The relative importance of individual differences, past history, and current circumstances for travel mode choices

Kiron Chatterjee, University of the West of England

Abstract
The data that is customarily used to estimate individual-level travel mode choice models is cross-sectional and relates the travel choices identified at the time of data collection to prevailing characteristics of travellers, their activity-travel requirements and the travel environment. Where longitudinal data on travel behaviour is available (repeated observations for the same individuals) it has been shown from estimation of dynamic models that current travel choices are influenced by past history (of the traveller and of the travel environment) as well as current circumstances (see Goodwin, 1997, for example). Longitudinal data also enables the effect of unobserved individual differences (more formerly known as unobserved heterogeneity) to be taken into account. This permits the unbiased and efficient estimate of model parameters and the recognition of persistence of behaviour over time not explained by observed variables. This paper is concerned with assessing the role and importance of individual differences and past history (referred to in short as dynamic effects) relative to current circumstances in determining mode choice behaviour.

Only limited study has been conducted in the travel behaviour field assessing the relative importance of individual differences, past history and current circumstances. Kitamura (2000) suggests that the limited development of dynamic models is a consequence of the increased complexity of data collection and model development associated with dynamic modelling. With respect to mode choice, Ramadurai and Srinivasan (2006) examined the role of past history (state dependence and habit persistence), unobserved heterogeneity and current circumstances in the within-day mode choice decisions of individuals from a San Francisco activity-travel survey data set. They found that half of the improvement in model fit was attributable to inclusion of dynamic variables. There have also been some studies of the long term stability of mode choices. Dargay and Hanly (2007) used 11 years of annual data from British Household Panel Survey to show a strong influence of state dependence and unobserved heterogeneity in annually recorded commuting mode choices.

While these papers offer important insights on mode choice determinants, a major area of policy interest is in the effect on mode choices from interventions designed to change the relative attractiveness of different modes. It is this context that is the focus of the paper. There is one example in the literature that has investigated this. Bradley (1997) tested dynamic model specifications when looking at the effect on mode choice of a new rail commuter line in the Netherlands. Using before and after two-wave panel data he found improved model estimation for dynamic model specifications (accounting for response lags and state dependence) and found that forecasts are quite different if dynamic specifications are used instead of static specifications. He concluded, though, that to understand and model the impacts of changes in the travel environment 'multiple "after" periods are necessary to determine whether policies grow, diminish, or remain stable over time'.

This paper presents an analysis of a four wave panel survey of the travel behaviour of residents of a town in Southern England before and after the introduction of a guided bus service route. The analysis is of the changing frequency of bus use of residents over the four waves of the survey and the impact on this of the new bus service taking into account individual differences and past history. The dependent variable in the analysis is the frequency of using the bus reported by residents which is recorded as a
A discrete, ordered variable with five possible response values. It is analysed using ordered probability models. A set of independent variables are used to represent the characteristics of travellers and their travel alternatives. Some of these are time-varying, including level-of-service variables for the bus travel alternative.

A random parameter model specification is used to incorporate unobserved heterogeneity and lagged dependent and lagged independent variables are added to this specification to incorporate state dependence and lagged responses respectively. With state dependence variables a particular problem is initial conditions which results from surveys not collecting data at the start of the process and assumptions having to be made regarding pre-survey behaviour. Different methods of specifying initial conditions are tested and the effect of these on results are discussed.

Key findings from the analysis include the following. The estimated coefficient for level of service variable (travel time by bus) is larger when unobserved heterogeneity is taken into account, thus indicating the importance of accounting for this. A one period lag specification for level of service variable provided better fitting model than non-lag version and suggests delayed responses to the new bus service of about two months. The inclusion of lagged dependent variables was found to improve model fit and a true state dependence effect to occur as well as unobserved heterogeneity (for example, one specification of initial conditions showed using the bus '5 days a week or more' in previous wave increased the probability of using the bus '5 days a week or more' by 37% and decreased the probability of using the bus 'not at all' by 55%). As well as inspecting coefficient values and model goodness-of-fit statistics, comparisons are made of different model specifications based on run-pattern predictions and forecasts for hypothetical scenarios. These illustrate the potential misinformation possible from ignoring dynamic effects.

To further develop dynamic modelling capabilities it is recommended that in areas where major transport initiatives are being contemplated (and therefore survey and monitoring resources can be reasonably justified) priority is given to incorporating a panel element in continuous travel surveys. It will be helpful in these surveys to include more detailed collection of trip making (through trip diaries) than was possible in this study, so that greater scope is possible to explore the impact of changing travel circumstances on travel choices, whilst accounting for individual differences and past history.

References