Heterogeneity in the choice of delivery time by receivers of goods
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Extended abstract

Objectives and motivation

In transport model systems that are used in practice for forecasting and project appraisal, time period choice is usually missing. However, there is evidence, especially in passenger transport, that departure time choice is rather sensitive to changes in transport time and costs. Transport models that do include a time-period choice are usually passenger models. This is probably due to the fact that for this segment more time period choice data is available. Very little is known about the sensitivity of the time period choice to time and cost changes in freight transport. Freight transport models with time-of-day choice modules are almost non-existent.

This paper describes the development of a new time-period choice model for freight transport based on Stated Preference (SP) data, that was collected in Flanders as part of a project to improve the current Strategic Flemish Freight Model (SVV) of the Flemish Traffic Centre. The current SVV does not contain an explicit time-period choice model. For the new version a module has been developed that can determine how many road freight vehicles will depart earlier/later in response to increasing transport times (i.e. congestion) and/or increasing transport costs (e.g. road user charging that is differentiated by time-of-day).

In the SP interviews we focussed on the receivers of goods (consignees). Industry experts and the (limited) scientific literature tell us that they usually determine the delivery windows of the goods, and that carriers are bound by the choices that the receivers make.

The SVV works at the aggregate level and the implemented time-period choice model can only handle a limited amount of information on the variation in behaviour between different receivers of the goods. In this paper we will report models that have been estimated subsequently on the same SP data, that allow for more heterogeneity among the respondents, both observed and unobserved heterogeneity.

General description

It is very hard to obtain revealed preference (RP) data on transport time and cost by time period of the day; these variables are difficult to measure directly, and transport time and transport cost are highly correlated. Furthermore, the transport costs vary only little over time periods since there are few areas that have road user charges that vary with time-of-day period. Therefore, we have based the time-period choice model on stated preference (SP) data.

Firms in Flanders receiving goods by road transport were selected from company registers and called by phone to check whether they are in scope and to ask them to participate in the SP survey. The stated preference interview itself was done by computer assisted personal interviewing (CAPI). About 25 pilot interviews were carried out, followed by a main survey of 150 firms. These were stratified by type of firm (manufacturers, wholesalers/warehouses and retailers) and by transport distance class for the typical transport that serves as the context and reference situation for the SP experiment.

Since we are interested in shifts away from the peak, if sufficed to sample shipments that are currently transported in the (morning or evening) peak. So in the interview we asked the respondents to describe a recent road-based shipment that was transported (at least partly) during a peak period and in the SP experiments they were asked to choose between two (hypothetical) alternative transports for this shipment. Each transport is described by the following characteristics:

- Transport time
- Transport cost
- The start and end of the delivery time window: this is the timeframe within the receiver wants the shipment to arrive at its final destination.

In the statistical design the presented attribute values are derived from four attributes: transport time, transport cost, width of the delivery time window and midpoint of the delivery time window.

The SP data have been used to estimate discrete choice models that explain the trade-offs between transport time, cost and earlier/later transports. First, multinomial logit (MNL) models were tried, with different specifications for time and cost (e.g. linear, logarithmic, Box-Cox), but without differentiating on the basis of characteristics of the receivers. After that we included variables for observed
heterogeneity (e.g. whether the receiver is a producer, wholesaler or retailer, type of commodity, transport distance) and estimated various random coefficients specifications allowing cost sensitivities to vary randomly (unobserved heterogeneity). We tested several statistical distributions for the random draws (including normal and lognormal), different numbers of random draws, and model specifications that take account of the ‘repeated measurements effect’ or ‘panel effect’ in the SP data.

Results and conclusions
In the paper we will present the existing literature on time-period choice models in freight transport, describe the questionnaire used and the SP experiment on time-period choice in freight. We will focus on the estimation results for the discrete choice models with observed and unobserved heterogeneity and report to which degree taking account of this matters for the estimation results and also for the time and cost elasticities of time period choice, calculated from the estimated models. We will also compare estimation results from Jackknife estimation (that corrects for the repeated measurements effect, but also for other specification errors) of the MNL model with those of the panel specification of the random coefficients mixed logit model.

When applying this new time-period choice model in the SVV, we found sensitivities for changes in transport cost (elasticities between -2.3 and -3.1) and transport time (elasticities between 0 and -0.1), which we think are plausible. There are hardly any elasticities of freight time period choice in the international literature to compare our results against. Our transport cost elasticities are (in absolute values) higher than the elasticities that we tentatively calculated from American studies. We will describe the differences of our study with these American studies and discuss to what extent this can explain these differences.

Keywords: time period choice; stated preference; freight transport; heterogeneity; random coefficients.