Modelling Heterogeneity in Willingness-to-Pay Directly: 
Implications for Estimates of Influence in Freight Decision-Making Groups

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Extended Abstract

A 2004 stated choice study of interdependent road freight stakeholders in Sydney yielded important estimates of preference and relative influence in freight decision-making groups (see Hensher and Puckett, 2007; Puckett and Hensher, 2008). These estimates were obtained through the use of a series of generalised mixed logit models that incorporated distributional assumptions on the heterogeneous preferences and relative influence held by respondents over each attribute in the stated choice alternatives. Whilst the modelling techniques in the study were advanced relative to the state of practice in general, Scarpa et al. (2008) raise an important question of direct relevance to the policy implications of the study. That is, how would the conclusions reached in the study change if preference heterogeneity were specified with respect to the ultimate measures of interest (i.e., willingness-to-pay) rather than with respect to attributes that are components of those measures (e.g., travel time and cost elements)?

When seeking estimates of willingness-to-pay (WTP), the state of practice involves two elements: the estimation of marginal utility parameters for both an attribute of interest and some measure of cost, and the calculation of a ratio of these two estimates. In models incorporating preference heterogeneity, the distributions of each component of the ratio need not have the identical properties. This leads to a distribution of WTP measures that has a form that is a function of the distributions of each component; this derived distribution may have undesirable properties (e.g., high skewness) that are merely artefacts of the calculation rather than being representative of the behaviour in the sample.

Indeed, as WTP may be the central behaviour sought in a choice study, it is intuitive to consider whether it is preferable to estimate choice behaviour with respect to WTP directly rather than deriving WTP through ratios of marginal utility estimates. Although the predominant model specification in choice studies centres on marginal-utility-focussed utility functions, WTP-centred models have been implemented successfully. The most prevalent example of these may be contingent valuation studies, which model the impact that changes in attribute levels have on WTP.

The decision whether to focus a model on marginal utility or WTP becomes more important when preference heterogeneity is added to a model. Train and Weeks (2005),
Sonnier *et al.* (2007) and Scarpa *et al.* (2008) explore the potential effects of specifying separate distributions for each component of a derived WTP estimate rather than specifying a single distribution for WTP. Train and Weeks and Sonnier *et al.* found promising behavioural results under a WTP-centred model of stated preference data, but could not improve upon the goodness-of-fit found in a model with a standard utility function. Conversely, Scarpa *et al.* were able to improve upon the goodness-of-fit of a standard model by specifying their model of revealed preference data in terms of WTP.

In this paper, we build upon the research of Train and Weeks (2005), Sonnier *et al.* (2007) and Scarpa *et al.* (2008) by investigating the changes in policy implications that can be found with respect to group decision making when specifying utility with respect to WTP rather than individual simple marginal utility. This is a critical concern, in that many transport decisions involve interdependent agents. Economic behaviour in road freight offers several examples of this, including route and departure or arrival time choice, vehicle choice, and the choice whether to generate a trip.

When attempting to gauge the potential behaviour of interdependent decision makers, it is essential to capture information on both the preferences of each agent involved and the relative influence each agent holds over the elements governing the decision-making setting. This enables the analyst to calibrate the individual preferences of group members with respect to the influence measures, to estimate a joint group response to a change in the market. For example, if the analyst finds that two classes of decision maker in a type of group hold highly divergent preferences with respect to a given attribute, and that one class of decision maker tends to hold strong relative influence with respect to the attribute, it is logical to project that such groups will tend to optimise over the attribute as though it holds preferences for the attribute approaching those of the stronger agent.

We begin our analysis by estimating a WTP-centred model of choices made by buyers and sellers of freight transport services in Sydney under a hypothetical road user charging system. The estimates from this model are then carried forward into a model of freight group decision-making structures, yielding estimates of the relative influence supply chain members have with respect to the attributes in the choice study. The centrepiece of the analysis is a comparison of distributions of both WTP and WTP-related group influence measures in the WTP-centred model versus the marginal-utility-centred model.

We demonstrate the potential gains in goodness-of-fit and behavioural inference that can be reached through centring choice analysis on WTP when WTP is the central preference measure of interest. The discussion concludes with a new look at the potential impacts of a distance-based road user charging system on road freight stakeholders. Estimates of shippers’ and transporters’ WTP for saving travel time and gains in travel reliability are coordinated with estimates of relative influence to project freight decision-making groups’ responses and welfare changes under road user charging.
References


