Journal of Choice Modelling 20 (2016) 16–34

Contents lists available at ScienceDirect

Journal of Choice Modelling

journal homepage: www.elsevier.com/locate/jocm

Impact of information on risk attitudes: Implications on valuation of reliability and information

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ARTICLE INFO

Article history:
Received 12 September 2015
Received in revised form
7 September 2016
Accepted 7 September 2016
Available online 17 September 2016

Keywords:
Value of information
Value of reliability
Risk attitudes
Experimental economics
Driving behaviour

ABSTRACT

Risk attitudes are an important behavioural characteristic that influences people's valuation of information and reliability. In a transport context, information has become widely accessible to road users through ITS systems, GPS technology and the internet justifying the importance of understanding the valuation of information by travellers. There have been a number of studies that have looked at the value of information and the value of reliability for a road user. However, to date there has not been a study that explicitly evaluates the impact of having information within a choice set on an individual's risk attitudes, which ultimately affects their valuation for information and reliability. This study conducts a controlled laboratory experiment, using methods of experimental economics, to measure the risk attitudes of users with and without the presence of information in the choice set. A model derived from Expected Utility Theory is used to infer the risk attitudes of the participants. The results of the analysis indicate that the presence of information in the choice set reduces risk aversion, which causes a reduction in people's valuation of information and reliability. It is critical to systematically incorporate these differences into behaviour models, since neglecting this fundamental difference could result in erroneous policy decisions, with respect to overpricing information, or inappropriately allocating funds for information systems.

1. Introduction

The provision of online information about driving conditions has become increasingly prevalent throughout transport networks. Information was initially provided with signage for upcoming detours and road works; this was further reinforced with radio traffic reports and the utilisation of Variable Message Signs (VMSs). Within the last decade, information has become even more accessible through Advanced Traveller Information Systems (ATIS), GPS navigation technology and the internet. Congestion mitigation strategies utilising information has predominantly been used to influence route choice behaviour to distribute traffic in an efficient manner (Mahmassani et al., 1986). It is therefore critical for transportation agencies to understand the value travellers place on information.

Information is used to reduce risk or at best resolve it. Risk attitudes influence the value an individual places on information and reliability within a transport network. An individual who is risk averse would have a greater value of information and reliability as compared to a risk loving person and therefore an individual's risk attitude influences their

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http://dx.doi.org/10.1016/j.jocm.2016.09.004
1755-5345/

choice regarding information acquisition. Furthermore, the presence of information within a user's choice set may impact their risk characteristics which can affect the value of an information source post implementation. Thus, if risk attitudes impact upon the valuation of information by a user, neglecting these impacts could result in disastrous pricing and investment strategies regarding infrastructure for information provision. This study attempts to address the critical question: Do risk attitudes remain the same when people are placed in a context where information acquisition is a choice? The answer to this question has wide ranging impacts on the valuation of information and reliability.

This study uses methods of experimental economics to design a controlled laboratory experiment to study risk attitudes and the choice of information acquisition in context of driving behaviour. The value of using laboratory experiments with methods from experimental economics is the ability for the researcher to induce utilities and study behavioural parameters, which is not possible with field data. Field data limits the control of variables and thus makes it difficult to isolate and study behavioural parameters and test theories. Vernon Smith won the Nobel Prize for Economics for his work on Induced Value Theory (Smith, 1976, 1982), which underpins the science of the methods within experimental economics.

The findings of this study indicate that the presence of information acquisition in the choice set results in a reduction in an individual's risk aversion. This implies that individuals actually value information and reliability much less compared to what would be estimated based on data where information acquisition was not in the choice set.

This paper is structured to first present the relevance of this study in the context of available literature. Section 3 provides details regarding the experimental design, which is followed by Section 4 that discusses the maximum likelihood procedure used to estimate the risk attitudes. Section 5 presents the results and the paper concludes with a discussion of the contribution and findings of the study.

2. Literature review

Information aims to mitigate the presence of risk and uncertainty, therefore the value individuals place on information and reliability is related to their risk attitudes. Jackson and Jucker (1982), suggest that travellers consider more than just expected travel time when selecting a route, but also the level of reliability. Since then, there have been numerous studies (Bates et al., 2001; Lam and Small, 2001; Brownstone and Small, 2005) over the years which have presented empirical evidence on the value travellers place on reliability while evaluating routes and transport modes.

Users make decisions based on *a priori* and online information. This particular study considers the behavioural implications with regard to online information which is received whilst a traveller is traversing a road network. Thus, from this perspective, the departure time of users is a foregone decision and will not affect their risk attitudes towards the information provided en-route. Accordingly, this study differs from the work of Ettema and Timmermans (2006), Arnott et al. (1991) and Jou (2001) which focussed on the impact of information in the context of departure time. Further to these works, De Palma et al. (2012) developed a theoretical model with heterogeneous risk attitudes, and found that risk neutral and moderately risk averse drivers benefited from information, while risk averse drivers would pay for information that would not necessarily benefit them. However an important assumption in all these studies were that people's risk attitudes do not change based on the access to information. If risk attitudes of road users are affected by the presence of information, evaluation processes carried out to determine the feasibility of ATIS infrastructure will also be affected. The costs and benefits of these systems will offer a different utility to the user at different stages of the implementation. For an example, prior to the implementation of an information system users may be risk averse and value the reduction in uncertainty the system offers. However, post implementation if the risk attitudes of users change, the value of the information system will also change. Accordingly, an awareness of changes in risk attitude will have a significant impact within infrastructure planning and decision making related to ATIS systems. This study attempts to fill this gap in knowledge by understanding the impact of the presence of information on users' risk attitudes in a controlled laboratory setting.

Recently, a few revealed preference studies have been conducted to evaluate the impact of pricing on the demand for information. Jou and Chen, 2013, surveyed Taiwanese drivers to understand the demand for real-time information under varied pricing and traffic conditions. They found that the presence of non-recurring conditions resulted in the greatest demand for information. In a similar study conducted by Tseng et al. (2013), it was found that drivers tend to react more strongly to variations in travel time when information is provided. As with the previous works, these studies provide insight into the value of information without taking into consideration the implication of risk attitudes towards the presence of information in the choice set.

The concept of reliability and its measures, such as travel time variability, have been extensively studied in recent times. The importance of reliability has been described in detail from a user perspective as well as a transport planning and operations level (Batley et al., 2009; Li et al., 2010; Robuste and Soriguera, 2010). In fact, travel time reliability has been valued more highly than travel time itself according to the study conducted by Batley et al. (2009). Risk attitudes have been incorporated in the measurement of travel time variability and the valuation of travel time savings (Hensher et al., 2011, 2013; Li et al., 2012; Hensher and Li, 2012). Hensher et al. (2011), Li et al. (2012) and Hensher et al. (2013) present a series generalised non-linear logit models which incorporates probably weighting of users and their risk attitudes within the utility function,. The models apply an extension of conventional Expected Utility Theory (EUT), "Extended Expected Utility Theory (EEUT)" by incorporating the underlying probabilities of outcomes for an attribute as a probability weighting function. By embedding these behavioural characteristics, the model has the ability to account for travel time variability in a