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New values of time and reliability in passenger transport in The Netherlands

Marco Kouwenhoven [a, *], Gerard C. de Jong [a, b, 1], Paul Koster [c, d, 2], Vincent A.C. van den Berg [c, d, 3], Erik T. Verhoef [c, d, 4], John Bates [e, 5], Pim M.J. Warffemius [f, 6]

[a] Significance, The Hague, The Netherlands
[b] Institute for Transport Studies, University of Leeds, Leeds, United Kingdom
[c] VU University, Amsterdam, The Netherlands
[d] Tinbergen Institute, Amsterdam, The Netherlands
[e] Independent Consultant, United Kingdom
[f] KiM Netherlands Institute for Transport Policy Analysis, Ministry of Infrastructure and the Environment, The Hague, The Netherlands

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ABSTRACT

We have established new values of time (VOTs) and values of travel time reliability (VORs) for use in cost-benefit analysis (CBA) of transport projects in The Netherlands. This was the first national study in The Netherlands (and one of the first world-wide) to investigate these topics empirically in a joint framework.

Stated preference (SP) questionnaires were designed for interviewing travellers, where the hypothetical alternatives were described in terms of travel time, travel costs and travel time reliability, the latter being presented to the respondents in the form of five possible travel times having equal probability.

For passenger transport, we first collected interviews using an existing internet panel. Additional data collection recruitment was done by asking travellers at petrol stations/service areas, parking garages, stations, bus stops, airports and ports to participate in the survey. One important conclusion is that the SP survey using members of this internet panel leads to substantially lower VOTs than the SP survey with en-route recruitment, probably because of self-selection bias in the internet panel.

We estimated discrete choice models in which the values of time differ between trips with different time and costs levels, different time and costs changes offered in the SP, and different observed characteristics of the respondents (e.g. education, income, age, household composition). By using a panel latent class model, we also account for unobserved differences between respondents in the value of time and for repeated measurements/panel effects. The reference values of time and the reference reliability ratios were estimated on the 2011 sample only, but the effect of time and cost level, time and cost changes offered and socio-economic attributes was estimated on both the 2009 and 2011 samples.

1. Introduction

In many countries, proposals for transport infrastructure projects and other transport policies such as road pricing or changes in maximum speed, are evaluated using cost-benefit analysis (CBA). Key benefits of such projects and policies for the travellers are often the travel time gains, as well as increases in travel time reliability. To include these benefits in the CBA, a conversion of travel time and travel time reliability into monetary units is required. These

* Corresponding author. Tel.: +31 70 31 21 544.
E-mail addresses: kouwenhoven@signficance.nl (M. Kouwenhoven), dejong@signficance.nl (G.C. de Jong), p.r.koster@vu.nl (P. Koster), v.a.c.vanden.berg@vu.nl (V.A.C. van den Berg), e.t.verhoef@vu.nl (E.T. Verhoef), 113300.3565@compuserve.com (J. Bates), Pim.Warffemius@minienm.nl (P.M.J. Warffemius).
[1] Tel.: +31 70 31 21 533.
[2] Tel.: +31 20 59 82 369.
[3] Tel.: +31 20 59 82 442.
[4] Tel.: +31 20 59 86 094.
[5] Tel.: +44 12 35 526 702.
[6] Tel.: +31 70 45 61 991.

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conversion factors are called Value of Time (VOT) and Value of Reliability (VOR).[7] Estimated VOTs and VORs can also be used in generalised cost functions in forecasting models, but the focus of this paper is on values for use in CBA.

Reviews of methods to obtain a VOT are provided in Hensher (2007) and Gunn (2008). Recently, a number of national VOT studies that have been completed have significantly advanced the methods used in survey design and especially in analysis of the data (Axhausen et al., 2008; Börjesson & Eliasson, 2014; Fosgerau, 2006; Ramjerdi, Flügel, Samstad, & Killi, 2010). In terms of numerical results for the VOT, the international meta-analysis in Wardman, Chintakayala, de Jong, and Ferrer (2012) contains the latest evidence. Methods for establishing a VOR are described in Significance et al. (2012) and a recent review of outcomes is provided in Carrion and Levinson (2012).

Most countries that use CBA in transport have official VOTs, but official VORs are missing in almost every country. Both the valuation of reliability and the inclusion of reliability in transport forecasting models are challenging. As a result, the benefits of projects and policies that reduce travel time variability are likely to be underestimated – although VOT estimates might include reliability aspects if these are not specified explicitly in the choice model underlying the estimates. But even then the estimates are biased for the evaluation of projects which have non-proportional effects on travel times and their variability. In the Netherlands, there is a long history of estimating VOTs for passenger transport (Hague Consulting Group, 1990; Hague Consulting Group, 1998). However, VORs have never been measured in a formal valuation study; i.e. a study meant to produce values for actual policy making.[8]

The objective of the study for the Dutch Ministry of Infrastructure and the Environment reported in this paper is to update the official CBA values of time for both passenger and freight transport in The Netherlands and to deliver values of reliability based on primary data. This paper is restricted to passenger transport; the results for freight transport are reported in Significance et al. (2013) and de Jong et al. (2014).

Based on earlier projects (Hamer, De Jong, & Kroes, 2005; HEATCO, 2006; RAND Europe, 2004), it was decided beforehand that the variability of transport time should be measured by the standard deviation of the travel time distribution. The main reason behind this choice was the assessment that including travel time variability in transport forecasting models would be quite difficult, and that using the standard deviation would be the easiest option. Any formulation that would go beyond the standard deviation of travel time (or the variance) would be asking too much of the national and regional models that are regularly used in CBA in The Netherlands.[9]

This study distinguishes three travel purposes: commuting, business travel (i.e. travelling on employer's business) and "other" travel. Furthermore, four modes are distinguished: car, public transport (bus, tram, metro and train[10]), airplane[11] and recreational navigation.[12]

Table 1
List of attributes in the SP experiments (excluding recreational navigation).

Attribute	Experiment 1	Experiment 2a	Experiment 2b
Usual transport time	√	√	√
Transport cost	√	√	√
Reliability, i.e. five possible transport times		√	√
Five possible arrival time		√	√
Departure time		√	√

Specific targets were set for the sample sizes by purpose and mode. Web-based Stated Preference (SP) interviews were carried out both in 2009 and in 2011 among travellers, and various types of discrete choice models were estimated on the resulting SP data.

The plan of this paper is as follows. Section 2 introduces the SP questionnaire and the survey design. The descriptive statistics of the samples are presented in Section 3. Section 4 presents the model specifications, as well as the estimation results. VoTs and VoRs from these models are presented in Section 5. This section also includes a comparison with the values from the previous national value of time studies in The Netherlands (data collected in 1988 and 1997) and the international literature. Finally, Section 6 contains conclusions and recommendations.

2. SP surveys

2.1. Questionnaire

The questionnaire consisted of the following parts (Table 1 lists the attributes in the SP experiments):

1. Questions regarding the attributes of a trip recently carried out,[13] e.g. travel time and costs. These values are used as the base levels for the attributes presented in the SP experiments.
2. Questions regarding the availability of another mode for this trip and what the attribute levels would be for that mode. (This, however, only produced a very limited number of RP choices and proved insufficient for the estimation of an RP model. Furthermore, such estimation results may be biased due to a systematic reporting bias in travel time (see Peer, 2013)).
3. SP experiment 1 with six choices between two route alternatives, each described by two attributes: transport time and transport cost.
4. Introduction of variable (unreliable) travel times.
5. SP experiment 2a with six choices between two route alternatives, each described by four attributes: transport time, transport cost, transport time reliability and most likely arrival time. A fifth attribute, departure time, was calculated from the other four. Respondents in the recreational navigation segment did not participate in this experiment.

[7] Other abbreviations used in the literature for the Value of Time are Value of Travel Time (VTT) and Value of Travel Time savings (VTTS). Other terms for the Value of Reliability are Value of Variability (VOV) or Value of Travel Time Variability (VTTV).

[8] Provisional values have been selected, however, based on an expert workshop (Hamer et al., 2005), and rules-of-the-thumb are used to include reliability in the CBA assessment of projects.

[9] When the travel time distribution is independent of the time of the day and known by the traveller, and when a traveller chooses his departure time optimally, it is possible to estimate a scheduling model (as in Small, 1982) and calculate a value of standard deviation of transport time from the estimated scheduling coefficients (Fosgerau & Karlström, 2010). Indeed, we have tried to estimate such "scheduling models" for our departure time experiment. However, models with a marginal utility for standard deviation performed better.

[10] The train mode includes conventional train services as well as high speed rail (we did not have enough observations to report separate high-speed rail VOTs).

[11] In the previous national VOT surveys of 1988–1990 and 1997–1998, airplane was not included.

[12] In the previous national VOT surveys of 1988 and 1997, recreational navigation was not included. However, a VOT for this mode is regularly needed in The Netherlands, especially for the appraisal of proposed locks and bridges.

[13] For the 2009 survey, respondents were asked to think back to the most recent trip they had made for a certain (preselected) purpose. For the 2011 survey, respondents were asked to think back to the trip they made when they were recruited.