The value of reliability with endogenous meeting time

Abstract

Dereje Fentie Abegaz and Mogens Fosgerau
The Technical University of Denmark (DTU)

The relationship between congestion and average delay is established and much of transport policy is directed at reducing average travel times. It is, however, increasingly being realized that increasing traffic levels make travel times on urban roadways unpredictable for travelers and that this day-to-day variation is costly to travelers, being a source of uncertainty and leading to undesirable outcomes such as being late for work, appointments or meetings (Noland *et al.*, 1998; Small *et al.*, 1999; Lam & Small, 2001). Travel time variability is hence becoming an important target for transport policy.

Some consensus has been reached regarding the theoretical basis for measuring the cost of travel time variability (Small & Verhoef, 2007). Usually, the value of travel time variability is modeled using one of two broad theoretical approaches. The approaches differ in their interpretation of what underlies the behavioral importance of travel time variability. While the mean–variance approach attaches importance to the uncertainty, pain or stress brought by travel time variability, the scheduling approach values travel time variability through the effect it has on arrival time outcomes. The scheduling approach thus has a stronger foundation in the theory of consumer behaviour (Small & Verhoef, 2007; Fosgerau & Fukuda, 2012).

In this paper, attention is paid to two important limitations of the conventional scheduling model: the assumption of exogenous scheduling preferences and the fact that the model takes scheduling choices merely as an individual matter. Since scheduling choices could affect and be affected by the distribution of travel times, the assumption of exogenous scheduling preferences is unreasonable. Fosgerau & Small (2010) examined how these preferences could arise endogenously as a result of temporal agglomeration economies. Moreover, in circumstances such as a joint meeting between two people, scheduling preferences could be interdependent; with the degree of punctuality determined socially as each person takes scheduling decisions in response to the scheduling choice of others (Basu & Weibull, 2003).

Fosgerau *et al.* (2012) develop a game theoretic model which overcomes these limitations. Their model considers two individuals who make interdependent scheduling choices to start a joint meeting in the presence of uncertain travel times. A crucial feature of the model is the strategic interaction between individuals in the choice of optimal departure time. This interaction causes individual scheduling preferences to be

endogenous. They find that whether an improvement in the reliability of travel times for either person benefits both individuals depends on how their travel times are correlated. Moreover, trip costs are found to increase with increasing variance of the difference of individual travel times.

In this paper, we extend the Fosgerau *et al.* (2012) model by adding the concept of an agreed meeting start time as well as penalties for being late relative to this time. We extend the model to incorporate a framework where individuals bargain to choose the meeting start time. In this model, we are able to derive the value to both individuals of an improvement in the reliability of travel times for either person. A marginal improvement in travel time variability for one individual is found to beneficial to both individuals. Results also explain why an individual might be punctual in some environments and tardy in others; or why the degree of punctuality varies across different contexts. The findings in this paper indicate that the value of reliability depends not only on the individual travel time distribution as in Fosgerau & Karlström (2010), but also on the distribution of the difference of individuals' travel times. These finding have implications to the current practice in eliciting experimental designs for empirical analysis.

References

Basu, Kaushik, & Weibull, Jorgen W. 2003. A cultural trait as equilibrium. *In:* Stiglitz, Joseph E., & Arnott, Richard (eds), *Economics for an Imperfect World: Essays in Honor of Joseph E. Stiglitz.* MIT Press.

Fosgerau, Mogens, & Fukuda, Daisuke. 2012. Valuing travel time variability: Characteristics of the travel time distribution on an urban road. *Transportation Research Part C: Emerging Technologies*, **24**(0), 83–101.

Fosgerau, Mogens, & Karlström, Anders. 2010. The value of reliability. *Transportation Research Part B: Methodological*, **44**(1), 38–49.

Fosgerau, Mogens, & Small, Kenneth. 2010. Endogenous scheduling preferences and congestion. *In: Kuhmo Nectar Conference and Summer School on Transportation Economics, 8–9 Jully 2010*. Valencia, Spain: ITEA.

Fosgerau, Mogens, Engelson, Leonid, & Franklin, Joel. 2012 (Dec.). *Endogenous scheduling preferences and random travel time*. Unpublished.

Lam, Terence C., & Small, Kenneth A. 2001. The value of time and reliability: measurement from a value pricing experiment. *Transportation Research Part E: Logistics and Transportation Review*, **37**(2–3), 231–251.

Noland, Robert B., Small, Kenneth A., Koskenoja, Pia Maria, & Chu, Xuehao. 1998. Simulating travel reliability. *Regional Science and Urban Economics*, **28**(5), 535–564.

Small, Kenneth A, & Verhoef, E. T. 2007. *The Economics of Urban Transportation*. New York: Routledge.

Small, Kenneth A., Noland, Robert B., Chu, Xuehao, & Lewis, David. 1999. *Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation*. Transportation Research Board.