# Assessing the Use of Welfare-Based Track Access Charging for Railway Capacity Allocation

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## *Abstract*

The deregulation of railway markets has brought new challenges to the capacity allocation process. In this context, we present a new hybrid methodology for allocating railway capacity to commercial train operators. Commercial freight or passenger train operators compete with each other as well as with subsidised local commuter trains. In the method presented in this article, minimal track access charges are computed using a social cost-benefit analysis of alternative commuter train timetables. These minimal charges are used as a starting or reservation price in an auction-based method for capacity allocation between the commercial operators. The aim of this study is to assess the use of such a welfare-based track access charging system in a real case scenario. On a congested line in the region of Stockholm, we evaluate the welfare-based access charges of commercial operators. We show that the new methodology can be used to allocate capacity between subsidized and commercial train operators. Moreover, we provide an estimate of the marginal minimal access charge per train path that the commercial operators request.

*Keywords: railway deregulation; track access charges; capacity allocation; social cost-benefit analysis; railway timetabling*

## *1. Introduction*

Due to increased traffic as well as deregulation of many railway markets, track capacity allocation has become more complex. While the infrastructure mostly remains state-owned, operations are carried out on a multitude of organizational formats, often mingled on the same tracks. For instance, these can be carried out as subsidized services locally on unprofitable lines or as open access commercial services on profitable ones.

Conventional railway capacity allocation and timetabling methods often deal well with vertically integrated railway markets where infrastructure management and train operations are under state monopoly. These traditional capacity allocation methodologies are less adapted to vertically separated and open access markets where several private commercial operators concurrently request train paths from a separate and independent infrastructure manager. There are not sufficiently transparent, efficient and well-established rules for conflict resolution between same-type services. In many cases, these conflicts are resolved using informal coordination processes based on discussions or priority lists based on certain rules of thumb.

Hence, there is a clear need for methodological development since very large social and commercial values are at stake. Making the capacity allocation process more efficient can potentially generate substantial societal benefits.

The need for new allocation methodologies for these railway markets is therefore clear. In this paper, we describe a new hybrid method for allocating the railway capacity in deregulated markets. Capacity for commercial operators is allocated through a market-based mechanism (e.g. auction of train slots), while the amount of capacity reserved for government-planned subsidised traffic is decided through societal cost-benefit analysis (CBA). We make use of the CBA tool described by Warg et al. (2019) to compute the societal costs of alternative commuter train timetables. These costs correspond to the loss in welfare value for using an alternative commuter train timetable rather than the ideal original one. This loss in welfare is used in the hybrid capacity allocation methodology in order to set the reservation prices (e.g. minimal track access charges) in an auction-like process to choose the commercial operator and to determine the track access charges.

The purpose of this paper is to present and explain the proposed railway capacity allocation methodology and apply it on a congested line in the region of Stockholm to assess and show the practical feasibility of the method. The results indicate a realistic range of marginal minimal access charges that commercial train operators

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should pay if capacity is reallocated from commuter to commercial trains. The case study shows also how the new allocation mechanism can be used in practice by computing how the track access charges that should be paid by commercial operators under this scheme vary with the number of requested train paths, i.e. marginal minimal track access charges per train request.

## *2. Related literature*

There are different methodologies to allocate railway capacity following different rules and methods. Talebian et al. (2003) divide them into administrative, market-based and value-based. Administrative methods correspond to the use of administrative rules to allocate capacity, an example of such rules is the use priority lists where for instance higher speed trains are prioritised. Marked-based methods use market mechanisms such as auctions to allocate capacity. Value-based mechanisms use capacity analysis to allocate capacity in a way that maximizes the use of capacity. Each of these methodologies has advantages and disadvantages depending on the type of traffic and railway market that it is used in.

Broman et al. (2018a) have described a hybrid mechanism for the Swedish railway system. Assuming fixed train paths for subsidised services, commercial operators also have to account for changes to these fixed paths due to the applied slots. Warg et al. (2019) have described a model to estimate these costs based on the change in welfare for alternative commuter train timetables. One advantage with these models is that unlike other approaches, a real timetable is used which otherwise is a source for bias according to Eliasson et al. (2014).

## 3. *Method*

In this paper, we propose a hybrid method to resolve capacity conflicts between commercial and publicly controlled subsidised traffic. The method is also used to resolve conflicts between competing commercial train operators in open-access markets. The main characteristic of subsidised train services is that supply and fares are determined by a public agency striving to maximize social welfare, i.e. infrastructure manager. Commercial train services are however run by a company striving to maximize profits, be it freight or passenger transport.

The idea of the method, in short, is to calculate a reservation price for a commercial operator's path request by calculating the societal cost (i.e. loss of benefits) of the changes needed in a baseline commuter train timetable to accommodate this path request (Warg et. al, 2019). The CBA model that is used to calculate these costs is illustrated in the overview diagram in Figure 1. If the commercial operator is willing to pay this reservation price, it is awarded the path and the commuter train timetable is adjusted; if not, the request is declined. The process can be extended to handle multiple commercial path requests.

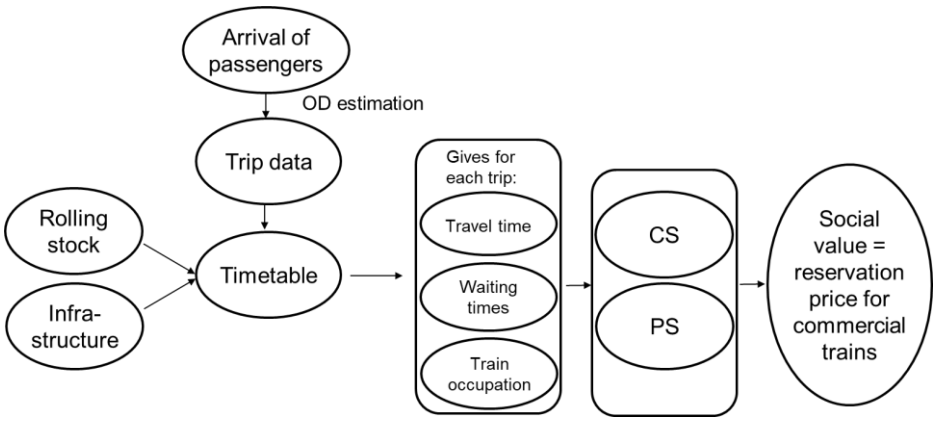


Figure 1 - Overview of the CBA tool's calculation of the reservation price for a commercial train path

This method is advantageous in deregulated open-access markets since on the one hand, an infrastructure manager does not have access to information necessary to assess the societal benefits of a commercial train service, and on the other hand that there is no clear correspondence between public agencies' willingness to pay (WTP) and the welfare value of the services they run. Instead of comparing benefit calculations or comparing WTP, the process proposed in this paper compares benefit calculations for commuter train services to the WTP of commercial train services. The advantages of such a process is in three key insights:

a) The information needed for benefit calculations of subsidised train services (fares, passenger volumes, operating costs etc.) should not be secret and can in principle be relatively easily obtained. It is therefore possible for policymakers to require this information of commuter train operators.
b) Commercial operators on the other hand strive to maximize profit, which is a directly observable measure. This makes them suitable to take part in an auction-like mechanism, as they get direct feedback on their strategies.

c) When commercial operators in competition decide their frequency of service and are not allowed to buy each other's access rights (or outbid each other in an auction), the resulting timetable is close to welfare-maximizing given profit-maximizing fares (Broman et al., 2018b).

As our test case, we use a line segment near Stockholm with scarce capacity, that is used both by long-distance commercial passenger (and freight) train operators and by government-planned commuter trains. We begin with an actual timetable, and increase (and decrease) the number of available train paths for commercial operators and make necessary adjustments to the commuter train timetable. We use timetable analysis in the microscopic simulation tool RailSys (described by Radtke et. al, 2001) to check the feasibility of the adjusted commuter train timetable. The commuter train timetables are then fed into the CBA tool, together with the trip distribution information, in order to compute the loss in total welfare between any alternative commuter train timetables. Consumer (passenger) and producer (operator) costs are calculated using recommended parameters from the local transport authorities (Trafikverket, 2018 and SLL, 2017).

As not all aspects of the timetable construction can be covered in the model (e. g. connection to busses, political motives, etc.) and as the timetable might not be the most optimal one due to missing information, capacity constraints or non-optimal validation parameters, the societal costs can be negative in some cases (in that case, the reservation price is zero).

## *4. Preliminary results and conclusions*

We have presented a new hybrid methodology to allocate railway capacity in a deregulated market. We focus on the conflicts between commercial and subsided services. We show that the CBA tool can be used in the proposed capacity allocation methodology on a relevant and important line segment in the region of Stockholm. The first and most important result from this work is the assessment of the minimum track access charges for commercial operators as a function of the number of requested train paths.

Some commuter services are more easily adjustable than others. Of that reason, some train paths get a lower reservation price than others and increasing the number of paths for the commercial trains does not follow a distinct function. Those findings show the importance of taking the real timetable, in accordance with Eliasson et al. (2014), into account instead of using average estimations for the effects of adjustments in the timetable. Being based on a microscopic simulation tool, the used method enables to exclude infeasible timetable solutions which most of the cost-based models cannot. Given rough estimates of the WTP of commercial operators, we will be able to make an early prediction of how the balance between commercial and government-planned traffic would change on this line segment, if the proposed methodology was to be used.

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