

# **Infrastructure charging, slot allocation procedures and harmonisation of charges in European railways**

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## **Abstract**

The paper shows how slot allocation procedures are affected by the organisation of the railway sector. A methodology is sketched, that shows one possible way of solving some important obstacles that arise when allocating track between competing railway operators.

## **Introduction**

Charging the use of the network is an important topic within the transport- and communication sectors. Network may be road, telephone grid or railroad network. The ways these charges are designed vary dramatically between sectors and modes. These differences are related to historical reasons as well as market mechanisms, technological characteristics and regulations. Understanding the nature of the industry in focus is essential for making recommendations for charging principles.

This paper provides some key findings of charging of access and use of railway infrastructure in Europe, based mainly on the research project Improverail financed by the EC. The aim of Improverail was to equip the infrastructure managers (IM) in Europe with a handbook to aid their daily activity, cost efficiency and investment plans.

The paper is based on the established reality of a vertically separated railway industry with one owner of the infrastructure; the infrastructure manager (IM) and operator(s) that possess rolling stock and sell services to end-users. In addition a typical railway system will have (partly) separated entities that have responsibility for other railway services, for example safety and timetabling procedures. In this paper it is sufficient to be able to draw the line between railway operators and the owner of the track, namely the infrastructure manager.

There exist no set of indisputable rules of infrastructure charging and track allocation procedures. Charges and procedures can be designed in order to meet different kinds of objectives. Typically, national opinions will vary with the level and structure of competition in adjacent sectors and congestion on track. Some nations experience extreme congestion in urban areas – railway is a crucial means to reduce growth in urban road traffic. Other nations are more concerned about railways that have reached the limit in terms number of freight trains etc. Countries of the first type will typically favour efficiency-oriented policies, while the latter might be more concerned about financing infrastructure.

## **Method**

The methodology applied in this study is as follows: Based on a comparison of a large amount of information from national railway systems, collected in the Improverail project<sup>1</sup>, and using multinational experiences and knowledge the state

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<sup>1</sup> The countries described are BLG, CH, D, F, BG, GR, I, N, NL, P, RU and UK.

of progress of charging methodologies are measured and ways to go for the future is described. Desk-research comparisons are made and results discussed. One major line must be drawn between economical analysis based on technological constraints as well as market constraints for the railways vs. an analysis where also laws and regulations are taken as given. In this paper, EC Directives, implemented as well as directives in the implementation phase are discussed, but the demands that these directives set is not directly used as limitations for the railways' opportunity set. After all, the directives can, and are amended after some time, while basic economic principles do not change. In this paper, the ideas presented are generally thought to be within the juridical constraints set in Directives 2001/12, 2001/13 and 2001/14, although this fact has not been regarded as vital. In general, the EEC directives have a far too wide scope to function as detailed recommendations, even though the directives have become more detailed after the amendments in 2001.

### **Slot allocation procedures**

From an economist's point of view slot allocation procedures and charging of infrastructure seem highly related. In theory, auctions may function as a way of allocating track efficiently, as well as a means of transferring some of the operators' surplus to the IMs. Although simple in theory, actual implementation of auction schemes in railways is far from coming to reality. The fixed railway network and the problem of maximize utility or capacity of the network seems like a too difficult matter for an algorithm. Still, if these technical obstacles could be passed, the huge welfare distribution affects that would occur might make any such practice politically impossible. Development of new software makes it perhaps easier to perform more such calculations in the future. Nevertheless, the public sector, the Government and departments will probably demand some control over this process also in the future. Still, land use, city planning etc. are such important political issues, so that some public control over the traffic patterns and investment patterns, will be needed also in the future.

Can market mechanisms give us information if a full auction procedure is not performed? The answer is yes. Given that the use of infrastructure is charged at social marginal cost, the realised output should correspond to the social optimum level of production. Infrastructure charges should allow operators to optimise the rolling stock in terms of external costs, both costs that are borne by the IM (internal to the industry) and costs that are borne by others, e.g. noise and pollution.

Often some mark-ups for public finance are added. This is partly related to the fact that EC directives demand, that the infrastructure managers' revenues from public transfers and infrastructure charge balance the costs. Thus, for fixed public transfers to the infrastructure, and with limited possibility to save costs, at least in medium term, charges and other sources of income are the only usable instruments in order to balance the costs. <sup>2</sup>

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<sup>2</sup> EC Charging rules:

Track access charges can stand for up to 35% of total production cost of rail freight services.<sup>3</sup> Infrastructure charges per train kilometre diverge by a factor up to 7 between EU member countries. This is often related to national governments fail to provide the infrastructure managers with stable and sufficient support. Pure short run marginal costs will normally stand for up to 10% of total costs. In extreme cases, for example with high level of congestion, marginal costs can amount to an even higher proportion. Implementation of auctioning methods for allocating slots would be another way of transferring producer's surplus from the operator to the infrastructure manager.

Only if the railways are profitable as a whole, except for external costs, it is a stable solution in the long-term perspective, to collect infrastructure charges at a level that actually make a full cost recovery for the infrastructure manager. In most cases the railways hardly run profitable and receive subsidies.

In a well-functioning market, the infrastructure manager will receive feedback from the operators in terms of reduced demand when the price for the use of the network rises. Such markets are explained in e.g. Tirole. J (1990). In the railway sector the feedback from the operators are likely to be very poor due to a number of reasons. The most important are:

- Timetables are fixed for a period of time. Level of railway activity will to a large extent be fixed at each interval
- Fares for passengers and shippers are perhaps fixed for some periods, not only for the cost of altering the fares, but also in terms of agreements with authorities, passenger groups etc or other transport companies
- Operators receive public funding through public service obligations (PSOs) or direct subsidies.

This section contains a short description of a methodology for infrastructure charging and slot allocation. It is not the most advanced system that could be developed. On the contrary: It forms a basic framework that might avoid some of the market failures, suboptimal solutions and awkward results that may have come from a hasty introduction of advanced infrastructure charging. The methodology

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#### EC/2001/14/Article 6

1. Member states shall lay down conditions, including where appropriate advance payments, to ensure that, under normal business conditions and over a reasonable time period, the accounts of an infrastructure manager shall at least balance income from infrastructure charges, surpluses from other commercial activities and state funding on the one hand, and infrastructure expenditure on the other.

<sup>3</sup> Scherp (2002)

described fits best, where the IM at some extent can take other aspects into consideration than profit maximisation. Also with a profit maximising IM a charging procedure can be introduced. Such a market would need extensive control from a public organ, securing the welfare of the passengers and the public as a whole.

The main conditions for this framework to function is:

- Infrastructure charges set by an organ securing public interests rather than own profitability
- No financial flows between government and any operator. If so, do not let this company use its financial advantages to destroy any attempts for competition

Some pitfalls that will erode the benefits from any commercially oriented systems are:

- Too high level of cost-coverage of the provision of infrastructure. Most car users do not pay for the road that they drive upon. Until then, full infrastructure cost recovery for the railway users is not recommendable. The need for a certain level of cost recovery is understandable. It is in general better to tax the companies' income, rather than a kilometre-dependent charge. This element creates a spike between the optimal charge and the actual charge, and thus induces a too low level of railway service production.
- Too much use of PSOs. PSOs should be used when railway services on some lines are socially profitable but not commercially profitable. Of course, if few lines are profitable, no market really exists, but as external conditions as technology, jurisdiction as well as the demand structure changes and evolves, new lines may become commercially viable. Then, the use of PSOs should be reduced. There is a risk that PSOs may function as a pillow, avoiding the stride to increase productivity.
- The authorities must ensure that international external conditions are set in such a way that international traffic faces the correct set of prices and as little bureaucracy as possible. National protectionism is a loss for all.

The methodology can be described as having two main stages:

**First stage: Set the infrastructure charges**

Charges should be set equal to marginal cost. The cost structure should include costs as wear and tear of track and signaling, but also external costs as noise and pollution. The congestion cost is a continuously changing function in time and space. For practical purposes we suggest a simple mark-up structure to be used in areas with congestion. Second-best considerations may be used, if based on proper analysis. Second-best charging is a good way of avoiding too high rail-tariffs compared to other modes of transport.

Add national financial mark-ups. Off course, the combination of second-best pricing and infrastructure-financing components is contradictory.

Add national time-dependent mark-ups to deal with congestion in the rush hours. Hence, this mark-up is predetermined at a one-step or multi-step level in this simple model. It is an estimate and not a market solution. Note that congestion – charges will improve the system's efficiency while financial mark-ups will undermine the efficiency.

Make this regime (all national charging regimes) transparent to all parties, domestically and abroad.

The capacity is at all times regarded as the feasible capacity given national and international regulations on accident risks etc.

### **Second stage: Design the timetable:**

At the stage of setting the timetable, there are multiple successive steps that must be taken.

1. Set the framework for the timetable. Define the total capacity on each line, taking into account the linkage between density on track and safety, reliability and expected number of delays as well as impacts of delays.
2. PSOs are the first type of departures to be set in the timetables. PSOs are first placed in the timetables without auction. The government is the purchaser of the PSOs. The government should be as flexible as possible in terms of time-slots for these trains. The PSOs have to be set in a transparent and discrimination free procedure. The PSOs can of course be distributed in a “competition for the track”-system, but if the government already runs a railway company it seems reasonable to give these contracts to this company (see above).
3. Long distance departures, international inter-city passenger traffic and transit trains are then adapted into the timetable. As far as networks are dedicated to long-distance traffic those relations should even have the priority.
4. Some corridors for freight are established mainly outside of peak-hours in order to ensure efficient international freight traffic. The freight trains should not come in conflict with any commuter train services etc.
5. At this stage, if the organ that sets the time table can cooperate with the purchaser of PSOs, the PSOs may be adjusted slightly in order to improve the timetable
6. Packages of slots, offering specific train products on specific networks are sold to a company – if possible by some kind of auction. This procedure is chosen, as there will generally be economies of scale in serving a certain region or passenger group in a certain area. Therefore letting different companies serve the same passengers with the same services might reduce overall efficiency. Avoid direct competition on track for similar services. Different packages could be like: City - commuter westwards Capital – Large city Intercity trains
7. The remaining slots are kept for a slot market for anyone to compete. The entrants must pay the same charges as in step 1 as well as the increased

system delay costs that the newcomer push upon the others. This charge is paid to the IM, even though the operators are the ones suffering.

8. This timetable is set for some predefined period of time. Adjacent countries would benefit from designing their national timetables simultaneously. This is a condition for ensuring this methodology to function
9. A second-hand market is established, in order for any pareto-improvements to be revealed.

A slot is the right to run a specific train at a specific line at a specific time. It is also a duty. This is necessary in order not to end up in a situation where one strategic company buys all slots. Equally important is the transparency of all processes in the timetabling procedure. There should be no need to keep things secret. On exception might be the bidding procedure, where closed bids might be used. But this does not contradict an open, non-discriminatory process.

### **Charging and the organisation of the railway sector**

The railway sector is a sector that needs public control in order to function in a way that ensures efficient provision of railway services. This fact is related to:

- Externalities
- Limited competition
- Significant risk of harmful predatory behaviour between market contestants
- Building and designing railways, station areas etc. affects land use and urban planning to an extent where public participation in the decision process is absolutely necessary.

These points are independent of profitability and ownership of railways.

In addition we will have in most railway systems, one or more of the following elements create needs for public regulation of railway activity.

- Price regulation of end-user prices in order to ensure end-user welfare. Price regulation may have many different motivations, such as interregional equity, maximum price regulations etc.
- Price regulation of infrastructure services. These regulation of these prices may be caused by political will to ensure non-discriminatory treatment of different operators as well as wishes to maximise the number of operators on track
- Public funding of investments in railways
- Indirect public funding of railways by guarantying the conduct of IMs or operators
- Public responsibility through ownership of railway entities

- Political set levels of railway services, which normally will lead to a need for subsidizing specific routes.

There will always be important externalities in production and consumption that needs proper regulatory measures in order to be internalised. There will also be, linked to the huge investments needed in order to provide rolling stock, necessary certificates etc. room for only a handful competitors within a market. Therefore, the need to ensure that market power is not exploited through cartels etc. will always be present. Finally, there will be a need for surveillance of all railway units, also IMs, in order to ensure that operators are handled in a non-discriminatory way.

There are different ways of performing this public control. In pre-reform environment, prices and activity were regulated directly:

$$S_1 = S(\bar{p}_s, \bar{x}_s)$$

Here S represents the social value of the railway activity, taking both consumer surplus and producer surplus and all externalities into account.  $\bar{p}_s$  is the vector of all politically set prices. This function was maximised given financial conditions etc. This practice has been rightfully accused for not give good incentives for cost-minimisation and to be regulated by too many political aims. The government is the actor that maximises this function

Vertical separation of the railway industry, has for most countries lead to this situation:

$$S_2 = S(S_{IM}(\bar{\Pi}_{Oi}(\bar{p}_s, \bar{p}_f, \bar{x}_s, \bar{x}_f)))$$

In this situation the social welfare is secured in two steps:

First the infrastructure managers, being public or semi-public have the right to set some of the charges for the operators and perform within different business activities. The government controls the overall activity, and is usually the party that decides on the level of PSOs ( $x_s$ ), and juridical and organisational decisions in the railway industry. The operators are free to set some prices and the activity on some lines up to a certain level ( $x_f, p_f$ ). This is obviously a more complex system, increasing the complexity of the task of regulating the railways. The “administration cost” of the railways may therefore have increased. On the other hand, the performance of operators has increased dramatically. Also IMs tend to be more effective than before, especially in countries where the IMs are free to make profit. If  $S_2$  is nearer to the true social optimum than  $S_1$  taking changes in public expenditures on regulation into account, has not been proven - only made probable. It is difficult to say in which way prices, output and regulations should be altered in order to make the system altogether run the best way, but progress has been made in the past decade that shows that a new era has started.

A third possible regulatory environment can be drawn:

$$S_3 = S(\Pi_{IM}(\bar{\Pi}_{Oi}(\bar{p}_s, \bar{p}_{IM}, \bar{p}_f, \bar{x}_s, \bar{x}_f)))$$

Here the IM is profit maximising, and the government ensures the social welfare. This solution may seem more plausible and simple than  $S_2$ , but the number of factors that needs to be controlled by the regulator increases dramatically. The

main problem is that a monopolist IM has an incentive to cooperate with one operator in order to function as an integrated monopolist. It can be shown that a situation with one IM and one operator is inferior to an integrated monopoly both in respect to producer surplus and consumer prices. (Tirole J. (1990)) Public transfers to operators will directly enter the IM's profit function, and the IM might be able to set prices in a way that maximises public transfers. Obviously, this leads to a suboptimal situation.

The latter regulatory environment ( $S_3$ ) is thus mainly an interesting solution if:

- The railway industry as a whole is profitable without public transfers. Even the most cost-effective railway industry may still be unprofitable. So, increased cost-efficiency is not enough to conclude that railways will be profitable in the future. In many countries the railways may never reach a size and standard where end-user payments will be larger than the total costs.
- The operators function as a competitive market, with limited market-power for all contestants.
- The IM's activity can be controlled by the authorities

Conditions 1 and 2 are usually not fulfilled even for most advanced railway systems. Profit maximisation demands profitable railways, and this is unfortunately a rare event. Condition 3 might demand a lot of public effort, which should be added to the cost- side when calculating costs and benefits of these different systems. If public transfers are given to the railway sector, for operation of for investment in infrastructure, a profit maximising IM is not a good solution.

Varying of the type of organisation, different cost elements will be internal. Having the aim of maximising social welfare, all cost elements should be charged for and thus internalised. This shows how the social planner must redesign the charging schemes when organisation of railways is changing, caused by political decisions or market forces.

## **Conclusions**

Organisation of railways affects how charging procedures must be designed. Liberalised railway systems may, perhaps contra-intuitively, create market situation where the task of creating an incentive-neutral charging system is even more complex.

Charges for the use of infrastructure should optimally be set according to social marginal cost. A general equilibrium model would find its optimum where social marginal cost is implemented in all markets adjusted for market failures etc.

Liberalisation of the railway sector has created the possibility for designing a more well functioning market, but on the other hand, has the complexity of the organisation of the railway industry increased. This paper has shown how organisation of the railway industry and charging policies are interlinked, and shows an example of a methodology that takes some of the problems that arise

into account. Any methodologies need to be encompassed to national variations, so the methodology is intended only to show some general considerations for slot allocation procedures.

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