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Title and Abstract

Title: The valuation of comfort in trains: Evidence from a real-life peak avoidance experiment

Abstract

Background

Peak-hour congestion is not only relevant in the context of car travel, but also for public transportation. While in public transport differences between peak and off-peak travel times are usually quite small compared to car traffic (at least as long as some dedicated infrastructure exists), peak-hour congestion in public transport mostly occurs in the form of crowding.

Crowding can cause discomfort to passengers as it reduces the chance to get a seat as well as the personal space available to each passenger, regardless of whether (s)he is sitting or standing. Fare differentiation over the time of the day may help to reduce crowding during peak hours, potentially limiting the need for expensive investments in vehicle and network capacities. In order to predict the effects of price-differentiation policies, reliable estimates on the consumers' willingness-to-pay for reductions in crowdedness must be derived.

Aim of the paper

In this paper, we study crowding in the context of train travel in the Netherlands. Specifically, we investigate the feasibility to reduce crowding by providing monetary incentives to regular train commuters for traveling outside peak hours.

We use discrete scheduling choice models to estimate the willingness-to-pay of train passengers for reductions in crowdedness, or more briefly, the valuation of comfort, based on both RP and SP data. In addition, we derive the willingness-to-pay for reductions in travel times, schedule delays, and travel time variability, which gives us the opportunity to analyze the relative importance of crowding in trip scheduling decisions. Finally, SP choice data from non-participants allow us to control for the effects of the non-random recruitment of participants.

Data

We make use of revealed preference (RP) and stated preference (SP) data from a large-scale peak avoidance experiment on the Dutch rail network. The experiment lasted for multiple months, with more than 600 regular train commuters participating. Only regular train users who had a yearly or monthly subscription for the Dutch rail network or on certain links thereof, were invited to participate.

The real-life experiment consisted of 3 weeks of pre-measurement, a reward-period of 4 months, followed by 4 weeks of post-measurement. During the reward period, participants obtained a monetary, distance-dependent reward when they were observed to travel outside the (morning or evening) peak. They could earn between 5 and 9 Euro per day in the high reward regime, and between 3 and 5 Euro per day in the low reward regime. Each participant spent an equal amount of time in either regime.

Participants were required to use a dedicated smartphone app that recorded the timing and routing of their trips, using GPS measurements. These primary RP data are enriched with data collected from the participants' logbooks, which contain, among others, data on train delays and the extent of crowding on the train. The crowding variable can assume 5 different levels, ranging from "There are so many free seats available that you can occupy 4 seats for yourself" to "Many passengers have to stand". We use the logbook data to derive time-, day- and link-specific expectations of reliability and crowding. Moreover, extensive data on person-specific characteristics (including socio-economic and workplace-related variables, scheduling restrictions, and the ability to work in the train) have been gathered in various questionnaires. These will be used as covariates in the choice models.

Finally, we also collected SP data from the participants of the peak avoidance experiment as well as from about 500 non-participants (i.e. regular train travelers who have been invited to participate in the RP experiment, but did not accept the invitation). The SP survey has been set up in such a way that the choice situations are very similar to those in the RP experiment. Moreover, it has been customized towards the current travel situation of the individuals, with the aim to provide realistic choice alternatives.

Methodology

We use discrete choice models to estimate the valuations of comfort, travel time, schedule delay and variability. The choice set is OD-pair specific, and consists of the feasible train connections a person can use to get from his/her home to work, and vice versa. We estimate panel latent class models to control for the panel nature of the underlying data.

Furthermore, a logit model is used to estimate which factors play a role in whether an individual decides to participate in the peak avoidance experiment or not. This allows us to draw conclusions on the presence of a self-selection bias (due to non-random recruitment), and to correct for it if required.

Results

We find clear evidence that the participants of the peak avoidance experiment react to the monetary incentives: The number of peak trips declined by 22% during the reward period compared to the pre-measurement.

We obtain very reasonable estimates for the willingness-to-pay values, both for the SP and the RP experiments. In fact, the estimates do not differ substantially between the SP and the RP domain, which is a fairly unusual result in studies that use choice data from both data sources. Concerning the valuation of

comfort, we find that comfort is valued relatively low compared to the other attributes of the train journey.

Also, we find clear evidence that participants and non-participants differ considerably. Participants are for instance more likely have flexible working hours, and to have high education levels. When comparing SP estimates for participants and non-participants, we find that non-participants have a higher disutility from schedule delays than participants. However, a more pronounced difference between the two groups is that the valuations are about 4 times as high for non-participants than for participants, meaning that for non-participants the rewards would have to be 4 times higher than for participants to achieve similar behavioral adjustments.

Contribution to the literature

In recent years, several SP-based studies on the valuation of comfort have been published. However, to our knowledge, this is the first study to derive the valuation of comfort in public transport based on RP data, and hence, also the first one to use them in combination with SP data. Our paper is also rather unique in using panel data in the RP domain, and in combining data from SP and RP experiments that resemble each other very closely. Moreover, as data from participants and non-participants are available, we are able to test and correct for self-selection behavior.