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Transportation mode and overnights stays: sequential or simultaneous choices?

Andrea Pellegrini

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Andrea Pellegrini
Università della Svizzera
italiana
city

Phone: +41 58 666 47 85
Fax: +41 58 666 46 62
email:
andrea.pellegrini@usi.ch

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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.

The implementation of the discrete continuous choice models allows modelling jointly the discrete and the continuous consumer choices from the same utility maximisation problem. Hanemann (1984) and Dubin and McFadden (1994) estimate the discrete continuous choice in two steps, as do Bernand, Bolduc and Belanger (1996). Mannering and Winston (1985)) and de Jong (1990) analyse the simultaneous determination of private car ownership and private car use.

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:

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

Where x denotes both the set of explanatory variables and the attributes of the alternative, β_j the unknown coefficients, and ε_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:

$$T_i = \gamma_i z + \omega_i \quad i = 1 \dots n \qquad (2)$$

z are the explanatory variables influencing the conditional demand for the time (the continuous variable), ω_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:

$$P_j = Pr\big(\beta_j x + \varepsilon_j \geq \beta_k x + \varepsilon_k, all\; j \neq k\big) = Pr\big(\varepsilon_j - \varepsilon_k < \beta_j x - \beta_k x, all\; j \neq k\big) \; (3)$$

Assume that disturbance ε_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 thakes the well-known multinomial $logit$ (MNL) form

$$P(j|m) = \frac{e^{U_j}}{\sum_{j=1}^{m} e^{U_j}} \quad (4)$$

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 β_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 ε_j of the discrete choice model and of the conditional demand model ω_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 ω_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 γ_i can be consistently estimated with least squares from the following model

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

Where r_j is the correlation coefficient between ε_j and ω_i, δ_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

Alegre, J., Pou, L., (2006). The length of stay in demand for tourism. Tourism Management, 27:1345-1355.

Barros, Carlos Pestana, Machado, Luis Pinto (2010) The length of stay in tourism, Annals of tourism research, Vol. 37, No.3, pp. 692-706, 2010 Amsterdam, 431-470.

Ben Akiva, Moshe, Daniel McFadden, Kenneth Train, Joan Walker, Chandra Bhat, Michel Bierlaire et al. (2002) Hybrid choice models: progress and challenges, Marketing Letters, 13, 163-175

Ben-Akiva, Moshe, Joan Walker, Adriana T. Bernardino, Dinesh A. Gopinath, Taka Morikawa, and Amalia Polydoropoulos (1998) Integration of choice and latent variable models, in H. Mahmassani (ed), In Perpetual Motion: Travel Behaviour Research Opportunities and Application Challenges, Elsevier, Amsterdam, 431-470.

Bernard, J.T., Bolduc, D. and Bèlanger, D. (1996), Quebec Residential Electricity Demand: A Microeconometric Approach, Canadian Journal of Economics 39 (1), 92-113.

Bierlaire, Michel (2003) BIOGEME: A free package for the estimation of discrete choice models, Proceedings of the 3rd Swiss Transportation Research Conference, Ascona, Switzerland

Bierlaire, Michel (2008) An introduction to BIOGEME Version 1.6, biogeme.epfl.ch

Dubi, Jeffrey A., McFadden, Daniel L. (1984), An Econometric Analysis of Residential Electric Appliance Holdings and Consumption, Econometrica, Vol 52, No. 2, pp. 345-362.

Duncan, Gregory M. (1980), Formulation and Statistical Analysis of the Mixed, Continuous/Discrete Dependent Variable Model in Classical Production Theory, Econometrica, Vol 48, No. 4, pp. 839-852.

Gate, Martin. F.m Gurgand, Marc (2007), Selection bias corrections based on the multinomial logit model: Monte Carlo comparisons, Journal of economic surveys. Vol. 21, No.1

Grigolon, Anna B., Borgers, Aloys W.J., Kemperman, Astrid D.A.M. (2014) Vacation length choice: A dynamic mixed multinomial logit model, Elsevier, 158-167.

Gronau, R. (1970), The effect of travelling time on the demand for passenger transportation, The journal of Political Economy, 78(39, 377-394.

Hanemann, W. Michael (1984) Discrete/Continuous Models of Consumer Demand, Econometrica, Vol. 52, No. 3, pp. 541-561.

Heckman, James J. (1979), Sample Selection Bias as a Specification Error, Econometrica, Vol. 47, No. 1, pp. 153-161.

Koppelman, F.S. and Eric I. Pas (1980) Travel-choice behavior: models of perception, feelings, preference and choice, Transportation Research Record, 765, 26-33

Lee, Lung-Fei, Maddala, G.S., Trost, R.P. (1980) Asymptotic Covariance Matrices of Two-Stage Probit and Two-Stage Tobit Methods for Simultaneous Equations Model with Selectivity, Econometrica, Vol 48, No.2, pp. 491-503.

Liddle, B. (2009) Long-run Relationship among transport Demand, Income, and Gasoline Price for the US, Transportation Research Part D, 14: 73-82

Lingling, Wu, Junyi Zhang, Fujiwara, Akimasa (2013), Tourism Participation and expenditure behavior: analysis using a scobit based discrete-continuous choice model, Annals of Tourism Research, Vol.40, pp- 1-7.

Mannering, F. and Winston, C. (1985), A dynamic Empirical Analysis of Household Vehicle Ownership and Utilization, Rand Journal of Economics 16 (2), 215-236.

Marin, C. A, Witt, S.F, (1988). Substitute prices in models of tourism demand. Annals of Tourism Research, 15: 255-268.

Martin, Harry W., Sue K. Hoppe, Lyn Larson and Robert L. Leon (1897) Texas snowbirds – Seasonal migrants to the Rio Grande Valley, Research on Aging, 9 (1), 134-147

McHugh, Kevin (1990) Seasonal migration as a substitute for, or precursor to, permanent migration, Research on Aging, 12 (2), 229-245

Morikawa, Taka, Moshe Ben-Akiva and Daniel McFadden (2002) Discrete choice models incorporating revealed preferences and psychometric data, Econometric Models in Marketing, 16, 29-55

Oppermann, M. (1995), Travel life cycle, Annals of Tourism Research, 22(3), 535-552.

Oppermann, M. (1997), First-time and repeat visitors to New Zealand, Tourism Management, 18, 177-181.

Rowles, Graham D. and John F. Watkins (1993) Elderly migration and development in small communities, Growth and Change, 24 (4), 509-538

Song, H., Li, G., (2010). Tourism demand modelling and forecasting: how should demand be measured? Tourism Economics, 61: 63-81.

Sung, H. H., Morrison, A. M., Hong, G.-S., & O'Leary, J.T. (2001), The effects of household and trip characteristics on trip types: A consumer behavioral approach for segmenting the US domestic leisure travel market. Journal of Hospitality & Tourism Research, 2581), 46-68.

Train, Kenneth E. (1986), Qualitative choice Analysis: Theory Econometrics, and an Application to Automobile Demand, MIT Press, Cambridge.

Train, Kenneth E. (2003), Discrete Choice Methods with Simulation, MIT Press, Cambridge.

Walker, Joan (2001) Extended discrete choice models: integrated framework, flexible error structures and latent variables, PhD Thesis, MIT

Walker, Joan and Jieping Li (2007) Latent lifestyle preferences and household location decisions, Geographical Systems, 9 (1), 77-101