Benefit Cost Analysis of Commuter Train Frequency: Operator's Revealed Valuation of Waiting Time and Crowding

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Introduction

Benefit-cost analysis studies of public transport investments and operations often require the valuation of several trip parameters such as waiting time and crowding. These values are often based on the valuation of travellers and mostly affect the public transport supply, i.e. service frequency.

Subsidised public transport are supposed to supply a degree of service that reflects best the valuation of the passengers. However, this is not the case if the service frequency is far from the societally optimal one that reflects the stated passenger preference, e.g. in terms of passenger's valuation of waiting time or crowding.

In this context, public transport service frequency is assumed to reflect the passenger's valuation of these trip parameters. This frequency can therefore reveal the valuation of certain parameters (e.g. waiting time and crowding) from the operator's perspective in contrast to that of the passengers.

Research question

With a focus on commuter train services, this paper aims at estimating the public operator's valuation of waiting time and crowding based on a benefit-cost analysis of service frequency.

The study looks at how this revealed valuation from the operator's perspective can be done using societal benefit-cost study of the commuter train service frequency.

Methodology

A benefit-cost model is used to study the total societal cost of adopting a certain service frequency, i.e. train operator's service supply. The model accounts for consumer (or passengers) and producer (or train operator) costs and compares the societal optimal frequency with the one currently adopted by the train operator.

The producer surplus includes variable linear costs of operations that depends on the service frequency. The consumer surplus accounts for the travel time including in-vehicle crowding as well as the waiting time. The parameters that are used in calculating the consumer surplus are borrowed from the national guidelines for benefit-cost models (Trafikverket, 2016). Those used in the producer surplus are mostly from the local transport agency (SLL, 2017).

Using first a disjoint (and then a joint) sensitivity analysis on both the value of waiting time and in-vehicle crowding, we show the revealed operator's valuation of these parameters based on the currently adopted service frequency, i.e. train timetable.

Expected results

The case study is based on the commuter train service in Stockholm. We focus on a commuter line and direction passing through the central station. We use data on the train timetable (i.e. frequency) and the passenger trip distribution (i.e. OD matrix) from September 2015.

We study three different time intervals: morning peak (6:00 – 9:00), afternoon peak (15:00 – 18:00) and mid-day off-peak (9:00 – 15:00). The BCA model allows to find the societally optimal frequency in each time interval. A comparison with the adopted frequency through the sensitivity analysis allows to find the revealed valuation of waiting time and crowding.

The comparison between the adopted service frequency and the socially optimum showed that the public transport agency (in Stockholm during 2015) generally adopts a difference service frequency, i.e. runs a total number of trains per hour that is not societally optimal. This results in a different implicit valuation of waiting time and crowding than the passengers' stated preference values.

These differences have several possible explanations that are discussed. For instance, political powers can interfere to increase (or decrease) the service supply than the societally optimum and thus lead to an expensive subsidised commuter system that is paid for by taxpayers.

References

SLL 2017. Dokumentation av SAMS 3.0. Stockholm.
TRAFIKVERKET 2016. English summary of ASEK recommendations.