Introduction

The structure of many large cities leads people to commute relatively long distances. These commuter trips are an important proportion of the total trips in an urban area and are mainly carried out during rush hours. Most commuter trips have a tendency to repeat themselves over time, having an important inertia component (Lanzendorf, 2003; Pendyala et al., 2001).

Inertia helps us to take decisions faster but increases the probability of maintaining the same choices. In a stable environment we would expect that choices are greatly influenced by inertia and, as a consequence, it may be unlikely that they can be influenced by travel demand management strategies. On the other hand, either a large disincentive or a large benefit can create conflicts between economic reasoning and habits. Thus, in a changing environment (i.e. one modified by travel demand policies), the probability that a person modifies her choice should be higher and this behaviour may be accelerated by the presence of a large/sudden change (i.e. a shock in the system).

The influence of habit or inertia in the choice process has been discussed in the literature (Goodwin, 1977; Blase, 1979; Williams and Ortúzar, 1982); Daganzo and Sheffi (1979) even proposed a multinomial probit formulation to treat this phenomenon. More recently, the discrete choice modelling arena has seen significant advances in incorporating inertia, examples of that are a model including prior behaviour on a time-series context (Swait et al., 2004) and a model including inertia on a two-wave panel formulation (Cantillo et al., 2007). However, we are not aware of any research on the shock issue apart from Yañez et al. (2008), and neither are we aware of work dealing with choice processes looking at what happens with inertia when an external intervention (i.e. a shock) significantly affects the choice context. We believe that such
an intervention may modify the choice conditions, with the effect of disturbing or even interrupting the effects of inertia.

In this paper we use data from the Santiago Panel to examine this problem. The panel is being built around the introduction of Transantiago, a completely new public transport system for Santiago de Chile (Muñoz et al., 2008). Our aim is to try and disentangle the potential presence of three main forces in the choice process: (i) the relative values of the modal attributes; (ii) the inertia effect, and (iii) the force produced by the shock resulting from the introduction of a radical new policy.

**Characteristics of the Santiago Panel**

The Santiago Panel is a five-day pseudo diary\(^1\) which will eventually have five waves, one before and four after the implementation of Transantiago; so far we have data for the first three waves and the fourth is currently under way.

The Santiago Panel’s sampling unit is the individual. The initial sample consisted of 303 individuals who live in Santiago and work full-time at one of the four campuses and two hospitals of the Pontificia Universidad Católica de Chile. The information sources used in the panel are:

- Face-to-face interviews with the aid of palms. The design of the survey was based on the 2001-2006 Great Santiago Origin-Destination survey (Ampt and Ortúzar, 2004) and considered characteristics of the trip to work during the morning peak hour, socioeconomic characteristics of the respondent and, from the second wave onwards, subjective perceptions about the performance of Transantiago.

- Precise measurement of level-of-service variables using GPS and geocoding of origin-destination pairs.

An interesting feature of the panel is that thanks to careful maintenance policies (see Yañez et al., 2008 for details) we have managed to keep attrition at just 5% and 3% respectively in waves two and three.

**Model formulation**

We are interested in modelling a habitual choice situation in the presence of an important change in its environmental context. The initial situation considers an individual \(q\) that uses commonly a given option \(A_r\) to travel to work; afterwards, at time \(t_s\), a new public policy is introduced as a consequence of which the transport system changes radically in terms of several attribute values. Our research attempts to combine and extend two existing model formulations: (i) models incorporating a shock effect (Yañez et al., 2008), and (ii) models allowing for inertia effects at two different time periods (Cantillo et al., 2007). The main difficulties relate to the appropriate treatment of more than two waves and the joint consideration of both inertia and shock effects. Our model formulation explicitly considers the effects of the three forces mentioned above (actual attribute values, inertia, and shock) on the choice process.

\(^1\) For budget reasons the panel considered information for the five working days, but only about the work trips on the morning peak hour.
The first force may be considered in any choice model, i.e. even in models for cross-sectional data. The other two forces, instead, can only be estimated with panel data because they require information over time. The main hypotheses supporting our formulation are:

- Individuals are utility maximizers
- Individual responses present panel correlation
- As the “usual” choices may have an important inertia effect, the probability of maintaining the current choice is high
- The inertia effect is a function of the previous valuation of the alternatives; we assume that individuals compare the current alternatives with the chosen previous alternative
- The inertia effect may be different for each wave and varies among individuals
- A radical intervention may generate a shock effect which in turn may have the power to modify the entire choice process; consequently, individuals may modify their valuation process altering their utility functions
- The shock effect may be different for each wave; moreover it should attenuate after the introduction of the new policy
- The shock effect may be different for each alternative and may vary among individuals.

Considering these hypotheses, the model specification assumes that wave 1 represents the “usual” choice. Hence the probability that alternative $A_i^1$ is chosen is given by:

$$A_q^1(A_i^1) = \frac{\exp(V_{iq}^1)}{\sum \exp(V_{iq}^1)}$$

where, $V_{iq}^w$ is the observable component of the utility function of option $i$, for individual $q$, on wave $w$.

As choices in subsequent waves are influenced by the choice made in the first, they can be modelled in terms of their relative (or conditional) position with respect to the choice in wave 1. Hence the probability to change from alternative $A_{i-1}^w$ to $A_j^w$ is:

$$P_q(A_j^w) = P(U_{j w} - U_{r q} \geq I_{j w} w - S_{j q} w \wedge U_{j q} w - U_{r q} w \geq I_{j q} w - S_{j q} w - I_{j q} w + S_{j q} w)$$

where $I$ stands for inertia and $S$ for shock. The probability not to change ($A_i^w$) is:

$$P_q(A_i^w) = P(U_{i w} - U_{i q} w + I_{i q} w - S_{i q} w \geq 0)$$

As we are working with a panel, more than one observation is available for each individual; so, given a sequence of modal choices $A_i^w$, one for each wave, the probability that a person follows this sequence is given by:

$$P_q(A_i^1 \wedge A_i^2 \wedge ...A_i^w) = \prod_{w=1}^{w} A_q^w(A_i^w)$$

As inertia, shock, and panel correlation are actually unknown, the probability of this sequence of choices is of Mixed Logit form (Train, 2003).
As usual, we will proceed to estimate models of increasing complexity:

- models with only shock effects: we have evaluated different ways to tackle this; our preliminary findings show that: a shock can modify the valuation process of alternatives and that the shock effect is different for each alternative and varies among individuals (the best model so far shows that the highest shock values appear in the case of combined modes; this can be explained by the fact that Transantiago promotes more transfers due to its feeder service to trunk lines structure, allowing transfers without an extra charge on a 2-hour window.

- models dealing only with inertia, with both constant and variable effects over waves.

- models that allow considering inertia and shock effects in conjunction.

References


