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Environmental attitudes and emissions charging: An example of policy implications for vehicle choice

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ABSTRACT

A growing global focus on environmental concerns, in particular the role of carbon emissions in global warming, has created an atmosphere where attitudes towards the environment are a pre-eminent focus. In particular, the role of the motor vehicle in climate change has become increasingly important. In this paper a stated preference experiment is used to examine the impact of an emissions charge on vehicle choice in the context of such environmental attitudes; which are found to be key in explaining preference variation. The policy implications of this result are discussed, highlighting the usefulness of latent class modelling for policy management.

1. Introduction

The growing focus on the role of carbon emissions in global warming, has created debate over the appropriate mechanisms to curb growth in CO_2 emissions and the effectiveness of such policy. The role of the automobile has been a particular focus; as in Australia, like many countries, motor vehicles remain a major cause of air pollution in urban areas, contributing 41.9 million tonnes of carbon dioxide or equivalent greenhouse gases, approximately eight percent of total national emissions in 2007 (Australian Greenhouse Office, 2008). However, a recent Australian government report supports the well known economic answer of pricing negative externalities, indicating that a carbon emissions price that effectively results in an increase in the price of petroleum-based fuels has the potential for lowering fuel demand, thus reducing emissions. (Garnuat, 2008).

Within the literature, one example of such a pricing policy that has received considerable attention is charging for congestion, a mechanism that has been shown to have a significant effect in reducing this externality in cities such as Singapore (Keong, 2002), London (TFL, 2008) and Stockholm (Eliasson and Hugosson, 2006). A by-product of the successful reduction in the congestion externality has been concurrent reductions in environmental externalities. In London, significant reductions in NOX, PM10 and CO_2 emissions were observed, suggesting that charging schemes could assist in attaining targets on air pollution as well as those relating to climate change (Beevers and Carslaw, 2005). Indeed, the city of Milan introduced a variable road pricing scheme in 2008 that is specifically linked to pollution outcomes (Croci, 2007).

Such experiences give scope for a charging regime that explicitly links the cost of owning and operating a motor vehicle to the emissions produced by using it; the implicit assumption of such policy being that pricing the negative externality of vehicle emissions will incentivise consumers to use their vehicle less and/or purchase a vehicle that is smaller and/or uses less

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fuel and/or uses an alternative fuel source. It is such a pricing scheme that is the focus of this paper. While studies of automobile choice within the existing literature have examined choice as a function of vehicle characteristics and socio-demographics (for example Ben-Akiva and Lerman, 1974; Berry et al., 1995; Bunch, 2000), environmental characteristics and alternative technologies (for example Brownstone et al., 1996; Golob et al., 1997; Dagsvik et al., 2002), and even incentives designed to encourage the purchase of cleaner fuelled vehicles (for example de Haan et al., 2009; Gallagher and Muehlegger, 2011; Hess et al., 2012), this paper is based on the first study to examine role of explicitly charging for vehicle emissions.

Attitudes have been shown to have a significant role in the choice of automobiles (Choo and Mokhtarian, 2004), particularly with respect to the adoption of alternative technologies such as hybrid vehicles (Kahn, 2007). In the case of a new pricing structure on vehicles, such attitudes are likely to have a significant impact on not only vehicle choice, but on the acceptance of the charging regime itself. Using congestion charging as an example again, in implementing such a charge, the cities of Edinburgh and Stockholm experienced completely different outcomes. A congestion charging trial period in Stockholm was sufficient to change public opinion from negative to positive (Eliasson and Jonsson, 2011), however in contrast, a public referendum in the city of Edinburgh rejected a congestion charging scheme, which had been in development for almost a decade, by a three to one margin (Allen et al., 2006). In both these studies, public attitudes to the schemes largely dictated their success.

The link between attitudes and actions is particularly important in the examination of environmental behaviour; for example Mobley and Vagias (2010) find environmental concern to be a strong predictor of environmentally responsible behaviour. Generally speaking, public awareness of environmental issues has increased (Phyper and MacLean, 2009) as has concern about the impact business activity has on the environment (Gerrans and Hutchinson, 2000; Robbins, 2001). This study, as a starting point on the role emission charging might play in curbing vehicle based carbon emissions is timely, as policies regarding vehicle ownership and use are being debated more openly in many economies. Indeed, within the European Union many countries implement their own system of CO_2 emissions-based vehicle taxation and annual fees. The stated preference data collected in this study examines behavioural responses to such a regime within the Australian context and, in particular, represents the first to apply a variable emissions surcharge which is linked to vehicle characteristics and use. The objectives of this paper, however, are to examine how attitudes might influence behaviour with respect to such a policy, and discuss the likely implications for decision makers.

The remainder of the paper is structured as follows. In the following section a review of the development of the stated preference survey is given, with particular reference to the vehicle surcharge component of the study. Section 3 provides a brief overview of the empirical methods employed in the analysis of the survey data. Section 4 describes the general characteristics of the data under analysis, and discusses the results of the empirical modelling. Finally, Section 5 provides discussion and concluding remarks, highlighting directions of future research.

2. Methodology

2.1. Development of the survey

Extensive thought was given to the focus of the study, given the growing social and political interest in identifying possible ways to reduce emissions from automobile ownership and use. It was decided that an ability to establish the elasticity of demand for low emitting vehicles with respect to a CO_2 emission charge per kilometre or per annum per vehicle was of fundamental interest in this context.

The choice set of interest was narrowed down to fuel type alternatives – petrol, diesel or hybrid. It was deemed that a labelled choice experiment was most appropriate for this research given the interest in estimating alternative-specific effects for each of the fuel types, as well as the calculation of market shares and demand elasticities. Numerous sources have expressed uncertainty about which fuels will be commercially viable in the future (e.g., Australian Emissions Trading Scheme workshop on June 27, 2007 in Sydney), or have debated which fuel source will provide greater future reductions (e.g., the commercialisation of the relatively unexplored fuel cell technology as the most appropriate strategy (Sperling and Gordon, 2009). As such, in the choice experiment, the hybrid alternative will not be referred to with respect to a specific fuel type, since the focus is on establishing the influence of various pricing and performance and emission regimes regardless of what the fuel is. The hybrid alternative will simply reflect a vehicle option that is cleaner with respect to emission levels.

Following the specification of the alternatives, consideration was given to the selection of attributes to use within the choice experiment. Nine attributes were included in the experiment, which were identified via a review of the available literature on vehicle purchasing, as well as through preliminary analysis of secondary data sources. Table 1 displays the levels that have been selected for each attribute. Note that the purchase price for the hybrid alternative is $3000 more at each level (across small, medium and large vehicles) in order to recognise that hybrid technology is currently more expensive than conventional fuel engines. However, in the process of generating the design, the purchase price level applied to each alternative is independent meaning that it is possible for the generation of choice tasks to have the hybrid price as the lowest purchase price.

Two attributes requiring particular attention relate to the mechanism via which vehicle emissions charges will be implemented. We test two approaches, a surcharge that is paid annually, and a variable charge that is a function of how much the