took place in March).

Main results of the direct surveys

12 RUs responded to the survey (attached), representing 69% of the kilometres travelled by all freight RUs and 6% of freight trains by 2022, as shown in Table 10.

Table 10 - Representativeness of questionnaire respondents (year 2022)

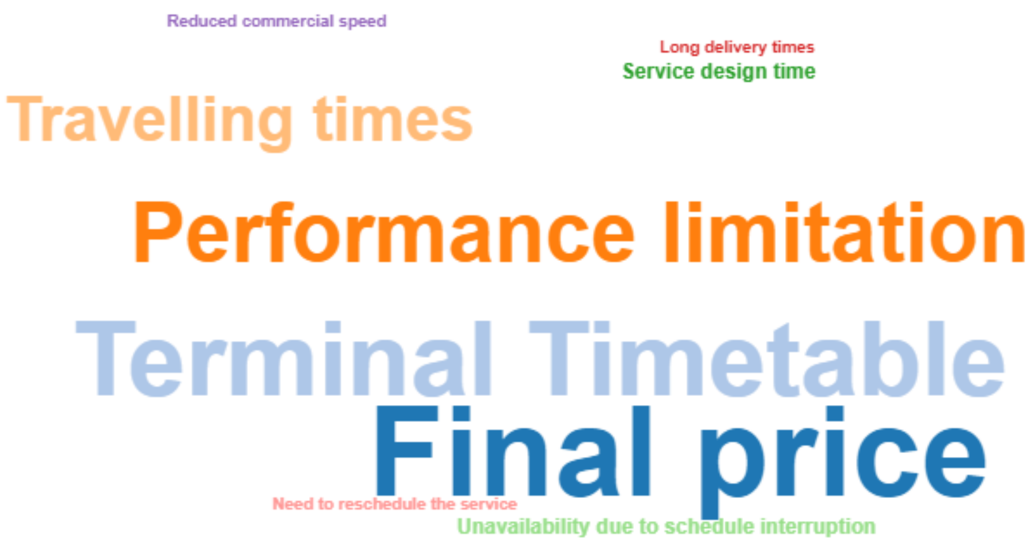
	Survey participants	Total freight RUs	% Respondents
Km	34,755,487.2	50,042,166.6	69.5%
Av. Weight (gross)	135,884,842,0	215,760,118.0	63.0%
Freight trains (nr.)	131,945.0	203,061.0	65.0%
TAC: Component A	23,219,353.4	33,481,856.8	69.3%
TAC: Component B	56,242,169.3	80,040,884.8	70.3%

Source: Own elaboration on RFI data

[16] Included in Annex 2

Out of the 12 RUs that took part in the survey, one third mainly realised combined trains, another third mainly realised conventional trains, and finally the remaining third realised between 20 and 50 per cent combined trains in 2022.
The questionnaire, which required a maximum of 23 questions to be answered, was set up trying to use closed-ended questions as far as possible (according to the 5-response Likert scale, where the answer 1 indicates the lowest match and the value 5 the highest match to the question) with the addition of some open-ended questions.
The first aspect investigated by the survey is the degree of freedom of the RUs in choosing a track consistent with the wishes of the end customer. 67% of the respondents stated that they have a limited ability to choose (8 out of 12 RUs indicated a value of 2), despite the fact that 75% of the respondents stated that customers choose the train mode according to both the path offered and its cost (7 respondents chose answer 4 and 2 chose answer 5) while half of the respondents stated that it is quite frequent that the reason for customers not using paths is due to the characteristics of the path offered.
The open question on the reasons given by customers of RUs for not using paths had as common answers the cost of the path itself and the timetable, as rail transport composing a part of the logistical cycle of goods must be able to be realised in a time consistent with the other links of the logistical chain, in particular the last mile (which is done by road and usually during daytime hours).

Figure 7 – Word cloud of the main reasons for not carrying out the planned tracks



The second block of questions addressed the role of incentives put in place by the government in the years 2020-2022 to counteract the effects of the pandemic. 85% of the RUs responding to the questionnaire stated that the incentives had acted positively on demand, although for two-thirds of the RUs not to the extent of maintaining pre-pandemic freight volumes. For 15% of the RUs, on the other hand, the incentives did not have a positive effect on rail freight demand; these RUs had

previously reported a low degree of freedom in their choice of train paths. These are the points of view of RUs, but it is worth noting that in the same period the overall number of train-km registered a relevant increase (+11% in 2021 and +19% in 2022 in comparison to the volume recorded in 2019).
The level of end-customer awareness of the amount of TAC paid by the RUs appears to be rather low (median value of the responses is 2, 58); moreover, no RU chose the highest level of awareness. The median response is 3 (on a scale of 1 to 5).
It is interesting to note that only one RU stated that it had fully passed on the rebate to customers. Of the remaining RUs, 3 claimed to have passed on between 50 and 90%; 3 others between 10 and 50%; and 3 RUs claimed to have used the incentive to cover (fixed) production costs.
Subsequently, the survey tried to bring out the factors that influence the most the determination of the planned timetable, since every year there is a considerable difference between the planned timetable and the trains operated in reality, and some RUs stated that this difference contributes to artificially saturating the lines, thus making demand management more complex. The first aspect investigated, therefore, concerns the weight that the individual RUs assign to their own customer portfolio and how much the expectations regarding the development of the target market influence their demand for tracks. 11 out of 12 RUs define the planned timetable by giving a considerable weight to the existing commercial contracts and to a lesser extent to the expected market development; only one RU declares a different behaviour, but this seems justifiable due to the small volume of train-km realised so far by this company. More than half of the RUs define their planned timetable by giving very little weight to expected market changes.
Almost all RUs report that they monitor deviations between planned and actual timetables[17]. This is due to the fact that half of the RUs declare that the share of realised but unscheduled trains is less than 15% of the total trains performed in the year, but for the other half this share is more than 20%, i.e. at least one out of every five realised trains was not included in the timetable at the time (not surprisingly some RUs complain that the time advance with which the applications for the formation of the scheduled timetable have to be submitted is excessive). For 8 RUs the penalty is paid for less than 5% of the unscheduled trains, while for 3 RUs the penalty is paid for 5 - 15% of the unscheduled trains (these are RUs which stated that they had limited freedom in the choice of train paths) and 1 RU declares that the share of unscheduled trains for which a penalty is paid is more than 30%.
RUs declare that RFI - the Rail Infrastructure Manager – largely succeeds in fulfilling the requests for additional trains compared to the scheduled timetable. The share of additional trains not satisfied is stated to be less than 10% by half of the RUs and between 10 and 30% by the other half. The differences also appear to be explained by the different level of utilisation of the most heavily used routes by the individual RUs.

[17] The only exceptions is represented by a small RU (in respect to the market size).

The requests for additional trains compared to the planned timetable may vary from what the RUs request from the IM. This concerns for half of the RUs less than 20% of the additional trains requested, but the remaining half stated that they were allocated different paths for half (and in one case even for between 80 and 90%[18]) of the additional trains.
Almost all the RUs (11 out of 12) state the need to revise the current binomials, but there is no agreement on the elements to which the new binomials should be linked. In fact, for only 4 RUs the binomials should more closely reflect the main drivers of demand for rail freight transport (such as different goods categories, places of departure and arrival of trains), while for 5 out of 12 RUs the binomials should more closely reflect the characteristics of the network (line gradient, saturation levels, crossing of nodes, etc.); of these five RUs only two had previously expressed themselves in favour of a greater correspondence of the binomials to the demand drivers.
Finally, among the constraints which could generate, if removed, an increase in demand, 7 out of 12 RUs point to the limitations resulting from the opening hours of terminals and in some cases also of railway lines. Furthermore, the need for adjustments to the PC/80 profile of the connecting lines to the intermodal terminals is noted. According to the opinion of the majority of the RUs, in order to achieve an appreciable effect on demand, the TAC (understood as the sum of components A and B) should be reduced by at least 50%; confirming the feeling of a low elasticity of final demand to the TAC. Such a fare reduction could stimulate demand on the north-south routes, on the pass lines and on the lines connecting to the main national ports.

The pairwise comparison of choice attributes

This second survey is aimed at understanding the attributes that in the opinion of the RUs weigh most heavily in the decision to request a new train, also taking into account the information they know about the preferences of their customers. The 10 attributes considered were defined, in agreement with RFI, also based on the suggestions and elements that emerged from the public discussion of the work; they are:

1. Speed class
2. Weight class
3. Maximum allowable axle mass
4. Loading gauge
5. Time slot (day/night train)
6. Line Module
7. Average line saturation
8. Opening hours of interchanges or terminals
9. Possibility of interconnecting tracks to optimise the use of transport means

[18] It is the case of a RU operating freight trains on a small selection of high-density lines.

10. Possibility of determining the path (in terms of timetable and route)

Following the hierarchical analytical approach of multi-criteria analysis (Saaty, 1988), each of the 10 attributes was compared with the other 9 on the basis of a 5-grade qualitative scale (extremely preferable, preferable, indifferent, less preferable, definitely less preferable).
Ten RUs, representing almost two thirds of the Italian freight RUs, responded to this exercise. Table 11 shows their weight in relation to freight traffic recorded in 2022.

Table 11 – Representativeness of pairwise comparison respondents (year 2022)

	Survey participants	Total freight RUs	% Respondents
Km	31,548,373.9	50,042,166.6	63.0%
Av. Weight (gross)	128,512,897.0	215,760,118.0	59.6%
Freight trains (nr.)	124,548	203,061	61.3%
TAC: Component A	2,117,577.2	33,481,856.8	63.1%
TAC: Component B	52,016,527.0	80,040,884.8	65.0%

Source: Own elaboration on RFI data

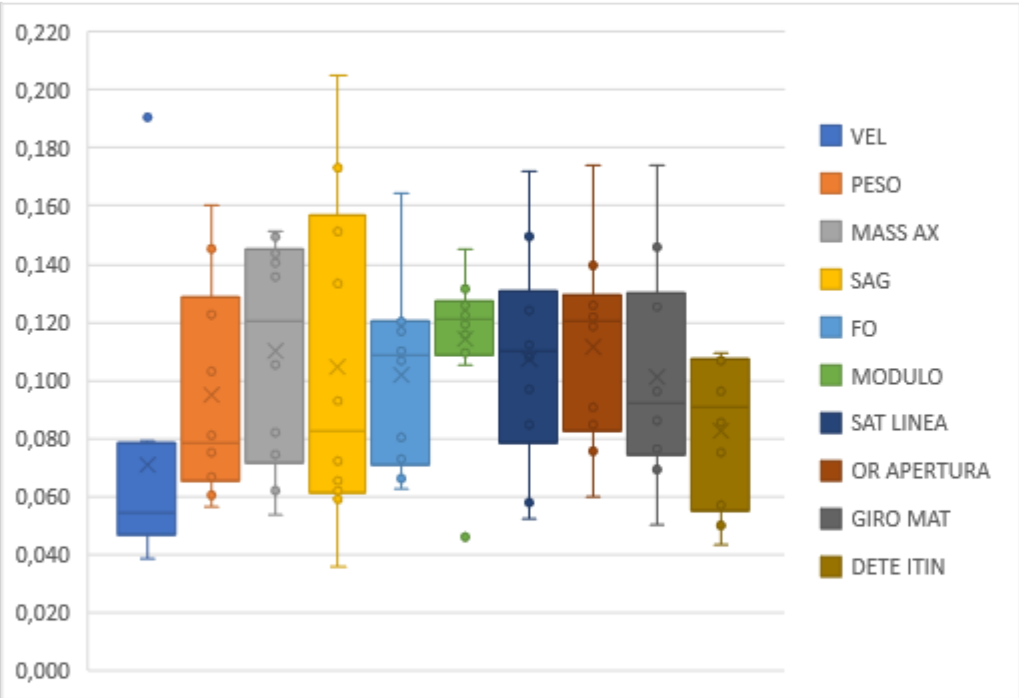
The responses obtained from the RUs were processed to construct a square matrix for each RU whose m_{ij} terms had the following values:

- 1 in the case of indifference between attributes *i* and *j*;
- 2 in the case the attribute *i* is preferable to attribute *j*;
- 3 in the case the attribute *i* is largely preferable to attribute *j*;
- 0.5 in the case the attribute *j* is preferable to attribute *i*;
- 0.3 in the case the attribute *j* is strongly preferable to attribute *i*.

Subsequently, a sum matrix was constructed of the preferences expressed by the 10 RUs whose elements were normalised.
The results are represented in Figure 8. It shows a substantial heterogeneity in the responses obtained, except for two attributes - line speed class and line module - which show a certain concordance between the RUs. In particular, speed does not seem to have a particular influence on the demand for train paths, unlike line module, which instead shows a relative importance for all the RUs that took part in the survey. Regarding the other attributes considered, the loading gauge reported the greatest variability in the responses obtained, indicating that its relative importance is probably dependent on the type of traffic normally carried out by the RU as well as the characteristics of the most frequently used lines.
According to the average value, the order of priority of the attributes, from the most relevant to the least relevant, is as follows: line module, opening times of interchanges and terminals, axle mass limits, level of saturation of the line, gauges, time slot, the possibility to interconnect paths, weight class, the possibility to determine the route and finally the maximum speed allowed on the line.

The attribute 'speed' was always dominated by the other attributes for 6 out of the 10 RUs responding to the survey. In part, this result can be explained by the presence of a certain number of "short" trains, i.e. trains covering distances of less than 100 km, with respect to which an increase in speed leads to moderate reductions in journey times, as well as a lack of interest on the part of demand for premium services based precisely on the speed of the service rendered.

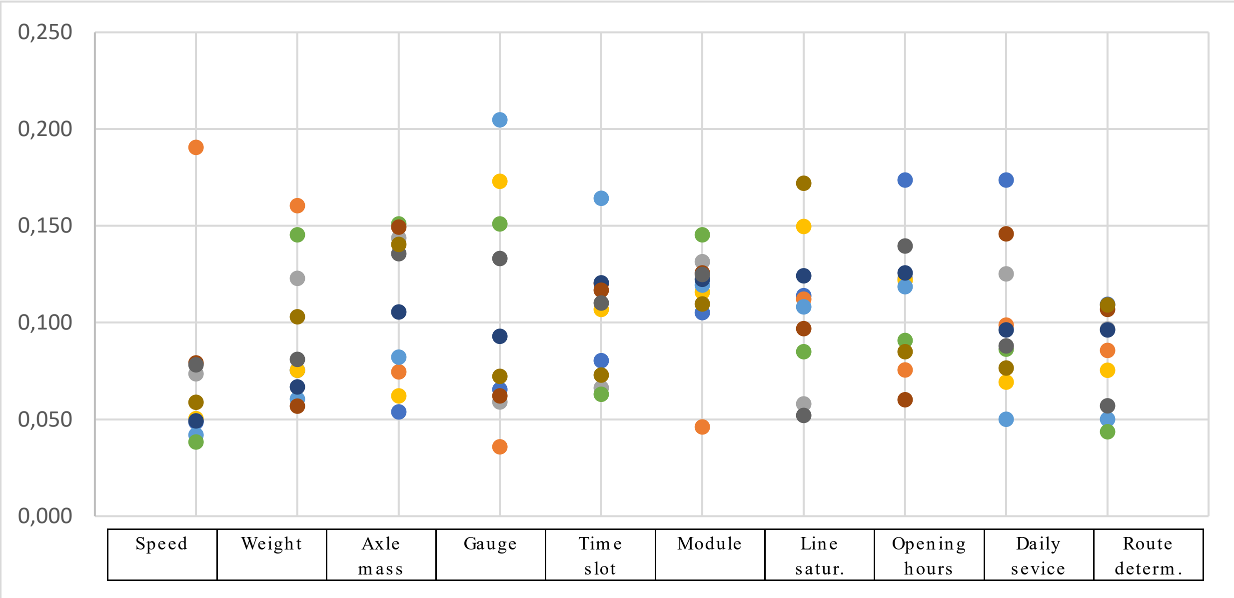
Figure 8 – Outcome of the pairwise comparison



Source: Own elaboration

The attributes 'line module', 'axle mass limit' and 'path interconnection' are never dominated for 3 of the 10 RUs which answered the survey.
The attribute "opening hours of interchange nodes and terminals" is non-dominated for only 2 RUs.
Overall, the average weight of the attributes is very similar; it ranges between the minimum value of 0.071 (for the train speed) and the maximum value of 0.115 (module), but the relevance of each single attribute shows also significant variations between the 10 responding RUs, as shown in Figure 9. In particular, the loading gauge of rail lines records a markedly different (relative) importance for the individual RUs.
It is quite evident from the figure how the relative weight of the individual attributes is also due to the individual specificities that characterise the RUs with regard to the target market (departure and arrival stations), the characteristics of the network used (i.e. the routes served) and the structure of the services (conventional versus combined trains as well as the degree of utilisation of intermodal nodes).

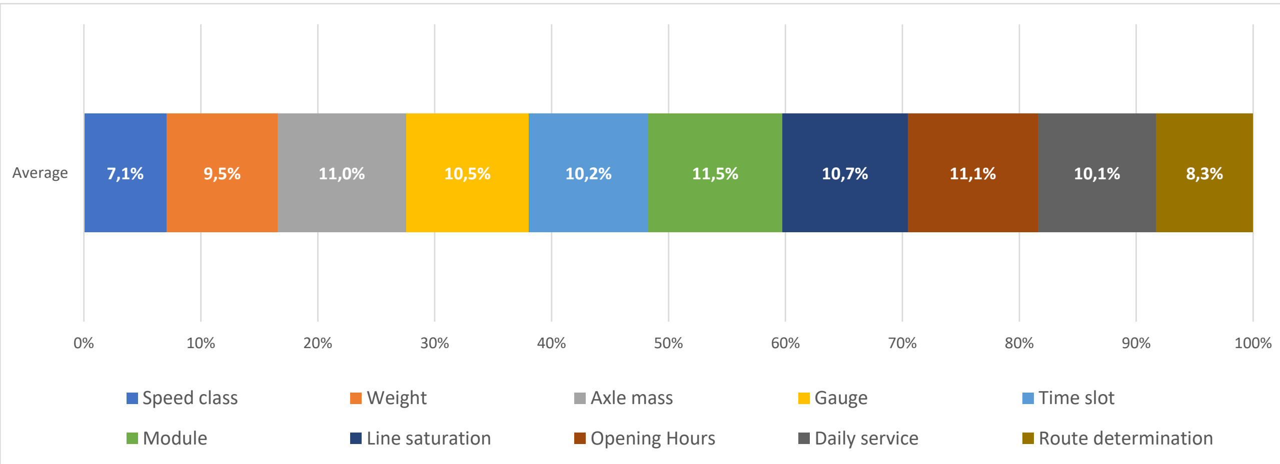
Figure 9 – Distribution of the relative importance of the individual attributes for RUs



Source: Own elaboration

Lastly, Figure 10 shows the average weight of attributes (%) for the 10 RUs participating to the survey. Even if all attributes have a certain significance in the decision-making process of RUs they are not really equivalent. The most important is the module of lines as is determine the maximum length of the trains, followed by a greater flexibility in the opening hours of terminals and the maximum mass allowed on lines. These are the attributes that directly impact on the output of Rus: the amount of train-km per year; it is therefore not surprising that they are considered the most important.

Figure 10 – Average weight of attributes

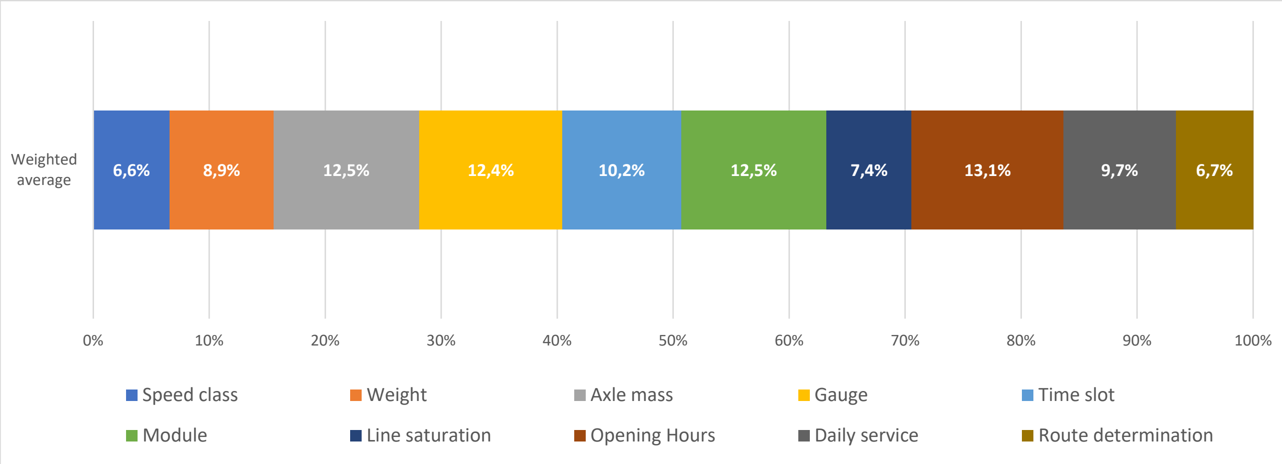


Source: Own elaboration

On the contrary, the attributes less relevant are the speed class of lines and the possibility to determine the route.

The relative importance between the different attributes considered is further confirmed if the responses of the RUs are weighted by the total number of trains run in the last available year (2022), as shown in Figure 11.

Figure 11 – Average relevance of attributes weighted for the number of trains operated in 2022



Source: Own elaboration

Conclusions

The freight segment of rail transport is operated in Italy by a rather large number of railway undertakings that give rise to a supply configuration typical of network industries, therefore rather concentrated and with the simultaneous presence of a few medium and large operators together with many small operators (to be understood in relation to the tonne-km produced and with respect to the overall size of the market).
The balance sheet structure of the RUs is rather rigid and therefore economic performance is affected by demand trends, as was observed in the pandemic period when demand remained weak despite the zeroing of the B component of the TAC.
This observation confirms what emerged from the econometric model: demand, expressed in train-km or tonne-km, appears inelastic to changes in TAC (with values equal to -0.157 and -0,431, respectively) with some, statistically significant, variations depending on the length of the journey and the type of trains operated (combined and conventional). In particular, the demand for train-km is less elastic than the demand for tonne-km due to the complexity of organising a train and the average loading capacity of the train compared to the average capacity of road vehicles (which can more easily adapt to even small variations in demand). Furthermore, the demand for train-km for particularly long (>800 km) or short (<100 km) routes appears to be more elastic – compared to the remaining demand for rail freight transport – because it is more subject to competition from other modes of transport. On routes between 100 and 800 km, slight differences in elasticity emerge depending on whether conventional or intermodal loads are handled as well as on the performance offered by the lines used.
Estimates about the relation between access charge and the demand for railway services are consistent with other studies in literature (e.g. Olarte-Bacares et al., 2022) asserting the relevance of other variables in determining demand for freight traffic.
The substantial rigidity of demand and the economic and financial performance of railway undertakings indirectly confirm the need for railway undertakings to set a price for freight services that mainly takes into account "what the cargo can bear", i.e. the willingness to pay for each individual load.

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List of abbreviations

ART: Autorità di Regolazione dei Trasporti (Transport Regulatory Authority)
IM: Infrastructure manager
PIR: Prospetto Informativo di Rete
RFI: Rete Ferroviaria Italiana
RU: Railways undertaking
TAC: Track Access Charge

Appendix 1

In this section main results are replicated using an alternative dependent variable, $lnTonneKm_{i,t}$, i.e. the gross tonne-kilometres transported on a route i at time t, and as main explanatory variable the average TAC per tonne, $lnTariffABTonne$. The model can be expressed as follows:

$$lnTonneKm_{i,t} = \varphi_i + \varphi_t + \beta_1\, lnTACABTonne_{i,t} + \beta_2\, lnTariffABTrain_{i,t} * Z_i + \beta_3 Z_i + \gamma X_{i,t} + \epsilon_{i,t} \quad \text{(A.1)}$$

Results from this analysis are shown in Table A.1 and Table A.2

Table A.1 Relationship between TAC (€/tonne) and Tonne-kilometres Circulated: Heterogeneous Effects – Length, Train Time, Quality of the Network, Type of Traffic, and Presence of Ports.

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS	(7) OLS	(8) OLS	(9) OLS	(10) OLS
	Dependent Variable: *lnTonneKM*									
lnTACABTonne	-0.461***	-0.483***	-0.568***	-0.565***	-0.519***	-0.539***	-0.545***	-0.564***	-0.551***	-0.568***
	(0.0217)	(0.0219)	(0.0194)	(0.0194)	(0.0203)	(0.0205)	(0.0194)	(0.0195)	(0.0199)	(0.0201
*lnTACABTonne*Length Dummy=1*	-0.247***	-0.237***								
	(0.0309)	(0.0305)								
*lnTACABTonne*Train Time=1*			-0.0259	-0.0153						
			(0.0223)	(0.0224)						
*lnTACABTonne*Quality=1*					-0.182**	-0.167***				
					(0.0400)	(0.0396)				
*lnTACABTonne*Combined Service=1*							-0.0140	- 0.0121		
							(0.0217)	(0.0123)		
*lnTACABTonne*Port=1*									0.0182	0.0125
									(0.0427)	(0.0422)
Year FE	√	√	√	√	√	√	√	√	√	√
Unit FE	√	√	√	√	√	√	√	√	√	√
Route Length	√	√	√	√	√	√	√	√	√	√
Total Trains	√	√	√	√	√	√	√	√	√	√
Lenght Dummy	√	√								
Dangerous Goods		√		√		√		√		√
Combined Services		√		√		√		√		√
Train Time (day/night)		√		√		√		√		√
Commercial Speed		√		√		√		√		√
Weekday/Festive		√		√		√		√		√
Obs.	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801	20,801
R-squared	0.336	0.349	0.226	0.343	0.331	0.344	0.329	0.343	0.328	0.343
Number of Panel ID	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332	12,332

Notes: All specifications are estimated via OLS. The dependent variable, $lnTonneKm$, represents gross tonne-kilometres transported on path i at time t, while $lnTACABTonne_{i,t}$, indicates the TAC (component A and B) per tonne that on average each RU pays on a specific route at time t. The interaction term in column (1) and (2) is constructed using the variable $Lenght\ Dummy$, which equals 1 if route <100km or >800km, 0 otherwise; while in column (3) and (4) the explanatory variable is interacted with *Train Time*, which indicates if trains on a route travel mostly at night (=1) or during the day (=0); in columns (5) and (6) it is interacted with the dummy variable *Quality* which takes value 1 when the line is considered high-performing and 0 otherwise; in columns (7) and (8) the interaction is constructed using the dummy *Combined Service* which takes value 1 in presence of combined service, and 0 in presence of conventional service; and in columns (9) and (10) the interaction accounts for the dummy variable *Port* which takes value 1 if at the origin and/or destination of the route there is a port or an intermodal node. The set of control variables includes: *Route Length,* a continuous measure of the route length expressed in kilometres; *Total Trains*, representing total number of trains circulated on a route; *Dangerous Goods Traffic*, a dichotomous variables which indicates if trains on a route carry dangerous goods (1= yes, 0 otherwise); *Combined Traffic; Commercial Speed* which is a categorical variable (1 if speed $\leq 50\ km/h$, 2 if speed $> 50\ and < 90 km/h$, 3 if speed $\geq 90\ km/h$; *Weekday/Festive*, a categorical variable that if the majority of trains on the route started and ended the trip on a weekday takes value 1, on a festive day takes value 2, while it takes value 3 when the majority started on a weekday (festive day) and ended the tip on a festive day (weekday). All specifications are estimated including unit and time fixed effects. *Quality* and *Port* variables are omitted from the list of controls for collinearity with fixed effects. Robust standard errors clustered at route level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Table A.2 Relationship between TAC (€/tonne) and Tonne-kilometres Circulated: Heterogeneous Effects – Conventional Standard, Combined Standard, Conventional Standard, Combined Top

	(1) OLS	(2) OLS
Dependent Variable: *lnTonneKM*		
*lnTACABTonne*Conventional Standard*	-0.398***	-0.423***
	(0.0251)	(0.0251)
*lnTACABTonne*Combined Standard*	-0.385***	-0.414***
	(0.0410)	(0.0410)
*lnTACABTonne*Conventional TOP*	-0.502***	-0.515***
	(0.0627)	(0.0629)
*lnTACABTonne*Combined TOP*	-0.660***	-0.712**
	(0.0956)	(0.0980)
Year FE	√	√
Unit FE	√	√
Route Length	√	√
Total Trains	√	√
Dangerous Goods		√
Combined Services		√
Train Time (day/night)		√
Commercial Speed		√
Weekday/Festive		√
Obs.	14,472	14,472
R-squared	0.337	0.350
Number of Panel ID	8,787	8,787

Notes: All specifications are estimated via OLS. The sample contains only routes with length >100 km and <800km. The dependent variable, $lnTonneKm$, represents train-kilometres circulated on path i at time t, while $lnTACABTonne_{i,t}$, indicates the TAC (component A and B) per train that on average each RU pays on a specific route at time t. The term $lnTACABTonne_{i,t}$, is interacted with a categorical variable that reflects different combinations of two separate characteristics: quality of the network and type of traffic (combined or conventional). The set of control variables includes: *Route Length,* a continuous measure of the route length expressed in kilometres; *Total Trains*, representing toral gross tonnes transported on a route, *Dangerous Goods Traffic*, a dichotomous variables which indicates if trains on a route carry dangerous goods (1= yes, 0 otherwise); *Combined Service*, which takes value 1 in presence of combined service, and 0 in presence of conventional service; *Commercial Speed* which is a categorical variable (1 if speed $\leq 50\ km/h$, 2 if speed $> 50\ and < 90 km/h$, 3 if speed $\geq 90\ km/h$; *Weekday/Festive*, a categorical variable that if the majority of trains on the route started and ended the trip on a weekday takes value 1, on a festive day takes value 2, while it takes value 3 when the majority started on a weekday (festive day) and ended the tip on a festive day (weekday). All specifications are estimated including unit and time fixed effects. *Quality* and *Port* variables are omitted from the list of controls for collinearity with fixed effects. Robust standard errors clustered at route level in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

Appendix 2

Here below the summary of the questions included in the survey circulated among the RUs.

#	Questions (*survey circulated in Italian*)
1	Inserire i dati identificativi dell'azienda e il nome o il ruolo di chi compilerà l'indagine.
2	Quale grado di libertà ha l'impresa ferroviaria nella scelta della traccia (e quindi della tariffa associata al segmento di mercato) rispetto alle esigenze del suo cliente?
3	In quale misura i vostri clienti scelgono la modalità ferroviaria in funzione della traccia da voi offerta e del relativo costo?
4	Quanto frequentemente il cliente rinuncia ad acquistare un treno per le caratteristiche della traccia offerta (es. per limiti di peso, lunghezza treno, etc.)?
5	Qual è il principale motivo di rinuncia del cliente alla proposta di traccia propostagli dall'impresa ferroviaria (ad esempio eccessivo costo, limitazione delle prestazioni, …)
6	Gli incentivi intervenuti nel periodo 2020-2022 hanno avuto un impatto positivo sulla domanda dei vostri clienti?
7	Che livello di consapevolezza hanno i clienti rispetto alla tariffa di utilizzo dell'infrastruttura?
8	Quale percentuale dello sconto sul pedaggio siete stati in grado di ribaltare sul prezzo applicato ai vostri clienti?
9	Nella determinazione dei volumi di traffico contrattualizzato di inizio orario di cosa tiene maggiormente conto l'impresa ferroviaria?
10	Contratti commerciali definiti con i clienti
11	Aspettative future sull'evoluzione della domanda
12	Altri traffici che l'impresa conta di acquisire
13	Siete soliti monitorare gli scostamenti tra traffico contrattualizzato (orario di dicembre) e traffico circolato?
14	Qual è in media la quota annuale di treni effettuati ma non contrattualizzati ad inizio anno?
15	Per quale percentuale delle tratte contrattualizzate non realizzate si è pagata la penalità prevista dal PIR?
16	In quale misura le richieste di nuovi treni (aggiuntivi rispetto al contrattualizzato) vengono respinte dal GI?
17	In quale misura le richieste di nuovi treni (aggiuntivi rispetto al contrattualizzato) vengono modificate rispetto all'esigenza iniziale?
18	A vostro giudizio, sulla base dell'esperienza di questi anni, è utile articolare in maniera diversa i binomi?
19	Fornire in maniera sintetica la ragione.
20	Secondo la vostra esperienza, i binomi dovrebbero riflettere i driver della domanda (es. caratteristiche merceologiche, origine e destinazione, …)?
21	Secondo la vostra esperienza, i binomi dovrebbero riflettere le caratteristiche della rete (acclività, saturazione, attraversamento nodo, …)?
22	Potreste indicare la quota percentuale di tonn-km di treni intermodali svolti nel 2022 rispetto alle tonn/km complessive?
23	Potreste indicare la quota percentuale di treni-km (o tonn-km) che ha usufruito degli incentivi nel corso del 2022?
24	Qual è lo sconto percentuale minimo del pedaggio totale (A+B) capace di determinare un impatto positivo sulla domanda espressa dai vostri clienti?
25	Quali tratte o corridoi potrebbero essere maggiormente interessati da questo aumento di domanda (es. collegamenti Nord-Sud, tratte di collegamento con l'Europa, etc.)?
26	Vi sono a vostro giudizio vincoli che se rimossi potrebbero generare un incremento della domanda ferroviaria di merci?