

Regulating Railways



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The rail sector in Europe like other network industries is in a process of organizational restructuring that is part of different forms of liberalisation as well as de- and re-regulation. In this process many approaches to railway regulation are reassessed. Achieving more, better and more cost efficient rail services for freight and passengers is a commonly shared goal, but there are different opinions on the right policies to achieve this goal. This issue of the Network Industries Quarterly will look at different aspects of rail regulation with examples from in and outside the European Union.

On the example of the Swiss rail reform Desmaris looks at the relationship between competition and performance. Kuligowska describes the recent reforms that the Polish rail regulator had to undertake when dealing with open access provision. Laroche discusses the issue of congestion of railway lines and how saturation of rail infrastructure can be modelled. Thiebaud & Amaral look at how prices influence coordination in the rail sector. Peña-Alcaraz et al. present an alternative view on capacity pricing in open access rail systems on the case of Tanzania.

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The reform of passenger rail in Switzerland: more performance without competition?

Christian Desmaris *

This note explains how the Swiss railway reform had succeeded to introduce good results both for taxpayers and for travelers. Unlike the European Commission pattern, this reform does not promote competition.

Located in the heart of the European network, Switzerland, although not a member of the European Union (EU), has recently conducted a major railway reform. This Swiss railway reform, in part inspired by the proposals of the EU, but also largely specific, raises many issues. What is the institutional design of these reforms? What are the results? How have these successes been obtained? What can be learned from Switzerland's example? It seems that more performance can be obtained without the need for more competition.

1. What is the institutional design of these reforms?

Swiss railway reform may be divided into three stages: the «Revision of the federal law on railways» (Railways Act) in 1996; the «Railway Reform 1», with broader scope, in 1999; and, from 2005, the «Railway Reform 2».

1) The first stage - 1996: regional traffic reform

The Swiss rail reform began with a new governance of the regional passenger transport. This first reform (LCdF, March 24th 1995) was based on three principles which had deeply transformed the relationship between the railway undertakings and public authorities (Genoud, 2000). The most important measure provides that public authorities will pay only for the services agreed in advance and for the amount clearly defined by the contract. Unplanned deficits will no longer be covered by the State. Secondly, the cantonal authorities become fully responsible for the regional transport services; however their decision-making autonomy remained supervised by the Federal Office of Transport (FOT). Thirdly, SBB's monopoly on regional and national long distance railway passenger services is cancelled. But for the moment, the cantonal authorities do not solicit the contest procedure and no new foreign supplier has entered this market. The national passenger transport is commissioned by the Confederation; it is currently provided by SBB.

2) The second stage - 1999: a new regulatory framework to comply with European legislation

A further step was achieved with the «Railway Reform 1» (LCdF, March 20th 1998). Its prior objective was to transpose the principles of the Directive 91/440/EEC into the Swiss law, according to the Agreement on Land Transport (1999). This reform has significantly renewed SBB's organization and its business model. The direct authority of the federal administration over SBB has been abolished and the national railway company was submitted to a multi-annual contract. To allow this newly created company to operate without the burdens of the past, the Confederation has accepted to erase its debts.

3) Since 2005, Railways Reform 2: controversial and incomplete

In 2005, the Government presented a further rail package to the Parliament, the so-called «Railway Reform 2», which aimed to transpose the content of the First and Second EU Railway Packages into Swiss law. This legislation included several measures about various topics, such as how to finance the rail infrastructure, how to establish a regulatory authority and how to improve safety in public transport. But as the Parliament rejected the bill, the Government decided to split up the package into separate, more focused bills (CER, 2011). The first part of this reform related to the railway system regulation, to safety and to the ordering period in regional transport (from one to every two years) entered into force in 2010. The second part of the Railway Reform 2, submitted for consultation in 2009, was presented to the Parliament in 2011. Some texts are now adopted; some of them entered into force and others are still under discussion.

Overall, the Swiss railway legislation developments show a pragmatic reform, step by step. If the principle of competition is introduced for the freight traffic, we ob-

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serve for the passenger traffic that the «Swiss model» differs from the standard promoted by the Commission, based on market competition between operators. This model is more akin to a particular type of governance involving public authorities, rail companies (and public transport companies more broadly) and travelers, than to a true change in the market structure, based on more open competition.

Unlike a “on the market” liberalization and competition between operators, it is more a special governance between the public authorities and the railway companies, rather than an overhaul of the market structure on a wider competition. Some describe the Swiss rail structure as a “hybrid system” that combines liberalization and integration (Finger, Holtermann, 2013; Maier-Gyomlay, 2013) and only partly conforms to European law and its philosophy.

2. What are the results?

Swiss rail reform of passenger transport had two positive outcomes: more efficiency in the use of public money and better and more services provided to passengers.

1) More efficient use of public funds

The most decisive result, a driving force behind the reform, has been the inversion of the trend whereby public compensation contributions steadily rose for regional traffic (Table 1). SBB have managed, with a constant volume of public funding, to regularly increase both the number of kilometers on offer and passenger traffic.

2) Higher quality services for rail passengers

The second result of the rail reform is the significant improvement in the quality of services for passenger rail. Switzerland is traditionally known for the excellence of its railways (Bovy, 1992). Intermodality has reached unsurpassed levels, linking together all constituent parts of the Swiss public transport network. Service frequency is the

highest in the world, setting Switzerland ahead of Japan.

The reform of the railways has led to two other satisfying results for travelers: increased commercial speed and more trains. The bulk of speed improvements took place between 1994 and 2005, following implementation of the broad investment and modernization program called «Rail 2000». Rail 2000 significantly improved the attractiveness of passenger rail by more train frequency (basically every 30 minutes and 15 minutes on the busiest routes, on peak hours) and by better correspondences between rail and other modes of transport. The increase of supply is another key factor in quality improvement. Measured in train-kilometers, the total SBB supply for travelers shows a considerable increase: 55.4% since the reform. This is one of the biggest increases in all of Europe.

3. How have these successes been leveraged?

We believe the performance gains obtained by Swiss rail should mainly be ascribed to the nature of their public governance, which tends to bring together all stakeholders in the rail system.

1) The first key to success: public governance promoting sustainable mobility centered on the railway system

The main reason for the success of Swiss rail reform lies in its particular form of public governance that aims to promote sustainable mobility based on train travel. We consider in this note three characteristics.

- A collective choice to foster rail transport based on a high level of infrastructure investment.

After having supported road, Swiss transport policy faced a major reorientation in favor of railways from the mid-80. Its maintained and updated national choice in favor of rail transport translates into sustained high level of investment programs. The earliest, “Rail 2000”, passed in December 1987, was to be undertaken in 1994 and

	1993	2000	2002	2004	2006	2008	2010	2011	2013
Million of Swiss francs (CHF) in current value	725	546	507	522	552	571	556	575	591
Index, basis 100 in 2000	-	100.0	92.9	95.7	101.2	104.6	101.9	105.4	108.3
Swiss francs by train-kilometer in current value	N.A.	10.2	8.9	8.1	7.6	8.1	7.6	7.7	7.8

Table 1: Public subsidies paid to SBB for regional passenger transport (calculated from SBB Management Reports)

finished in 2004. It has been extended by a second railways investment program, called “ZEB”, whose realization started in 2004 and should be spread out until 2022. In addition, a more controversial third program aims at creating a New Rail Link through the Alps (so called “NRLA”), by the digging of two new tunnels (the Gothard and the Lötschberg) to be able to carry freight in a more environmentally friendly way.

- Local authorities are increasingly implicated in decision-making and funding.

The Swiss rail reform included a process of decentralization that is manifested in two facts: the cantons have full responsibility over decisions regarding provided services, including offer consistency, which, in return, are funded by local public funds. As a result, the Confederation share to financing the regional passenger traffic decreased drastically (from 65% in 2003 to 50% today, as stipulated in the Act).

- SBB corporate governance to enhance motivation and increase accountability.

The reform renewed SBB’s governance on two aspects: the introduction of clear, precise, demanding and strictly controlled strategic objectives and a mandatory adherence to drastic financial constraints. Firstly, SBB’s activities are carried out within the framework of a four-year contract, called the «Service agreement» which requires a constant improvement in the quality of services and in terms of efficiency gains in the use of public funds. Secondly, the Federal strategy seeks to maintain the real value of the public operating funds allocated to SBB at a stable level, while increasing demands in terms of targets to be reached. The logic clearly being followed is to «do more with less».

2) The second key to success: an incumbent operator capable of considerable productivity gains and sweeping innovations in organization

The explicit aims of SBB are to systematically keep operating and production costs down and to seek new revenues wherever possible (Genoud, 2000).

- To seek and find significant productivity gains

SBB must grow while reducing costs. Measured in terms of apparent labor productivity, the gains are substantial, despite the negative impact of the crisis on traffic, especially on freight (Table 2). This sharp productivity rise breaks with earlier trends, although there was growth before. These productive efficiency gains in Switzerland, contrary to many other European railways, are based more on a sensible increase in passenger and freight traffics than on staff reductions (Desmaris, 2010).

- To increase railway company revenues

Following the railway reform, SBB orientated their activity towards their customers, both to improve quality and to increase the railway earnings. Good results have been achieved. Thus, between 2002 and 2011, while the passenger traffic income has increased by 52%, SBB total government subsidies have grown by only 19.7%. The total general expenses for this period have registered an increase of 22.2% (with 17.6% of personnel expenses), smaller than the incomes growth. As a result, the operating income (EBIT) has improved from CHF 194 million to CHF 530 million in current value (SBB, 2014b).

We also observe that SBB have developed a particular active policy with regards to their real estate assets. SBB are indeed among the major players in the Swiss real estate market, with a book value of about 4 billion Swiss Francs (especially around stations) for a turnover of nearly CHF 698 million in 2013. The business unit “Real estate” now provides an essential contribution to the overall financial health of the railway company being the most profitable of SBB’s activities, ahead of transport (SBB, 2014b).

	1980	1995	2011	Variation in %	
				1980-1995	1995-2011
Passenger-kilometer in millions (1)	9,167	11,712	17,749	+27.8	+51.6
Ton- kilometer in millions (2)	7,220	8,156	12,346	+13.0	+51.4
Staff in full-time equivalent, except subsidiaries (3)	38,367	33,529	25,840	-12.6	-22.9
Labor productivity - million traffic units (4)	0.43	0.59	1.16	+38.7	+96.6

Table 2: Changes in SBB traffic, staffing and productivity (calculated from the UIC statistics)

NB. (4) = [(1) + (2)] / (3). Based on the hypothesis that a passenger-kilometer is equivalent to a ton-kilometer.

3) The third key to success: the strong support of consumers and citizens

The satisfaction expressed by travelers and citizen and their support for the rail reforms carried out by the Confederation are important elements of their success.

The passenger satisfaction is expressed by an upward trend in passenger traffic with an overall increase for SBB travelers is 51.8% since the reform, expressed in terms of passenger-kilometers. This trend is the highest in Europe after the United Kingdom, with more than 2,250 km per capita on average. Another relevant indicator is loyalty: one in two adults is a regular SBB customer and has a subscription (usually half price or with a community tariff) and their number has significantly increased after the reform.

One must also mention the deep commitment the Swiss citizens express towards their railway system and the policies carried out on their behalf. Each of the major stages in Swiss transport policy was submitted to a popular vote.

Conclusion - What can be learned from Switzerland's example?

We conclude this note with three lessons taught by the analysis of the Swiss railway passenger reform.

1) Although it is said to be modeled on the reforms instigated by the Commission, detailed analysis shows that the Swiss railway reform has its own particularities and appears to have reached its stated objectives. Switzerland has obviously chosen to increase the railway system efficacy and efficiency by prescribing an original form of governance in opting for cooperation between the actors, rather than in submitting it to competition forces (CER, 2011; Nash, 2011; Finger and Holterman, 2013). The Swiss railway reforms have imposed a «stress performance» to the national incumbent rail operator, and more generally to all public transport companies, generalizing a contractual agreement. The regional passenger traffic, conceded by the cantons to SBB, is a typical example of this type of governance.

2) The high quality rail transport has a major financial, political and managerial cost for the Community. First of all, the high quality railway services involve a significant financial effort from the taxpayers, with no equivalent

anywhere else. Secondly, a political cost: to maintain this high quality level, the government must engage in an everlasting and strong involvement as «major assembler» of the public transport system, especially through the tasks entrusted to the FOT. Thirdly, it also induces a managerial cost: as sole shareholder of the historical railway company, the Swiss government should fully assume their role as owners.

3) The sustainability of such a model is uncertain. The constant search for savings and productivity gains is reducing the sustainability of the rail system, both from a technical point of view (disinvestment limiting future improvements in traffic) and from a social one (access to services). The sustained increase in traffic, which has exceeded expectations, within a network where use levels were already very high, means substantial infrastructure maintenance requirements. The slight increase in public contributions for regional transport also illustrates the limits of the quest for the efficient use of public funds.

All in all, Swiss railway reform deserves more consideration and further studies. A careful examination of its specificities would probably show that it would not be an easy model to replicate in other national contexts. In the matter of railways, progress might be slow, gradual and highly path-dependent. This simply does not exclude incremental changes.

References

1. Bovy, P.H. (1992), 'Le modèle ferroviaire suisse : un modèle à suivre ?', *Les Cahiers scientifiques du transport*, 25: 47-66.
2. CER (2011), *New Reforming Railways – Learning from Experience* (Brussels: CER).
3. Desmaris, C. (2010), *Le transport ferroviaire régional de voyageurs en France: à la lumière de la théorie néo-institutionnaliste et des comptes de surplus*, PHD thesis, University of Lyon.
4. Finger, M., Holterman, M. (2013), *Incentive-based Governance of the Swiss Railway Sector* (Firenze: Florence School of Regulation).
5. Genoud, C. (2000), *La régionalisation des transports publics : implications de la nouvelle loi sur les chemins de fer à l'exemple des cantons de Berne, Zurich, Neuchâtel et Jura* (Lausanne: Cahier 188, IDHEAP).
6. Maier-Gyomlay J. (2013), 'Learning lessons from Switzerland – A BLS perspective', *Railway Gazette International*, January, 36-40.
7. Nash, C. (2011), 'Developments in European railway policy', *Network Industries Quarterly*, 13 (1): 11-13.
8. SBB (2014a), *SBB: Facts and figures 2013* (Bern: SBB).
9. SBB (2014b), *SBB: Annual and Sustainability Report 2013* (Bern: SBB).

Current regulatory challenges in access to the rail infrastructure in Poland

Izabela Kuligowska*

This article focuses on specific solutions adopted by the Polish rail regulator to ensure open and non-discriminatory access to the rail infrastructure. Retaining necessary regulatory flexibility remained crucial in this process.

Introduction

This article presents the main regulatory challenges in ensuring open and non-discriminatory access to the rail infrastructure in Poland. While many of those might be regarded as similar to the problems of the regulatory regimes of the rail sector in other countries of the European Union, this paper will focus on the unique solutions adopted by the Polish rail regulator (Urząd Transportu Kolejowego, UTK). The rail sector in Poland is undergoing rapid and significant changes mainly due to the introduction of the EU competition regime, which places the rail regulator in a position that requires very careful balancing of the vital interests of all market actors. UTK's mostly pragmatic attitude to the regulation of the access and the strong commitment to the introduction of a competition regime resulted in the application of a few procedures allowed within the Polish legal framework: the decisions of the President of the UTK replacing rail infrastructure access contracts; the open access to the internal market of the rail passenger services; and the development of the contractual penalty arrangements for delays on the network.

1. Decisions of the President of the UTK replacing rail infrastructure access contracts

The Railway Transport Act (Ustawa 2003) empowers the President of the UTK with significant competences in the supervision of contracts between the infrastructure manager and the rail operators on the access to the rail infrastructure. These provisions envisage an active role of the President of the UTK in the negotiation process between contracting parties and ultimately, in the absence of a conclusive agreement, the possibility for the President of the UTK of issuing its own decision which in effect replaces the contract.

The introduction of such deep changes in comparison with the original wording of the Act was deemed necessary in order to regulate the position and the powers of the

President of the UTK in a similar manner to the other sectoral regulatory bodies, and to allow the President of the UTK to regulate all aspects of the access to the rail infrastructure in execution of his supervisory powers over the rail market (Wierzbowski and Wajda 2014: 544). Aside from the enforcement of regulatory control and the enforcement of equal rights of access for all rail operators, there were practical reasons for the introduction of these provisions. Among them there were recurring complications during the negotiation processes and successive lengthening of periods of time in which these contracts were not concluded.

In the execution of his supervisory powers over the access to the rail infrastructure, the President of the UTK is allowed to conduct proceedings on the negotiation and the conclusion of the infrastructure access contract, to approve the dissolution of the access contract and to sanction the conclusion of the framework agreement. In the proceedings on the negotiation and the conclusion of the infrastructure access contract, the President of the UTK is empowered to impose an obligation of conducting the negotiations on the access contract, oblige the parties to conduct the negotiations with the participation of the representatives of the Office, specify the date of the conclusion of the negotiations, and issue the decision replacing infrastructure access contract. During the supervision over the dissolution of the access contract, the President of the UTK has to consent to the termination of the contract. In the proceedings sanctioning the conclusion of the framework agreement the approval of the President of the UTK is gained if such a contract is justified by the existing long term trade agreements and executed or planned investments (for a period longer than five years), if services are using specialized rail infrastructure which requires long term investments (15 years) or where such investments are covered by contractual commitments including a long term amortization schedule (for a period longer than 15 years), and if the provisions of the framework agreement

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do not limit the use of the railway line by other rail operators (Urząd Transportu Kolejowego 2014).

2. Compensation scheme for rail operators

Due to increased investments in the infrastructure carried out by the main infrastructure manager in Poland, the PKP PLK, many complaints on disturbances and increased costs of the access to the rail infrastructure were submitted to the UTK both from passenger and freight operators. The problems reported by the rail operators to the UTK in 2011 included the increased costs of train path replacement, the necessity to provide additional resources, significantly longer travel times leading to constant changes in timetables. The President of the UTK acting on his own initiative imposed an obligation on the infrastructure manager and the rail operators to agree upon the adequate compensation scheme. Relevant provisions were included in the decisions replacing rail infrastructure access contracts for the 2011/12 timetable.

The negotiations of the rail operators and the infrastructure manager were held with the participation of the representatives of the UTK in September 2012. According to the proposals of the rail operators, in case of disturbances on the network as were then occurring, the operator should be able to determine the length of the commercial stop, which is normally left for the infrastructure manager to decide. Moreover, the difference between travel time predicted in the timetable and the total sum of time periods of actual travel, operating reserves and total length of commercial stops should not exceed 5%. If the admissible travel time is exceeded, the affected rail operator should receive a paid compensation for any excess minute of the journey. The extension of the travel time schedule developed by the rail operators is to be approved as binding. Ultimately the infrastructure manager informed the UTK and the operators in November 2012 that due to the financial constraints the introduction of a compensation scheme to the infrastructure access contracts for 2012/2013 was not possible.

Therefore, the President of the UTK decided to intervene. Following a detailed analysis, the President of the UTK concluded that, although necessary and justified, the investments carried out by the PKP PLK should have not imposed an additional financial burden (increased charges) on the rail operators. Moreover, the increase in costs of the operations had an obvious negative impact on the competitiveness of rail transport and encouraged modal shift. Thus, to limit these tendencies and reduce the impact on both passenger and freight operators, a twofold

compensation scheme was introduced.

For rail passenger transport the scheme was designed to limit the profit margin of the infrastructure manager when the amended timetable was applied. The cancellation of the allocated train paths by the infrastructure manager was subjected to a special regulation regime. Separate rules for levying of charges for allocation of replacement train paths were also imposed. Finally, the financial compensation for the cost of providing replacement bus transport was envisaged. For rail freight transport the scheme included the predefining of routes and the compensation for allocating replacement train paths longer than 50 km as compared to predefined ones. The compensation was to be settled by the reduction of the infrastructure manager's profit margin. These provisions were included in the decisions of the President of the UTK replacing infrastructure access contracts for the 2012/2013 timetable.

The development of contractual penalty arrangements for causing the delays on the network, so that delays imposed by one train operator on another require penalty payment, is another example that the intervention of the regulatory body might be required. This kind of arrangements initially agreed between the infrastructure manager and the rail operating companies remained optional until it became clear that freight operators were less likely to join the scheme than passenger services operators as they were not so tightly bound by the time factor. Therefore the intervention of the rail regulator became necessary, resulting in uniform application of the arrangements to all rail operators.

3. 'Internal' open access

In January 2014 the UTK introduced the procedure for granting open access for any rail operator that intends to run passenger services on a commercial basis (Urząd Transportu Kolejowego 2013). Under Polish law the operation of rail services is possible when the services are operated under a public service contract (PSC) or when a positive decision concerning open access right is granted. Polish internal open access differs from open access regulated in EU law as it only looks at domestic and not international rail services.

The basic element in this procedure is a two-step analysis of the impact of the proposed new service on the economic conditions of the services operated under PSC (run on the same routes in similar time periods). The first step in this analysis is the verification if there is a substantial change in the value of the public service contract, which

implies that services operated under PSC might no longer be sustainable and generating a reasonable level of operating profit. Thus the economic equilibrium of a public service contract is regarded as compromised if the new service might have negative consequences for the profitability of the PSC services or the net cost for the authority which concluded the contract.

The verification of the impact of the proposed new service on the services operated under PSC is conducted according to the following scheme: the comparison of the nature of the services, the estimation of the geographical coverage of the services, the comparison of the timing and frequency of the services, the determination of the amount of the compensation paid for the operators of the rail services under the PSC for the duration of the contracts, the estimation of the share of the revenues generated by the PSC services in the compensation paid under the contract (10% threshold), the verification of the possibility of total loss of revenues generated by the PSC services (crowding out of the service from the route), and subsequent evaluation of the rationale behind the relevant public service contract as a contract concluded to supply transport services which would not be run under market conditions.

On the basis on this preliminary analysis the assessment of the possible impact of the decision on granting open access to the proposed new service on the economic equilibrium of the PSC is formulated. Thus, either it is stated that the new service might impact on the economic equilibrium of the relevant PSC in adverse manner or such impact is not determined.

Then, if the possibility of an adverse impact is anticipated, the regulator is obliged to conduct a supplementary analysis in which two criteria of evaluation are considered. First, the negative impact on the regularity of the service under PSC is assessed by comparing the timetables of both services operated on the same route and the type of the rolling stock used. If a disruptive effect of the new open access service on the frequency of the PSC service by addressing the same passenger market segment is proved, this in part constitutes a prerequisite for rejection of the applicant's request.

Then, the second criterion is considered. On the basis of calculations provided by the authorities that awarded the relevant public service contracts, the cumulative effect of the operation of the new open access service on the specified route on the public services is estimated. Thus, the overall change in the level of the compensation paid to the

PSC operators is determined. If the level of compensations is not changed or rises below 10% and, in result, it does not compromise the economic equilibrium of the relevant services, the open access is granted to the operator of the new service. If the level of compensations rises above 10%, the possibility of rejection the applicant's request or granting the access in a limited scope is considered.

The final decision also depends on factors which, although not purely financial, might benefit the passengers in the short and medium term. In particular the possibility of widening the range of rail services offered on the routes with significant potential or providing additional services on the routes with deficit related problems should be taken into account. Moreover, the quality criteria are worth consideration as additional supply of services might lead to the reduction of ticket prices while maintaining or even raising the level of services. It might also be argued that the introduction of new services could result in a more effective use of available capacity or act as an incentive for investments in rail infrastructure.

Depending on the results of the analysis described above, there are three resolutions possible. The open access for the applying operator of the new service is granted if such decision might have a positive impact on the development of the market and thus on the supply of the rail services. If the estimated effect of the introduction of the new service could be limited to only taking over the same segment of the passenger market with consequent increase of the compensation paid by the contracting authorities, the access is denied. Finally, if the evaluation indicates that the positive and negative effects might balance each other out, the access might be granted within certain limits. Due to the multiannual perspective in which these conditions are considered, it should be noted that such analysis is in essence only an approximation.

Conclusion

In recent years it became clear that, in order to remain effective as a sectoral regulator, the Polish regulatory body in exercise of his regulatory and supervisory functions had to adopt a very flexible and pragmatic approach. In constant challenge of continuous adjustments of the regulatory framework to requirements of the changing rail market, fast reaction of the regulator to arising problems seemed crucial to maintain overall competitiveness of the sector. The creation of fair conditions for commercial activity was backed by a growing acceptance of market actors that the regulator is effectively overseeing the market and is ready to take action when needed. This led to improved

stability and predictability of the rail market in Poland.

References:

1. Ustawa z dnia 28 marca 2003 r. o transporcie kolejowym (Railway Transport Act of 28 March 2003), 2003, Dz. U. 2007 r. Nr 16, poz. 94 z późn. zm.
2. 28 March 2003), 2003, Dz. U. 2007 r. Nr 16, poz. 94 z późn. zm.
3. Urząd Transportu Kolejowego (Office of the Rail Transportation) (2014), Wewnętrzna procedura prowadzenia postępowań dotyczących nadzoru nad umowami o udostępnianie infrastruktury kolejowej, sprawowanego w zakresie: zawierania tych umów przez zarządcę infrastruktury kolejowej i przewoźnika kolejowego, wyrażenia przez Prezesa UTK zgody na ich rozwiązanie, zatwierdzania przez Prezesa UTK umów ramowych (Internal procedure on conducting proceedings regarding supervision over rail infrastructure access contracts exercised in conclusion of these contracts between infrastructure manager and rail operator, approval of the President of the UTK of dissolution of these contracts, sanctioning of the President of the UTK the conclusion of framework agreements), 2014 (Warszawa: Urząd Transportu Kolejowego).
4. Urząd Transportu Kolejowego (Office of the Rail Transportation) (2013), Wewnętrzna procedura prowadzenia postępowań dotyczących wydania decyzji w sprawie wykonywania przez przewoźnika kolejowego przewozów w ramach otwartego dostępu (Internal procedure concerning decisions on the operation of rail services under open access conditions), 2013 (Warszawa: Urząd Transportu Kolejowego).
5. Wierzbowski, M., and Wajda, M., eds. (2014), Ustawa o transporcie kolejowym. Komentarz (Warszawa: Wolters Kluwer).

Methods for saturation modelling of railway lines: the case of High-Speed Line Paris-Lyon

Florent Laroche*

This paper discusses the saturation for a high-speed line. It shows that the saturation is a relative concept and that different solutions exist to increase capacity of one infrastructure. **Key words:** infrastructure, capacity, railway, utilization rate, innovation

The congestion phenomenon remains a poorly-researched issue in railway studies (Brunel et al., 2013). Well-known in road transport, socio-economic interest in studying congestion has been reinforced in the railway sector in the process of market opening from the 1980's, supported by the European Commission. The EC/91/440 directive introduces as the fundamental principle the access right to infrastructure and addresses the issue of capacity allocation. Capacity is a complex concept to apprehend in the railway sector because of the diversity of stakeholders and networks (Abril and al., 2008)

This issue is currently researched in France on the case of the Paris-Lyon High-Speed Line (HSL). Being the first historical line of the French high-speed network, it is also the most used one in 2014. According to the infrastructure manager, the anticipated traffic evolution could lead to its saturation as soon as 2020-2025 (RFF, 2011). The solution considered by the National Transport Infrastructure Scheme (SNIT, 2011) is to build a new line to relieve the existing one. The project, for which costs are estimated at 14 billion€, raises the questions of its economic relevance in a context of scarce public funds and of possible alternatives of adaptation of capacity to demand increases.

This paper suggests an analytic framework of the saturation of transport infrastructure, applied to the Paris-Lyon case study. The objective is two-fold: how to conceptualise the saturation of a high-speed line? Which levers to increase its capacity?

A definition of saturation is proposed in the first part. The second part introduces the saturation assessment method, and the last section explores the alternatives for a possible adaptation of the capacity.

Which type of saturation?

Saturation can be defined by an utilisation rate measuring the relationship between demand and supply for an

infrastructure.

Two rationales can be distinguished:

- The infrastructure managers' for whom the demand is expressed in trains and the supply in the "number of trains that can circulate on a given section, in a given time" (Burdett and Kozan, 2006);

- The operator's rationale for which the demand is expressed in users and supply in number of seats in a train.

As a result, saturation might be considered as between users or between trains (Brunel and al., 2013).

Considering infrastructure, the literature identifies two types of capacity:

- The absolute or theoretical capacity (C_t), being the maximum number of trains that can circulate on the infrastructure (Burdett and Kozan, 2006);

- The practical or commercial capacity (C_p), that considers the effective capacity of the infrastructure (Liotta and al., 2009).

The difference between them is the resilience of the system, meaning its capacity of recovering a normal functioning after a traffic disruption (Setra, 2009). It puts the infrastructure manager in a judge position between the capacity offer and the targeted level of quality of service. The econometric analysis demonstrates a non-linear relation between traffic density and delay risks (Brunel and al., 2013). In contrast to road, delay is not factual and is expressed as a risk (planned activity). From a certain threshold, it increases exponentially for a supplementary circulation. The threshold usually stands for a risk of below 10 minutes delay.

As a consequence two levels of saturation can be considered for the infrastructure:

- A "structural" saturation (S_2) based on the theoretical capacity, including heavy investments on both mid- and long-terms;

- A "daily" saturation (S_1) linked to the commer-

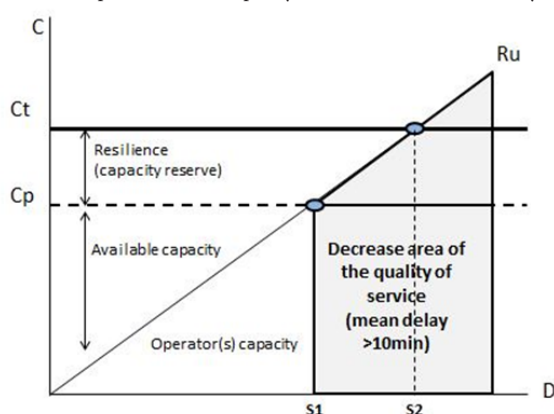
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cial capacity resulting in the system performance and the trade-off made by the infrastructure manager.

The disaggregation of the different capacity levels leads to the identification of the train capacity and the commercial strategy of the operator(s). This capacity has a bias for the infrastructure manager who only has an indirect link with the demand, as expressed in travellers. The operator manages its capacity in terms of available seats per train, under typical technical and comfort constraints, but also in terms of frequency, under the constraint of the capacity made available by the infrastructure manager.

This deeper study of the saturation concept highlights several capacity thresholds and a strong interaction between the different stakeholders. However, they all correspond to very distinct rationales that are even clearer in an unbundled system.

Figure 1: Conceptualisation of capacity for an infrastructure railway.



Which assessment method for saturation?

The assessment method of saturation is adapted to a French-model based high-speed line. Traffic is recognized as being homogeneous both in terms of speed and service. Only passenger high-speed trains have the possibility to circulate on the network.

The utilisation rate (R_u) is calculated according to the theoretical capacity of the infrastructure section (an entry/exit). It is the ratio between demand in terms of passengers and offer in terms of available seats.

The demand (D) is calculated on peak-hours regarding the concentration coefficient (ϕ). This coefficient enables to assess the demand concentration during peak-hours in comparison to off-peak hours.

Supply (C) is calculated regarding the maximal capacity of train, expressed as the number of seats (C_r) and the theoretical capacity of the infrastructure (C_t) expressed as the number of trains per hour. The train capacity is

weighted by the load factor (μ) and the double train rate (μ). The theoretical capacity is weighted by the resilience coefficient (k) to result in the commercial capacity (C_p). Supply is divided by the number of commercial exploitation hours (h) during a year.

$$(1) Tu = (D \cdot \phi) / [((C_r \cdot \theta) \cdot \mu) \cdot ((C_t \cdot k) \cdot h)]$$

Infrastructure is a priori saturated when the utilisation rate is higher than 100% to the theoretical capacity. However, saturation is considered, in this analysis, according to the commercial capacity. It shows an increasing tension in the system between demand to satisfy and the purposes for regularity.

Application to the Paris-Lyon HSL

Regarding the Paris-Lyon HSL, the method assesses the horizon of saturation of the commercial capacity as being up to 2020-2025 (between 75 and 80% of the theoretical capacity). The reference year is 2008, and the hypotheses of demand and offer are based on studies undertaken by RFF (2011) in the context of public debate about the project of doubling the line by creating a new line Paris-Orleans-Clermont-Ferrand-Lyon (POCL).

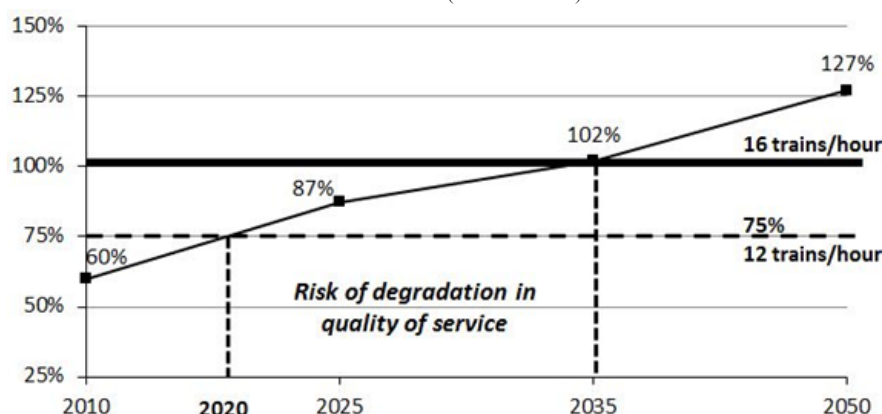
In 2008, the effective demand was up to 38 million passengers. The central scenario foresees a rise of 39% in 2020 (53 million passengers) and of 115% in 2050 (83 million passengers). This dynamic is due to the expected 30% of economic growth and 70% of the development of the HSL network, according to the SNIT (2011).

The supply situation in 2008 is as follows: the average theoretical capacity of the circulating trains is up to 450 passengers. This result considers the Duplex trains offering 512 seats and the first generation of HST (377 seats), still circulating to Switzerland. The observed double train rate is of 1.3 during peak-hours and the average load factor is up to 80%. The network operability is of 18h/day (5:30 – 23:30). The theoretical capacity is up to 16 trains/hour, in accordance with the signalling system (TVM 300) for a commercial capacity of up to 12 trains/hour (75% of the theoretical capacity). Eventually, the concentration coefficient is estimated at 1.5.

Which ways to adapt capacity?

Regarding the saturation risk, since 2007 the public actors have been calling for the doubling of the line (POCL project). This solution would lead to the doubling of the theoretical capacity (+100%) and to the improvement of the exploitation of the Paris-Lyon corridor, thanks to the redundancy of the route (Leboeuf, 2014). The deadline

Figure 2: utilisation rate of the HSL up to 2050 according to the observed situation on the network in 2008 (source: author)



of saturation is postponed beyond 2050 for a commissioning start date in 2025. Nevertheless, this lever raises two main controversial issues. On one hand, the cost is estimated at 14 billion€ and would stand for a record among all HSL projects (SNIT, 2011). On the other hand, the saturation risk might be postponed from the line towards Lyon railway hub, which opens to question the issue of the re-planning of the main interconnectivity stations and its financing scheme.

Out of the infrastructure, four means of adaptation can be identified: three technical levers (exploitation, traffic management and rolling stock) and one economical lever (pricing). Each lever is characterised by the parameters of the previous equation.

The tested hypotheses are the results of current experiences. Their generalisation could be effective at the horizon 2025.

The rolling stock lever: solution “Ouigo”

This scenario proposes to test the “high density TGV” principle, according to the experience currently undertaken by SNCF (Ouigo offer). It increases the existing train density through the generalisation of the second class standard. This type of solution applied to the whole commercial offer on the Paris-Lyon line could lead to a capacity gain at least as important as the doubling of the infrastructure (+131%). The lever of this hypothesis relies on an average capacity per train of 600 seats. This estimation takes into consideration the increasing of capacity of Duplex trains (634 seats) and the replacement of the first generation of HST by AGV 10 trains (462 seats). The double train rate is up to 2 (optimisation of the rolling stock management) and the load factor up to 90% (optimisation of sales and tickets booking).

However, while this scenario seems to be credible on

a technical standpoint, it raises the issue of the operator’s ability to evolve the business model which is until now focused on the first-class and comfortable seats spacing. Similar to the airway model, this evolution involves a new conception of high-speed and services.

The traffic management lever: the solution of an optimised schedule

This scenario suggests to testing the adaptation of the daily capacity on the basis of a better traffic management. The resilience can be improved on the model of the new schedule, defined by RFF in 2013 after the opening of the Rhin Rhone HSL (Deborde, 2012). The commercial capacity is, so far, up to 13 trains/hour (80% of its capacity) during a peak-hour in a week (Friday evening). The generalization of a schedule optimization could increase the capacity by 13% and postpone the saturation horizon by 5 to 15 years. To achieve such a scenario, the effort must be made on the solidity of the circulation schedule, the management real-time tools and the ability to deal with disruptive situations. Without any significant change, the increase of the commercial capacity might damage regularity and raise the delay risk.

The exploitation lever: the ERTMS 2 solution

The exploitation scenario tests the effect of an increase of the theoretical capacity by introducing the new European signalling standard ERTMS level 2, in replacement of the existing (TVM 300). This standard is known to allow a better traffic management in real time by because of a shorter interval between trains and a better resilience of the system (Delaborde, 2012). The theoretical capacity is up to 20 trains/hour for a corresponding commercial capacity of 16 trains/hour (80% of the theoretical capacity).

The capacity gain is of 33% and the saturation deadline postponed by 15 to 25 years. This scenario enables a greater capacity on the line without any particular optimisa-

tion of the offer to be made by the operator. Nevertheless, the estimated cost is 500 million€ equally shared by the infrastructure manager and the dominant operator (Leboeuf, 2014). The necessary communication between the on-track installation and the cabin to make the system operational requires coordination in investments. Guihery and Laroche (2013) have demonstrated that there might be several barriers to migration if the historical operator does not align its choice to the infrastructure manager.

The pricing lever: the congestion economics solution

The last lever possible relies on the principle of railway congestion developed by RFF to weigh the value of the network use (Brunel and al, 2013): valorisation of surplus by discriminatory pricing between peak and off-peak hours. The price signal leads to a staggering of circulations and a reduction of the concentration coefficient (1.3). The given rate is directly inspired by the Japanese model, whose observed difference in 2013 was up to 1.3 on the Tokyo-Osaka line. On the operator standpoint, the hypothesis has to be made that the price signal of the infrastructure manager is passed on the pricing policy (scarcity effect) resulting in an optimised load factor (90%) without particular change in supply.

The global gain is around 30%, and the saturation deadline postponed by 10 to 25 years. The associated cost of such a scenario can also be a gain for the sector, but it feeds some social reluctance, if not supported by a deep evolution of mobility behaviours. The maximisation of surplus could indeed lead to a rise in the users' transport cost, and thus a running out-of-course effect.

Thus, this scenario would be, nowadays, limited by the pricing regulation of the state-controlled ticket prices (Perennes, 2012) and by the development of intermodal competition.

Conclusion

In conclusion two options can be considered regarding the saturation issue: the creation of a new infrastructure, despite high investment costs; or the evolution of tools

and production methods, following an increasing-return rationale. The latter scenario could lead to better results than the doubling of the line, both in terms of capacity and costs. Nevertheless, it supposes a redefinition of the operator's commercial high-speed train supply and the introduction of new conditions of exploitation (ERTMS). For the infrastructure manager, it means finding the right price signal to encourage investments and support the evolution of mobility behaviours.

The Paris-Lyon HSL case study certainly provides the experiment basis for the future of high-speed lines. Nevertheless, the capacity increase of the lines might worsen the railway hubs situation, necessitating great investments, mainly because of their location, in urban areas.

References:

1. Abril, M., F. Barber, L. Ingolotti, M. A. Salido, P. Tormos & A. Lova (2008). An assessment of railway capacity. *Transportation Research Part E*, 44, 774-806.
2. Brunel, J., G. Marlot & M. Perez (2013). Measuring congestion in rail sector: the French experience. 13th WCTR, 15 – 18 juillet, Rio de Janeiro.
3. Burdett, R.L. & E. Kozan (2006). Techniques for absolute capacity determination in railways. *Transportation Research Part B*, 40, 616-632.
4. Delaborde, F. (2012). Augmentation de capacité de la LGV Paris-Lyon. *Le Rail*, 185, 30-35.
5. Guihéry, L. & F. Laroche (2013). European Rail Traffic Management System (ERTMS): Supporting competition on the European rail network?. *Research in Transportation Business & Management*, 6, 81-87.
6. Leboeuf, M. (2014). Grande vitesse ferroviaire. *Collection Documents*, Paris, p853.
7. Liotta, G., P. Cicini & P. De Luca (2009). A simulation-based approach for estimating the commercial capacity of railways. In: *Proceedings of the 2009 Winter Simulation Conference*, Washington.
8. Perennes, P. (2012). Pourquoi les tarifs de la SNCF sont-ils régulés? *Concurrence*, 3, 1-8.
9. RFF (2011). Perspectives de trafic et de circulation Sud-Est : LGV Paris – Lyon et LGV POCL. RFF, Paris, p62.
10. SETRA (2009). Le transport ferroviaire de voyageurs sur le réseau ferré national français. *Synthèse des connaissances*, Bagneux, p93.

Vertical Separation in Rail Transport: How Do Prices Influence Coordination?

Miguel Amaral*, Jean-Christophe Thiebaud **

This paper studies the impact of the governance structure on the coordination mechanisms in the railway market and how prices can achieve coordination between the infrastructure manager and railway operators. **Keywords:** Vertical separation, Regulation, Rail transportation.

1. Introduction

In the last two decades, major structural reforms have been implemented in most network industries in Europe. Driven by the European institutions, the railway transport sector in Europe has also gone through both institutional and organizational reforms during the last twenty years. One of the main objectives of those reforms was to break up the national monopolies in order to open up rail market services to competition. Directive 91/440/EC¹ was the first milestone of this process. It introduced a degree of vertical separation in the sector by separating the management of railway operation and infrastructure from the provision of railway transport services which were deemed potentially competitive. Considerable attention has been devoted by economists to the analysis of gas, telecoms or electricity industries but, surprisingly, relatively little notice had been paid to railways so far.

Directive 91/440/EC allows for different degrees of vertical separation and, as a consequence, four main modes of organization can be found in Europe. A large body of the literature in industrial organization analyses the pros and cons of vertical separation in network industries, especially in an industrial economics perspective (e.g. Vickers 1995, Sappington 2006) comparing the merits of the different vertical separation degrees. Yet the coordination issues between the infrastructure manager (IM) and railway undertakings (RUs) have not led to any theoretical developments in the railway sector, despite being a central matter in the choice of the governance structure (Williamson 1985).

The coordination issues in the railway sector have recently been highlighted by the results of a survey conducted by Merkert and Nash (2013). In particular, the capacity allocation process is perceived, along with day-to-day operations,

as the most frequent, intense and complex transaction area. The allocation process is also perceived differently if the sector is partly integrated to those countries where full separation is in place. Mizutani and Uranishi (2013) give empirical evidence that separation becomes more costly on the overall efficiency of the system when the network is more densely used. In this case network density is a proxy for the complexity of the transaction. This can be interpreted as a higher need for coordination when the complexity of the transaction is growing.

The objective of this paper is to better understand the vertical interaction within the railway sector, in order to see how coordination can be achieved using prices. In order to do so, we study the French allocation process to identify the characteristics of coordination in the railway sector. In the second section, we develop a simple model using the characteristics identified beforehand and find that coordination should be achievable using prices if certain conditions are met when deviating from marginal cost pricing.

2. The French capacity allocation process

During the capacity allocation process, capacity made available must be matched with the capacity needed. As supported by the findings of Merkert and Nash (2013), it is a critical part of the interface between network management and train operations regarding coordination.

The organization of the French railway sector, which is unbundled with delegation of maintenance, highlights the fact that the IM is facing not one, but two transactions. There are two types of uses for the capacity on the network: commercial use (i.e. to run trains) and maintenance. Regarding maintenance, the objective of the IM is to limit both its cost and its capacity consumption. Those two objectives are not always compatible. For instance the IM can concentrate its maintenance to deploy the main-

¹ Directive 91/440/EEC of 29 July 1991 on the development of the Community's railways

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tenance team only once. This way it is less costly but it blocks a track segment for a longer time. Another trade-off is maintenance at night which is more expensive but has less impact on the maximum number of trains running.

This trade-off takes place during the first out of three stages of the capacity allocation process. This first stage consists² of structuring and pre constructing the timetable and to define the general maintenance policy. The objective is to find the long term needs of the operators and therefore to reduce the information asymmetry between the two.

The second stage is constructing the service timetable after the formal requests are made in April, seven months before the start of the timetable. Therefore, some requests for capacity can still be made up more than one year before the train effectively runs. Especially for the freight transport services this time span means that there is environmental uncertainty as it is very difficult for a railway operator to forecast its demand for transport services in advance.

One of the issues is that there are many incentives for the operators to ask for more than what they need, especially in the freight market. First of all overbooking may occur because operators are anticipating some negative responses for capacity and want to be sure to have an alternative route. Secondly, they also have to anticipate for hazard during the service. This hazard might be due to technical conditions, or may be entailed by the infrastructure manager changing its maintenance slots. Thirdly, overbooking might be a strategic behavior to pre-empt capacity from the other operators.

We refer to the third and last stage as adaptation. Interestingly it is during this stage that agreement between the infrastructure manager and the operators becomes binding: reservation fees will not be reimbursed only if the capacity is given back less than 2 months prior to the date the train is scheduled to run in order to offer flexibility to the operators. During this stage there is trade-off has to be made between allocation certainty and flexibility.

Throughout the description of the French allocation capacity process, we want to stress that coordinating the need for capacity and its demand is both a long and uncertain process. We want to highlight that during this process several trade-offs take place. On the one hand between allocation certainty and flexibility, any binding agreement is postponed since the upstream and downstream firms

2 Starting four year before the circulation date.

do not have to commit to one another in terms of quantities. On the other hand the infrastructure manager has to choose between lowering the overall cost for maintaining the network and making capacity available. And if the network is used more intensely, creating extra capacity becomes more costly, and flexibility entails more spillage. Therefore our read on the situation is that with vertical separation, the cost of coordination arises because of the need for flexibility along the allocation process while commitments in specific inputs are made on both sides.

3. The model

III.1 Description of the model

In this section, we develop a simple model to analyze the coordination issues in the railway sector we have described earlier. In order to do so, we use a simple form game between the infrastructure manager and one railway operator.

Both players have to set their level of production which can be either low or high (denoted q_L and q_H). As per suggested by the normal form game, the level of output has to be decided before observing the choice of the other player and players are committed to it. Let us denote k the marginal cost for producing one extra unit of output for the IM, and c the marginal cost for producing an extra unit of output for the operator. In addition, each unit of rail services produced requires one unit of capacity. The demand for the final good is given by the realization of the state of nature that can either be low or high as well. We denote π the probability for demand to be high (H) or low (L) and the distribution is common knowledge.

Given the particularity of demand in our model, we do not have a smooth match between supply and demand, therefore we have to define the following rules: regarding the prices, we denote the two mark-ups the railway operator may levy Mu_H and Mu_L with $Mu_H > Mu_L$. The ability of a railway operator to levy a mark-up depends both on the state of nature and the level of production. More precisely, a firm may levy a high mark-up if the demand is high and if it has produced a high level of output. In other cases, we assume that it will only be able to levy the low mark-up. Regarding the infrastructure manager, we define only one mark-up denoted Mu^{IM} , otherwise it is 0.

In order for quantities to be coordinated, we assume that a firm can only adjust its production by selling less than it has produced:

1. If a firm played H and the other firm plays L, then it has to sell less, that is selling q_L instead of q_H ;

2. If a firm played L and the state of nature is H, it has to sell at a lower price, that is levying Mu_L instead of Mu_H (or 0 instead of Mu^{IM} in case it is the IM).

We enforce those two rules in order to have market clearing.

III.2 Outcome of the game

Given the form of the model, four Nash equilibria may arise. We focus on the two uncoordinated equilibria that may arise due to the absence of administrative control when the firm is separated or its incentives are misaligned. In both these outcomes, either the network manager or the operator is left with unsold goods which leads to a costly coordination between the upstream and downstream entities and to inefficiency in the railway sector.

Result 1: Should $Mu^{IM} \in [\frac{(1-\pi)}{\pi} \frac{q_H - q_L}{q_H} k; \frac{1}{\pi} \frac{q_H - q_L}{q_L} k]$ then no uncoordinated outcome can be a Nash equilibrium.

Result 2: Should

$$Mu_H - Mu_L \in [\frac{q_H - q_L}{q_H} (\frac{(1-\pi)}{\pi} c + (Mu^{IM} - Mu_H)); \frac{1}{\pi} \frac{q_H - q_L}{q_L} c]$$

then no uncoordinated outcome can be a Nash equilibrium.

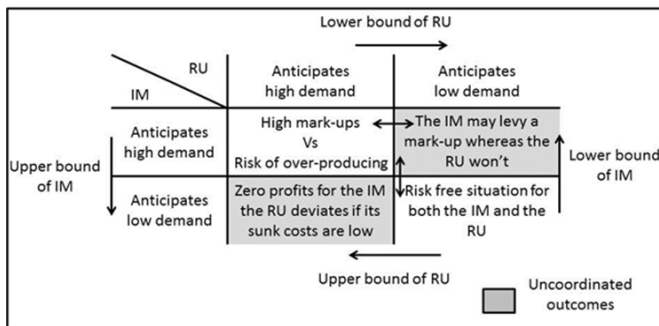


Figure 1 : Pay-off's matrix and possible deviations

up. Given that the pricing scheme of the infrastructure manager can be reviewed by an independent regulator in the European Union, this mark-up can indeed be limited. The lower bound corresponds to the amount of incentive the IM needs in order to avoid producing low quantities. In particular we find that if we rule out the possibility to have access charges above marginal prices when the market can bear it, then the network manager will never risk producing a high amount of capacity. The upper bound is needed so that the infrastructure manager does not always anticipate high quantities. If the allowed mark-up is too high, the regulated monopoly will be over-producing.

If we consider that the IM can only have prices above its marginal cost in order to recover its full cost, as stated in Directive 2012/34/EU³, then an extra condition for this result to hold is that the difference between full cost and marginal cost be within the bounds of the interval we

have defined. With full separation, the pricing scheme can be an important tool for the regulator to mitigate the risk of an uncoordinated outcome to occur as well as inducing the right amount of capacity to be produced on the network.

Result 2 refers to the mark-up of a railway operator. Contrary to the IM's case, the increase of the mark-ups is an outcome of the market and cannot be regulated when there is downstream competition. The lower bound states that the increase in mark-up should cover the uncertain increase in costs due to over-producing plus the mark-up of the infrastructure manager.

Rewriting the threshold as:

$$Mu^{IM} < \frac{Mu_H * q_H - Mu_L * q_L}{q_H - q_L} - \frac{(1-\pi)}{\pi} c$$

we identify the condition in our model under which the downstream market can bear any deviation from marginal cost pricing for access charges. The mark-up of the infrastructure manager becomes harder to bear for the railway undertakings as their market power decreases.

IV. Conclusion

Our objective in this paper was to contribute to the debate over the relevance of vertical separation/integration in network industries by studying if coordination can be achieved using prices in the railway sector.

The nature of the allocation process could lead to uncoordinated outcomes. Yet we find that with an effective price regulation, the regulator may constrain the infrastructure manager to choose a coordinated outcome. We also derive the condition for the market to bear any deviation from marginal cost pricing for the access charges. Those are directly related to the market power of downstream firms.

References

1. Merkert, R. and Nash, C. A. (2013). Investigating European railway managers' perception of transaction costs at the train operation/infrastructure interface. *Transportation Research Part A: Policy and Practice*, 54:14-25.
2. Mizutani, F. and Uranishi, S. (2013). Does vertical separation reduce cost? An empirical analysis of the rail industry in European and East Asian OECD countries. *Journal of Regulatory Economics*, 43(1):31-59.
3. Sappington, D. (2006). On the merits of vertical divestiture. *Review of Industrial Organization*, 29:171-191.
4. Vickers, J. (1995). Competition and regulation in vertically related markets. *Review of Economic Studies*, 62(210):1-17.
5. Williamson, O. E. (1985). *The Economic Institutions of Capitalism*. The Free Press, New-York.

³ Directive 2012/34/EC establishing a single European railway area

Capacity pricing schemes to implement open-access rail in Tanzania

Maite Peña-Alcaraz*, Ignacio Perez-Arriaga, Joseph M. Sussman

We analyze alternative capacity pricing schemes (access charges) to implement an open-access railway system in Tanzania. We show that the implementation of variable access charges widely used in the railway industry may result in levels of traffic lower than the traffic operated by an integrated railway company. We propose the use of fixed access charges to avoid this problem and discuss the main advantages and disadvantages to implement them in the context of multiple freight train services in Tanzania.

1. Rail transportation in Tanzania

In 2013, Tanzania's government committed to the implementation of one of the first open-access railway systems in the world (Big Results Now, 2013) as a way to ensure adequate level of rail service by 1) allowing efficient train operators (TO) to access the infrastructure and operate train services, and 2) providing sustainable resources through access charges to maintain the infrastructure and keep the system operative in the future. These objectives are critical to prevent future railway systems failures such as the 2001 and 2006 Tanzanian railway system concessions failures (Olievski, 2013) that resulted in a major underinvestment in rail transportation in the country (Railistics, 2013). This underinvestment critically impacted the operating capacity and the reliability of the railway system, essential to improving accessibility to the East African landlocked countries: Rwanda, Burundi, Uganda, and Western Democratic Republic of Congo (AICD, 2008; Amjadi and Yeats, 1995; Arvis et al., 2010; Raballand and Macchi, 2009).

However, open-access rail also requires new railway regulations that clarify the roles and responsibilities of railway institutions and define a capacity pricing scheme (Railistics, 2013; World Bank, 2014). This research analyzes how alternative open-access capacity pricing schemes for freight TOs would affect the system level of service and the revenues collected to maintain the infrastructure and recover capital costs in the context of the Central Corridor in Tanzania. Tanzania's railway system provides a useful case to illustrate multiple important concepts to be considered when implementing a pricing scheme in more complex railway systems.

The rest of the article is structured as follows: Section 2 presents the main types of capacity pricing schemes and discusses the financial model used to determine the behavior of TOs under each scheme. Section 3 presents the resulting level of service that container and general cargo

freight TOs would operate under alternative capacity pricing schemes. Section 4 concludes with some recommendations for open-access capacity pricing schemes.

2. Capacity pricing schemes for open-access railway system

The implementation of an open-access railway system requires some level of vertical separation between the TOs that operate the trains in the system and collect the revenues selling transportation services to the final customers and the infrastructure manager (IM) that maintains and manages the infrastructure. Vertical separation requires the definition of a capacity pricing scheme that determines the access charges that TOs pay to the IM to access and use the infrastructure (Gomez-Ibanez, 2003). The IM uses these revenues to cover infrastructure costs. The use of the state national budget to cover shortfalls is the last resort.

The railway literature proposes three cost-based capacity pricing schemes designed to allow the IM to recover maximum infrastructure costs: variable access charges, two-part tariffs (variable access charges plus a fixed access charge), and fixed access charges (Gibson, 2003). Under variable access charges, TOs pay some amount per train operated; the charge is in general a function of the type of train, distance, and tonnage. Under fixed access charges, each TO pays an annual lump sum to have a license to operate, regardless of the number of trains the TO operates during the year.

The practice and the broad economic literature in the field recommend the use of variable access charges based on marginal cost plus mark-ups (DB, 2009; UIC, 2012; World Bank, 2014). However, from an engineering standpoint, infrastructure related costs in Tanzania are mostly independent of the level of service. In other words, the short-term and long-term infrastructure marginal cost are very low and high mark-ups are required to recover infrastructure costs. This research analyzes the implications of

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resulting alternative pricing schemes for the system.

For this analysis, we compare the behavior of independent TOs with the behavior of an integrated railway company (social planner). We assume that both the independent TOs and the integrated railway company are rational agents, i.e. they determine the level of service (number of services per direction per week) by maximizing the annual operating margin (operating profits). An independent TO would only be interested in operating trains if the average annual net cash flow is positive after remunerating any invested capital at an adequate rate of return (no operation subsidies).

We use a financial model developed following (PPIAF et al., 2011) to determine the integrated railway company, independent TO, and IM's operating margin and cash flow for a representative year under different levels of service (see World Bank, 2014 for detailed assumptions). The integrated railway company faces capital costs associated with the investments in railway infrastructure, variable costs of operating trains (train lease, personnel, fuel), and obtains revenues from transporting freight. The vertically separated case is similar: the TO faces cost of accessing the tracks (access charges), variable costs of operating trains, and obtains revenues from transporting freight. The IM faces investment costs in railway infrastructure, maintenance costs, and obtains revenues from access charges.

Investment in railway infrastructure includes \$300 million investment required to rehabilitate the current Tanzanian railway system (CPCS, 2013; World Bank, 2014) plus periodic investment in maintenance. The revenues of the TOs are determined multiplying the cargo transported (minimum between the capacity of the trains operated and the demand) by the shipping rate. Due to the strong competition from trucks that offer door-to-door transportation services, railway companies have an upper limit on the shipping rate they may charge and they have low control over the demand that would likely shift to rail. The state should facilitate strong intermodal integration with the port and with truck companies that provide last mile transportation to/from the terminal rail station to make rail transportation more attractive and increase the utilization of the highly underused railway capacity.

3. Discussion of the results

In this section, we discuss the main results obtained for alternative capacity pricing schemes designed to recover maintenance and financial infrastructure costs and to ensure that TOs can viably operate (positive profits) in Tanzania in two scenarios: 1) considering only container TOs, and 2) considering both container and general cargo (non-container freight) TOs.

3.1. Container traffic

Figure 1 shows the annual operating margin and the

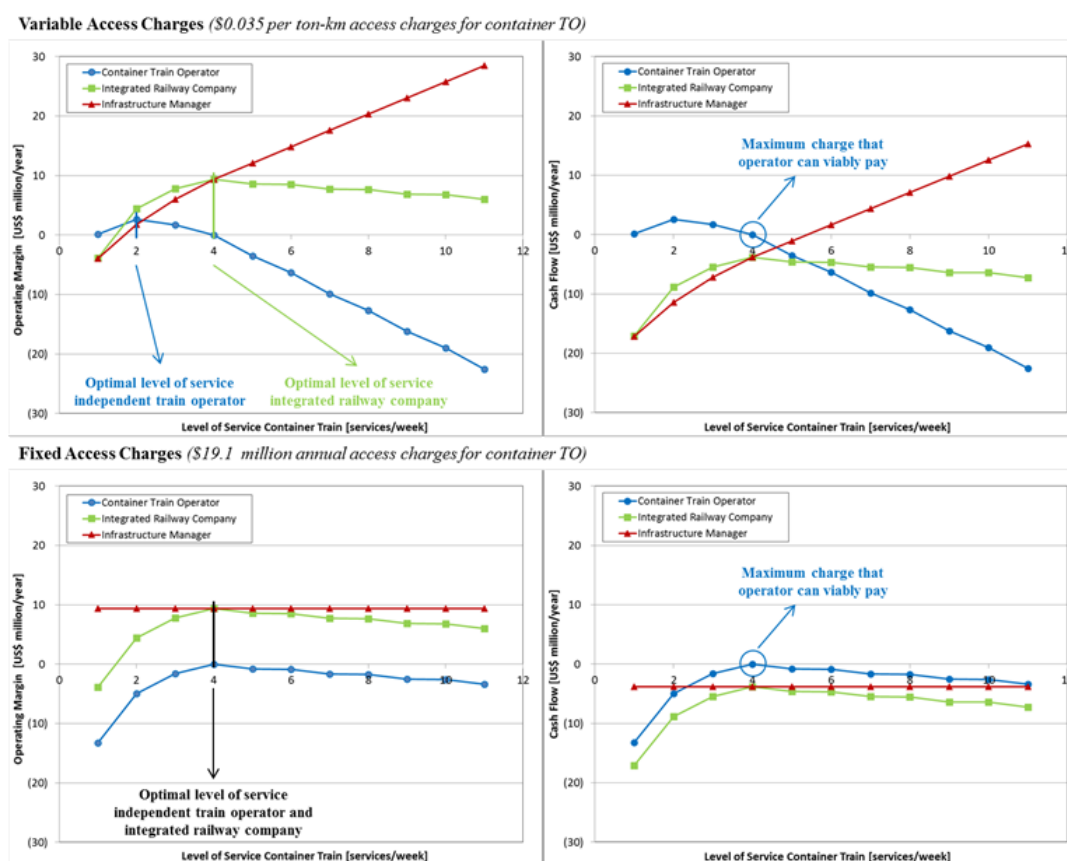


Figure 1. Operating margin and cash flow for different levels of service with variable and fixed access charges.

cash flow for an independent container TO, for the IM, and for an integrated railway company in Tanzania under variable and fixed access charges when no other type of TO operate in the line. Both access charges have been calculated to recover as much of the infrastructure costs as possible, while ensuring that the operating margin and the net cash flow of the independent TO are positive. Note that it is not possible to recover all the infrastructure cost (\$22.9 million per year in Tanzania) only with container services. The maximum charges that an independent TO could viably pay are \$0.035 per ton-km (variable) or \$19.1 million per year (fixed). We compute these numbers estimating the TO maximum revenues, the variable and fixed costs, and therefore the maximum fixed and variable access charges that the TO can viably pay to achieve an annual net cash flow equal to zero.

The results also show that under only variable access charges, a rational independent TO would operate only two trains per direction per week while the social planner would operate four. This mismatch happens because when the social planner tries to maximize its operating margin, it operates a train when the additional revenues produced are higher than the additional variable costs (train lease, personnel and fuel). For the social planner, most infrastructure investment cost is a sunk cost: it is already made and it is independent of the level of service. Under variable access charges in contrast, the infrastructure costs are charged as variable costs for TOs. Therefore, a rational TO would only operate a train if the additional revenues produced are higher than the true variable costs plus a share of the infrastructure cost that appears now as an artificial variable cost (the variable access charge).

Under fixed access charges, the infrastructure costs are charged as a fixed cost for TOs. Therefore, this cost will also be a sunk cost for the TO. Consequently, the TO will operate a train when additional revenues produced are higher than the true variable operation costs and there is no mismatch with the level of service of the social planner.

3.2. Container and general cargo traffic

The previous subsection considers container traffic because container shippers have high willingness to pay to ship containers. Nonetheless, there is plenty unused capacity in the Tanzanian railway system and there are other types of customers interested in transporting non-containerized freight (general cargo) along the corridor. We carried out a similar analysis of costs and revenues for general cargo services (World Bank, 2014) 0 per ton-kilometer (variable) or \$10.5 million per year (fixed). In both cases

an integrated railway company and an independent TO would operate ten services per week.

Considering these numbers, the IM would need to charge a variable access charge of \$0.023 per ton-kilometer (variable) or \$12.4 million per year (fixed) to the container TO to recover all infrastructure costs. Note that if the container TO was charged only \$10.5 million per year or \$0.010 per ton-km it would not be able to recover infrastructure costs (only \$21.0 and \$15.9 million per year respectively). This shows, first of all, that discriminate pricing would be needed to recover infrastructure costs. Although a general cargo TO cannot viably pay as much as a container TO per ton to access the infrastructure, allowing access to the infrastructure to general cargo TOs 1) allows the IM to recover infrastructure costs (not possible only with container TOs), 2) allows container TOs to pay lower charges to access the infrastructure, and 3) improves welfare (for general cargo TOs and general cargo shippers) from a state point of view.

Although these charges are consistent with the industry benchmark (World Bank, 2014), a regulator needs considerable information (operation costs, demand estimates) to determine the maximum access charges that each TO is able to pay. Lower charges would not allow the IM to recover infrastructure costs; higher charges (particularly for general cargo in this case) would not allow TOs to viably operate trains in the system.

With a variable access charge of \$0.023 per ton-kilometer, an independent container TO would only operate three (note that the variable charges are now lower than in 3.1.) train services per direction per week (instead of the four that a social planner would operate). Under fixed access charges, the level of service of independent TOs in equilibrium matches the level of service that an integrated railway company would operate. The main challenge to implement fixed access charges in this case consists of determining the share of infrastructure costs (\$22.9 million per year) that each TO should pay. Nonetheless, our computation shows that the level of service operated by the TOs is robust when the distribution of fixed access charges change: the container and the general cargo TO would be able to pay up to \$19.1 million and \$10.5 million per year respectively while still being profitable. Any choice such that the annual fixed access charge for the container TO is lower than or equal to \$19.1 million, for the general cargo TO is lower than or equal to \$10.5 million, and the sum of both charges is \$22.9 million would improve level of service with respect to variable charges while enabling infrastructure cost recovery. This result has

important implications: 1) it relaxes the constraint on how much information the regulator needs to determine fixed access charges, and 2) it allows the regulator to design the fixed charge level for TOs with different objectives: such as ensure equity, ensure efficiency, ensure general cargo services.

Under fixed access charges with no variable charges per train, states could implement different schemes to allocate operating licenses among potential TOs. First, the regulator could determine a fee (fixed access charge) that a container and a general cargo TO would have to pay to get the license to recover infrastructure costs (\$22.9 million per year). If the charges allow the operators to viably operate, they would apply for the license and retain the additional profits (\$19.1 or \$10.5 million per year minus access charge for each type of TO). Second, when there are several companies willing to operate trains, the state could implement an auction to allocate the license to operate in each market. If the license is awarded to the TO with higher willingness to pay at each market, the most efficient container and general cargo TOs would bid \$19.1 and \$10.5 million respectively. In this case, the publicly owned IM would obtain \$29.6 million per year (instead of \$22.9). The IM can either use the additional revenues to invest in infrastructure in the future or transfer them to the government. If the license is awarded to the TOs that offer best shipping rate to customers provided that the IM can recover infrastructure costs, the IM would recover \$22.9 million per year, the TOs would recover their costs with some return, and the customers would benefit from a discount in their shipping rate of \$6.7 million per year (\$29.6 minus \$22.9). Further options can be explored when more than one license per market (container and general cargo) are allocated.

4. Conclusions

In this article, we analyze different capacity pricing schemes designed to recover infrastructure costs (periodic maintenance and financial costs) and to ensure that TOs can viably operate (positive net cash flow) in Tanzania. The insights derived from this case are useful to design open-access railway systems in other countries.

First of all, we show that the adoption of variable access charges widely used in the railway industry may create incentives for rational TOs to operate fewer trains than an integrated railway company (social planner). We show that the use of fixed access charges aligns the behavior of vertically separated firms with the behavior of an integrated railway company. This result is important in the railway industry because most infrastructure costs are fixed, i.e., for the most part they do not vary with the level of service as is generally assumed.

The results obtained also show that: 1) discriminate pricing may be needed to be able to recover infrastructure costs when different types of TOs face very different levels of cost and revenues, 2) regulators need considerable information about the sector (demand and cost) to determine adequate access charge levels that TOs can viably pay, 3) the level of service offered by TOs is robust for a wide range of fixed access fees, relaxing the regulator needs of information, 4) different levels of fixed access charges can be designed with different objectives, and 5) the state choice of different capacity pricing schemes has implications on the welfare distribution among stakeholders.

Future work should analyze further how to implement fixed access charges effectively, especially in cases with competing TOs in the same market to avoid barriers to entry. Future research should also determine how these conclusions change with demand uncertainty, elasticity in the demand, and imperfect information, in instances in which infrastructure capacity is limited or there are important network effects in the system, and in instances in which the capacity of the regulator is limited.

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References

1. AICD (2008), Transport Prices and Costs in Africa: A Review of the Main International Corridors, (U.S.: World Bank Working Paper 14).
2. Amjadi, A., and Yeats, A.J. (1995), Have Transport Costs Contributed to the Relative Decline of Sub-Saharan African Exports, (U.S.: World Bank Policy Research Working Paper 1559).
3. Arvis, J.F., Raballand, G., and Marteau, J.F. (2010), The cost of being landlocked: logistics costs and supply chain reliability, (U.S.: World Bank).
4. Big Results Now, Tanzania Development, Vision 2025 (2013), Executive Summary of the Transport Lab National Key Results Area Report, 2013 (Tanzania: Big Results Now).
5. CPCS (2013), Financial and Economic Analysis of Tanzania Intermodal and Rail Development Project (TIRP), Report prepared for RAHCO and The World Bank (Canada: CPCS Report 12124).
6. DB (2009), Feasibility study for the Isaka-Kigali/Keza-Gitega-Musongati Railway Project, Study Summary Report prepared for Multinational Tanzania, Rwanda, Burundi (Germany: DB).
7. Gibson S. (2003), Allocation of capacity in the railway industry, Utilities Policy, Vol. 11, pp 39-42.

8. Gomez-Ibanez J.A. (2003), *Regulating infrastructure: monopoly, contracts, and discretion*, (Cambridge, MA: Harvard University Press).
9. Olievski, V.N. (2013), *Rail Transport: Framework for Improving Railway Sector Performance in Sub-Saharan Africa*, (U.S.: World Bank, Sub-Saharan Africa Transport Policy Program (SSATP) Working Paper No. 94).
10. PPIAF, World Bank, and TRS (2011), *The Railway Reform Toolkit*, (U.S.: World Bank).
11. Raballand, G., and Macchi, P. (2009), *Transport Prices and Costs: The Need to Revisit Donor's Policies in Transport in Africa*, (U.S.: World Bank).
12. Railistics (2013), *Institutional Assessment of Tanzania Railway System Report*, Report prepared for RAHCO and The World Bank (Tanzania: Railistics).
13. UIC (2012), *UIC Study on Railway Infrastructure Charges in Europe*, (France: Report prepared by IST & UPC).
14. World Bank (2014), *Project Appraisal Document for Intermodal and Rail Development Project*, (U.S.: World Bank).

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