

# **A latent variable model to capture attitudes towards risk and risk perception in the valuation of travel time variability**

Farideh Ramjerdi<sup>1</sup> and Askill Halse  
[fra@toi.no](mailto:fra@toi.no) and [ash@toi.no](mailto:ash@toi.no)

Institute of Transport Economics  
Gaustadalléen 21  
N-0349 Oslo, Norway  
[www.toi.no](http://www.toi.no)

Travel time variability (TTV) is now recognised to be an important concern for both the users and the providers of transport services. It is hence important to be able to measure TTV and its value when designing transport policies.

Travel time variability is associated with risk. There are differences in behaviours of travellers in a risky situation, reflected by their willingness to pay to contain risk, in another words, their risk attitude. However, it is also possible that those who make more risky choices only underestimate the riskiness of their choice. In this case the risky behavior is explained by their perception of the risk. Both the risk attitude and the perception of the risk are subjective. As explained by Dixit et al (2011) under the usual theories characterizing behavior in these settings, one has to examine risk attitudes and risk perceptions jointly (see Dixit et al 2011).

This study applies data from a recent Valuation Study in Norway that was collected in two waves. The first wave focused on value of travel time and travel time reliability for all modes of travel and for both long and short distance travel (Ramjerdi, et al, 2010). The risk attitude of respondent can be established from the experiment on travel time variability. The second wave of the Norwegian Valuation Study focuses on valuations of environment and traffic safety. The second wave includes questions on respondents' beliefs and attitudes. It also includes a stated choice experiment where respondents have to choose between two lotteries. The intention with this experiment is to establish the respondents' perceptions of risk. Most respondents in the first wave took part in the second wave. Hence merging data from the two waves provides further opportunities for analysis of travel time variability.

The two choice experiments in the first wave of the Norwegian valuation study are used by Hjorth and Ramjerdi (2011) to examine the risk attitude of respondents related to travel time variability by application of a Cumulative Prospect Theory (CPT) approach. CPT is a descriptive theory of decision making under risk that departs from Expected Utility Maximization in two essential ways;

the transformation of outcomes using value functions where the carriers of value are gains and losses rather than final levels, with diminishing sensitivity for both gains and losses; and the rank-dependent transformation of probabilities using probability weighting functions. In the first experiment, travel time is known with certainty, while in the second it is subject to variability, represented by a five-point distribution. Behaviour was modelled using a logit model with separate value functions for travel time and cost and a rank-dependent transformation of probabilities. The estimates of the value of travel time differ between the two experiments, since the value from the second experiment includes the additional disutility due to travel time variability and the risk attitude of the respondents. The difference between the values of time provides a measure of the value of travel time variability

The present paper extends the work by Hjorth and Ramjerdi to include respondents' perception of risk as latent variables in structural models to explain travellers' behaviour when facing travel time variability. In another word, risk attitude and perception will be jointly addressed. We use the choice experiment on lotteries in a structural model and show heterogeneity of both subjective beliefs about TTV and respondents' risk attitudes. We only look at data for short distance travel with car.

Hjorth, K, & F. Ramjerdi, 2011. A Prospect Theory approach to travel time variability. Paper presented at the second International Choice Modelling Conference (ICMC), Leeds, England , 4-6 July 2011

Ramjerdi, F., S. Flügel, H. Samstad & M. Killi , 2010. Verdien av tid, sikkerhet og miljø i transportsektoren – Dokumentasjonsrapport B: Den norske tidsverdiundersøkelsen. TØI rapport 1053B/2010

Dixit, V. Harrison, G. W. & Rutstrom E. E. (2011) The Subjective Risks of Driving. Paper presented at the Kuhmo Nectar Conference, Stockholm, Sweden, 27-29 June 2011

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<sup>i</sup> Corresponding author