Transportation mode and overnights stays: sequential or simultaneous choices?

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Abstract

The transportation system plays a key role in our daily life because it allows both tourists and citizens to reach their destinations. Generally, the transportation mode is seen as a way to carrying people from a point A to a point B. When transportation is considered from a touristic prospect, instead it refers at providing the link between the origin and the holiday destination of tourists. The travel and tourist experience start and end with transportation, thus it is impossible to consider tourism without transportation. Moreover, the transport services not only affect the destination’s choice but also the entire decisional process, such as length of stay, type of accommodation, destination activities and so on. In tourism literature, the duration of the journey and the transportation mode are selected as the main explanatory variables to predict the tourism demand. The purpose of this paper is to investigate how the length of permanence at destination depends on a specific mode of transport and vice versa. Therefore, we implement a discrete continuous choice models that allows modelling jointly the discrete (transportation mode) and the continuous (duration of trip) consumer choices from the same utility maximisation problem.

Keywords

Duration, transportation mode, Discrete – Continuous choice model
1. Introduction

When tourists organize a trip, a number of decisions must be taken into account such as the type of destination, the transportation mode and the type of accommodation. Although decisions about vacation can be seen as a sequence of steps, their main characteristic is their interdependence (Alegree, Lorence, (2006)). The holiday time, like the actual decision to choose e.g. private or public transport, are mainly related to both personal and family characteristics of the tourists. The social characteristics variables that determinate the length of stay are the tourist’s age, the family status, children on trip, level of education and profession. Some of these have a direct influence on the choice of the means of transport. For instance, the presence of children leads tourists to choose a more comfortable transport to reach their destination. In addition, the economic aspects such as her/ his income level, the price of the holiday and the cost of accommodation influence the stay at destination.

The purpose of this research is to exploit the link between time and type of transport and how it influences the tourism demand. In our work we exploit the discrete-continuous choice model (Hanemann (1984) and Dubin, McFadden (1984)) to the Swiss touristic travels by considering as means of transport both private and public transportation and how their choice influences the duration of the journey and vice versa.

2. Literature review

In the tourism literature, the duration of the journey and the transportation mode are selected as the main explanatory variables to predict the tourism demand. Whenever, one of the two variables is the dependent variable and the other one is the explanatory variable, we face the classical problem of endogeneity. Hence, researchers need to seek the suitable instruments in order to solve this econometric problem. Therefore, we decide to apply the discrete continuous choice model, which allows to consistently estimating the link among the two variables and how they influence the tourism demand.

Diverse factors are taken into account in order to analyse the phenomenon of length of stay: number of trips per year, age, civil status, level of education and labour status (Oppermann (1995, 1997); Seaton, Palmer (1997); Sung, Morrison, Hong and O-Leary (2001)). Oppermann (1995) also points out that change in the family unit may affect directly the duration of the journey and this is due to the tourist’s choice of holiday destination. In relation to the latter, Gronau (1970) shows that the existing distance between the tourists’s residential area and their holiday destination (i.e. the travel distance) might positively affect the length of stay. Hence, travel distance is a useful variable to predict travel demand. For example, distance relates to infrastructure requirements, transportation cost and accessibility to public transport. Tourists, like other customers, react to changes in price of transport e.g. how far people travel (Liddle (2009)), where they acquire fuel, and what kinds of vehicles or modes they choose to reach their destinations.

3. The model

Our model follows a two-stage design: in the first part a model for the discrete choice among alternative means of transport is estimated. The second part is a model of the number of days spent at destination (the continuous variable) in which the results from the first stage are used in order to correct for the simultaneity of the choice of transportation mode.

In our framework, a tourist is supposed to choose an option $J$ for getting to his/her holiday destination. The choices are either private or public transportation mode: the alternative private transport considers car, whereas the public transport includes train. Therefore, a tourist $i$ choose the alternative $j$ as well as how much time to spend at the destination.

The utility $U_j^*$ from selecting transport $j$ among a finite choice set of $m$ alternatives is:

$$U_j^* = \beta_j x + \varepsilon_j \quad j = 1, 2$$  \hspace{1cm} (1)

Where $x$ denotes both the set of explanatory variables and the attributes of the alternative, $\beta_j$ the unknown coefficients, and $\varepsilon_j$ the error term. The latter accounts for unobserved characteristics influencing the selection of transport. The second component of the model estimates the time at destination $T_i$.  


For the chosen transportation service \( j \) the conditional demand for time \( T_i \) is as follows:

\[
T_i = \gamma_i z + \omega_i \quad i = 1 \ldots n \tag{2}
\]

\( z \) are the explanatory variables influencing the conditional demand for the time (the continuous variable), \( \omega_i \) is the error term with expected value \( E(\omega_i|z,x) = 0 \) and variance \( V(\omega_i|z,x) = \sigma^2 \).

With respect to the transportation choice model, it can be assumed that the tourist is observed to have chosen the alternative \( j \) in order to maximize her/his utility from all alternatives such that \( U_j^* > U_k^* \forall j \neq k \).

For instance, the choice probability \( P_j \), may be expressed as:

\[
P_j = Pr(\beta_j x + \varepsilon_j \geq \beta_k x + \varepsilon_k, all\ j \neq k) = Pr(\varepsilon_j - \varepsilon_k < \beta_j x - \beta_k x, all\ j \neq k) \tag{3}
\]

Assume that disturbance \( \varepsilon_j \) is identically and independently distributed across alternatives and tourist and that it follows the extreme value distribution \( \varepsilon_j \sim EV(0,\mu) \).

The probability that alternative \( j \) is chosen then takes the well-known multinomial logit (MNL) form

\[
P(j|m) = \frac{e^{U_j}}{\sum_{j=1}^{m} e^{U_j}} \tag{4}
\]

\( P_j \) increases monotonically with the systematic utility of that alternative \( j \) and decreases with the systematic utility of each of the other alternatives.

The parameter vector \( \beta_j \) of the MNL can be easily estimated by maximum likelihood estimation. In our research the choice set \( m = 2 \), thus the multinomial logit model is the classical binary logit model.

The parameter vector cannot be directly estimated in the continuous equation. The disturbance term \( \varepsilon_j \) of the discrete choice model and of the conditional demand model \( \omega_i \) may not be independent. The means of transport and the number of days are related decisions; unobservable factors may affect either one or the other decisions.

If these factors are correlated, the application of the ordinary least squares on the continuous equation will produce inconsistent estimates. Therefore, the conditional expectation of \( \omega_i \) is not zero, but a function of the choice probabilities. In order to correct this endogeneity problem, we follow the approach by Dubin and McFadden (1984) as also suggested by Train (1986). A linearly specified selection correction term enters the continuous equation. It is specified as a
consistent estimate of the choice probabilities (that is predicted probabilities from the discrete choice problem).

The coefficients $\gamma_i$ can be consistently estimated with least squares from the following model

$$T_i = \gamma_i z + \sigma \frac{\sqrt{6}}{\pi} \left[ \sum_{j=1}^{m} r_j \left( \frac{P_j \ln(P_j)}{1 - P_j} \right) - r_i \ln(P_i) \right] + \delta_i \quad i = 1 ... n \quad (5)$$

Where $r_j$ is the correlation coefficient between $\varepsilon_j$ and $\omega_i$, $\delta_i$ is independent error term; there are $(m-1)$ selection terms, one for each of the alternative transportation mode. In order to have consistent and asymptotically normal and efficient estimations, the final step is to estimate the variance-covariance matrix of the residuals of the model (5), $\mathbb{Q}$, and multiplied each member of the equation by $\mathbb{Q}$.

4. Data and sample description

The present study builds on a recent Household Budget survey conducted by the Federal Statistical Office (FSO) in 2010. The data collection comprises the number of trips, the character of the travel and the profile of the traveller. In addition, it contains day trips (i.e. day trips are over 3 hours), overnight travels, and distinguishes between private and business trips. Our study considers 624 private trips from 1 day up to 30 days; the average of days spent at destination is around 7 days. The vast majority of respondents are women (56%) and the average age is around 49 years old. The biggest share (more than 70%) of Swiss tourist live in agglomeration area, instead the rest of the responders are located between rural area and isolated city. Moreover, our database contains information about the choice of the means of transport. The 76% choose to get their destination by private transportation, whereas the 24% decides for a public service.

5. Preliminary results

Our preliminary results confirm, as we expected, that the discrete choice model predicts lower probability toward public transport for those who live both in periphery and rural area than who reside in the city centre. On the other hand, the public transportation seems to be preferable when tourists plan on travelling to destinations located at the seaside rather than visiting a city centre. As for the estimated type of holiday’s coefficient, an abroad destination appears to increase the probability of selecting public transport as the way to get to holiday places.
Explanatory variables in the conditional time at destination equation are gender, expenditure, type of accommodation and from the discrete choice equation the number of participants. The duration of the journey decreases when tourists intend to meet friends or family. In contrast, the number of days is positively influenced by those tourists who choose among accommodations that might be less costly than hotel and luxury resort such as hostel, b&b, camping and so on.

The number of travellers is considered both in the discrete and continuous equation. The reason is that the number of people might affect simultaneously the decision between private and public transport and the time at holiday place. According to the results, the model shows that an increase of number of voyagers induces the choice of private transport as the way to reach the destination. This result might be driven by the fact that the marginal cost per an extra person for the private transportation is null, whereas for the public transportation is positive. By contrast, in the continuous model this increase has a negative effect on the number of days.

6. Conclusions and future advances

Using the Swiss household budget survey of 2010, and a joint discrete - continuous modelling framework, we investigate the effect of trip characteristics, holiday characteristics and traveler profile on the probability to use two holiday mode choices, along with the length of stay.

With respect to the determinants of the travel mode choice, we find that tourists who live in both periphery and rural areas are more likely to travel by car than those reside in the city centre. For tourism length of stay, type of accommodation results to be a significant determinant, for instance, the days at destinations increases when tourists spent their holiday in accommodation such as second home, camping or apartment as opposed to a hotel. By contrast, the number of trips per year has a negative effect of the permanence at destination.

Moreover, we cannot claim to be representative of the entire population of Swiss travellers since we dispose of a survey, which provides detailed information about 2010 only. Our intention is to take into account surveys from 2008 to 2013 in order to rich source of micro-level data to complement the existing econometric model.

Concerning both the subject discussed and the methodology proposed in this paper, several advances might be adopted. From a methodological point of view, the simultaneous maximum likelihood estimation as opposed to two-step estimation may be helpful to obtain more efficiently estimations.
From a conceptual point of view, several new aspects such as children on trip, level of education and the civil status might be exploited in the modelling of the phenomenon in order to achieve new evidences.
7. References


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