



Improving the analysis of road pricing acceptability surveys by using hybrid models



Floridea Di Ciommo^{a,*}, Andrés Monzón^b, Alvaro Fernandez-Heredia^c

^aTRANSyT, Universidad Politecnica de Madrid, Calle Profesor Aranguren s/n, 28040 Madrid, Spain

^bTransport Department, Universidad Politecnica de Madrid, Calle Profesor Aranguren s/n, 28040 Madrid, Spain

^cCivil Engineering Department, Universidad Europea, Calle Tajo s/n, 28690 Villaviciosa de Odón, Spain

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ABSTRACT

Several international studies have analyzed the acceptability of road pricing schemes by means of an attitude survey in combination with the results of a stated choice experiment using both a descriptive analysis and a discrete-choice model with binary choice (“accept” or “not accept” the toll). However, the use of hybrid discrete choice models constitutes an innovative alternative for integrating subjective attitudes and perceptions deriving from the survey of attitudes with the more objective variables from the stated choice experiment. This paper analyzes the results of applying these models to measure the acceptability of interurban road pricing among different groups of stakeholders (road freight and passenger operators, highway concessionaires, and associations of private car users) with qualitatively significant opinions on road pricing measures. Our results show that hybrid models are better suited to explaining the acceptability of a road pricing scheme by different groups of stakeholders than a separate analysis of the survey of attitudes and a discrete-choice model applied on a stated choice experiment. A particular finding was that the strong psycho-social latent variable of the perception of fairness explains the rejection or acceptance of a toll scheme by road stakeholders.

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1. Introduction

Experience has shown that the introduction of road pricing is a controversial topic (Jones, 1998; Schade, 2003; Ison and Rye, 2005; Gaunt et al., 2007). The European Commission has started on a path towards the gradual introduction of charges to encourage efficiency and at the same time to compensate for the ecological damage caused by road transport (CEC, 2001, 2008). A number of European Directives foster the deployment of a European common toll system: Directive 2006/38 on the charging of Heavy Good Vehicles (HGVs) for the use of certain infrastructures (CEC, 2006, 2008, 2011); Directive 2008/0147 includes the regulation of future road pricing based on external costs; and the Directive 2011/76.

Various European studies have addressed the issue of the acceptability of road pricing schemes for passenger and freight transport (Jakobsson et al., 2000; Link and Polak, 2003; Jaensirisak et al., 2005; Link, 2007; Vrtic et al., 2007; Winslott-Hiselius et al., 2009), and systematic studies of prevailing trends in public opinion based on polls taken before and after the implementation of road pricing measures have been carried out in several European countries (Kottenhoff and Brundell-Freij, 2009) and American states (Ungemah and Collier, 2007).

Spain has a network of 13,156 km of interurban highways (MIFO, 2007), of which only 2814 km are tolled sections. Like all EU countries, Spain is obliged to consider the European Union’s transport policy and the regulations enacted to define and

* Corresponding author. Tel.: +34 91 336 52 59; fax: +34 91 336 53 62.

E-mail addresses: fdiciommo@caminos.upm.es (F. Di Ciommo), andres.monzon@upm.es (A. Monzón), alvaro.fernandez@uem.es (A. Fernandez-Heredia).

promote a fair and homogeneous generalized road pricing system. A survey of public opinion revealed differing attitudes toward country-specific pricing measures in nine Nordic European countries (PATS, 2001), but no survey has so far addressed the acceptance rate for pre-implementation road pricing schemes in a southern European country such as Spain. Between November 2008 and March 2009 an internet-based survey on public acceptability was conducted as part of the META research project, whose aim is to define a Spanish road pricing model (Di Ciommo et al., 2010). The target population consisted of various groups of road stakeholders: Spanish freight and passenger road operators, highway concessionaires, associations of private car users, and some agents of transport policy. The objective was to capture different dimensions of acceptability vis-à-vis the potential implementation of a generalized road pricing system in Spain.

The current methods to assess road pricing acceptability are basically based on the analysis of attitudinal and perception questionnaires and stated preferences experiments (Link, 2007; Vrtic et al., 2007). Different studies analyze it through descriptive statistical analysis, or structural equations and even through discrete choice models (Pridmore and Miola, 2011). In this paper we propose a combination of those analytical tools to better understand the results. To this end a hybrid model has been developed. It allows integrating subjective attitudes and perceptions derived from an attitude questionnaire with a stated preferences experiment.

Despite the general agreement that environmental problems due to road passenger and freight transport are serious threats to the public welfare, proposed solutions such as the implementation of a road pricing system are not readily accepted. In other words, social responsibility is not a major variable in explaining the acceptability of road pricing (Pridmore and Miola, 2011). However, various other studies using a psychological approach show that a strong latent variable which explains the acceptability of tolls before the implementation of a road pricing scheme is the perceived fairness (De Groot and Steg, 2006; Eriksson et al., 2008). The proposed method completes the economic approach of the discrete choice model with attitudinal factors (Ubbels and Verhoef, 2006). Therefore the acceptability approach based on cost and benefits of toll is improved with an evaluation of individual attitudes towards pricing (Bamberg and Rölle, 2003; Jones, 2003; and Schade and Schlag, 2003).

The paper is divided into six sections. The second section – after the introduction – provides an overview of the state of research and methods to assess acceptability. It investigates the determinants of stakeholders' behavior, and shows how the integration of subjective attitudes into a choice model helps to identify barriers to public acceptance; it also identifies the potential supporters and opponents of pricing. The third section describes the research methodology used for the survey. Section 4 presents a descriptive and statistical analysis of the results. The fifth section contains the theoretical formulation of the hybrid discrete choice models, including latent variables. It also includes the main results comparing different statistical and modelling analyses. Section 6 draws conclusions as to the implications for road pricing policy as a result of the analysis of hybrid discrete choice models.

2. Background

2.1. State of research methods on the acceptability of road pricing

The degree of acceptability of toll-road pricing effects is a complex matter that can be analyzed in a number of ways, such as for example from a psychological and sociological standpoint (Schade and Baum, 2007; Kottenhoff and Brundell-Freij, 2009).

Three kinds of research and methods can be undertaken to analyze transport policy measures, and particularly road pricing policies. First, predictions about acceptability derived from theoretical models that rest on assumptions about individual behavior tested against the results of a road-user survey (Jakobsson et al., 2000; Schuitema et al., 2007; Eriksson et al., 2008). Second, individual attitudes can be analyzed by means of an empirical survey (questionnaire, interview, etc.) (De Groot and Steg, 2006; Link, 2007). Third, ex-post study permits the investigation of individual behavioral changes in response to specific policy measures (Swicher and Ungemah, 2006; Schade and Baum, 2007 and Winslott-Hiselius et al., 2009). The first approach is based on assumptions about individual behavior in a theoretical model that must be tested a posteriori, while the second derives from direct observations used to construct the hypothesis of an empirical model. Both approaches are based on two types of surveys. The first one is oriented to measure attitudes and perceptions using point scale questions. The second type uses stated or revealed preferences questionnaires to assess the acceptability before or after the transport measure implementation. Once we have collected data, there are three different methods to analyze the survey results; first a psychological analysis based on consistency tests (De Groot and Steg, 2006). Then, two methods based on modelling: discrete choice and hybrid choice models. The latter including attitudes and perceptions seems to be a more powerful tool for integrating the economical variables with a deep attitudinal construct, that is latent variable (Ben-Akiva et al., 2012). This paper approaches the question of the acceptability of road pricing by examining the collected primary data and integrating socio-economic and psychological considerations using hybrid model.

2.2. Acceptability links with perception of freedom, fairness and efficiency

Several European studies confirm that the acceptance of road pricing by users is closely linked to the perception of freedom, fairness and efficiency (Verhoef et al., 1997; Jakobsson et al., 2000; Schade and Schlag, 2006; Ubbels and Verhoef,

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