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RECREATIONAL BEHAVIOR FORECAST; THE RELATIONSHIP BETWEEN TRIP FREQUENCY AND DEMAND FOR ON-SITE TIME IN DISCRETE CHOICE CASE.

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1. INTRODUCTION

Within in the contex of recreational behavior forecast, one of the subjects of the observer is to decide whether or not the representative individual consumes recreational activities. Without prejudice, this decision may based on a complete free choice of individual's preferences of priceable factors such as goods and time inputs and nonpriceable factors such as attributes of the site, that can be represented by

$$\delta = \begin{cases} 1 & \text{if } V_1 + \varepsilon_1 \geq V_0 + \varepsilon_0 \\ 0 & \text{otherwise,} \end{cases}$$

where $\delta=1$ indicates the participation of the individual in recreational activities; V_1, and V_0 represent the indirect utility levels associated with recreation and nonrecreation activities; and ε_1, and ε_0 (that are i.i.d. according to Gumbel distribution) represent the unobservable preferences associated with V_1 and V_0 respectively.

In this decisive matter, the assumption imposed on the utility function is vital in the formulation of the demand functions and the resulting indirect utility function. Thus, instead of excluding the trip frequency, x, from the utility function as conventionally practiced, this paper investigates the relationship between x and the on-site time, T_s by assuming x as a utility factors, and apply the derived x and T_s in a log-linear indirect utility specification.

2.1 RANDOM UTILITY MODELS

Based on household production approach, let z be a vector of consumer goods with price p; T_{nr} be nonrecreational leisure time; b be a vector of qualitative attributes that taken as a constant and is weakly complementarity to demand for x and T_s. Knowing that $x = f(T_t, q)$, where q is a composite market goods input of a recreational trip, let $q = xT_t$. By these definitions, let the individual maximizes his utility by controlling z, T_{nr}, T_s and x under his full budget constraints, Ω, such that

$$\max U(z, T_{nr}, \delta T_s, \delta x, b)$$

$$\text{s.t.}\quad zp + \delta x\{(p_s+w)T_s+(p_t+w)T_t\} + wT_{nr} = y + wT = \Omega$$

where, U(.) denotes the utility function; p_s is a fee or price charged per unit of on-site time; p_t is the market price for q; w is the wage rate; y is the income; and T is the total time.

The above utility maximazation problem is slightly different from the Kobayashi's one, that[1]

$$\max U(z, T_{nr}, \delta T_s, b)$$

$$\text{s.t.}\quad \Omega \text{ with } x=1$$

2.2. T_s, T_t, AND x ISSUES

Considering the possibility of a corner solution, T_s is assumed to be a nonessential commodity having the property that $\delta T_s = 0$, if p_s exceeds some finite level, and the benefits of the trip is assumed to be strictly increasing in T_s while T_t is assumed to be a necessary input in the production of T_s with zero (or nonpositive) contribution to the utility function. The additional cost associated with T_s and T_t is assumed to be w, since the consumption of recreational activities reduces other leisure activities and (or) working time. Even though the use of w implies overestimation of T_t and T_s values, it offers a simpler formulation of the demand models.

More importantly, the regression of T_t and T_s by x implies the dependency of T_s on x, presumingly to be inversely related; *the more frequent* (fewer) the trip, the shorter (longer) is the demand for on-site time.

2.3 LOG-LINEAR SPECIFICATION

Assuming the substitution of the factors input to be unity, the Lagrangian of the maximazation problem takes the *following form*

$$\underset{z, T_{nr}, T_s, x, \lambda}{L} = \ln\alpha_0 + \alpha_1 \ln z + \alpha_2 \ln T_{nr} + \alpha_3 \ln T_s + \alpha_4 \ln x + \lambda[\Omega - zp + \delta x\{(p_s+w)T_s + (p_t+w)T_t\} + wT_{nr}]$$

The 1st order conditions (δ=1) are ;

$\alpha_1 = \lambda pz$,

$\alpha_2 = \lambda w T_{nr}$,

$\alpha_3 = \lambda x T_s (p_s+w)$, and

$\alpha_4 = \lambda x[(p_s+w)T_s + (p_t+w)T_t]$

$\Omega = pz + xT_s(p_s+w) + xT_t(p_t+w) + wT_{nr}$

Let $\phi = \alpha_1+\alpha_2+\alpha_4$, then $\lambda = \phi/\Omega$, and we obtain a set of the following demand equations,

$z = \alpha_1\Omega/\phi p$,

$T_{nr} = \alpha_2\Omega/\phi w$,

$T_s = \alpha_3\Omega/\phi x(p_s+w)$, and

$x = \alpha_4\Omega/\phi[(p_s+w)T_s + (p_t+w)T_t]$

As can be seen, both T_s and x are inversely proportional when they are in the position of the explanatory variable to each other. Solving for T_s and x from the two equations yield,

$$T_s = \frac{\alpha_3 \; T_t(p_t+w)}{(\alpha_4-\alpha_3)(p_s+w)}, \text{ and } \quad x = \frac{(\alpha_4-\alpha_3)\Omega}{\phi T_t(p_t+w)}$$

Apparently, the travel cost is directly related to T_s but inversely related to x, since for long distance trips, the individual will prefer a longer on-site time but a fewer trip.

By substituting the respective equations in the utility equation, we get the simplified form of indirect utility as

$$V_{1x} = \alpha_{0x} + \phi\ln\Omega - \alpha_1\ln p - \alpha_2\ln w - \alpha_3\ln[T_t(p_t+w)/(p_s+w)] - \alpha_4\ln[T_t(p_t+w)]$$

(This is done knowing that $\alpha_1+\alpha_2+\alpha_3=\phi$ and denoting $\alpha_{0x} = \ln\alpha_0+\alpha_1\ln\alpha_1+\alpha_2\ln\alpha_2+\alpha_3\ln\alpha_3+(\alpha_4-\alpha_3)\ln(\alpha_4-\alpha_3)-\ln\phi$)

As a comparison, the Kobayashi's utility maximazation problem will give the following equations (with x = 1),

$z = \alpha_1[\Omega - T_t(p_t+w)]/p$,

$T_{nr} = \alpha_2[\Omega - T_t(p_t+w)]/w$,

$T_s = \alpha_3[\Omega - T_t(p_t+w)]/(p_s+w)$, and

$V_1 = \alpha_{01} + \ln[\Omega - T_t(p_t+w)] - \alpha_1\ln p - \alpha_2\ln w - \alpha_3\ln(p_s+w)$,

(where $\alpha_{01}=\ln\alpha_0+\alpha_1\ln\alpha_1+\alpha_2\ln\alpha_2+\alpha_3\ln\alpha_3$).

Note that, in both formulations, the indirect utility for the case, δ=0 is

$V_0 = \alpha_0 + \ln\Omega - \alpha_1\ln p - \alpha_2\ln w$,

(where $\alpha_0 = \ln\alpha_0+\alpha_1\ln\alpha_1+\alpha_2\ln\alpha_2$).

CONCLUSION AND RECOMMENDATION

Viewing from the resulting indirect utilities, V_{1x} and V_1 have the same factors but are specified in different forms. Unless, a numerical analysis is made to compare between the two formulations, the role of x in utility formulation is undetermined. *Nevertheless, the relationship* between T_s and x is somewhat established.

The numerical analysis can be proceeded in two ways. First, the coefficient of the discrete choice can be estimated by MLE and then the instrumental variable obtain from the MLE is applied in the regressional analysis of the demand model. Alternatively, by regressional analysis of each demand equations, the indirect utility can be estimated with substitution of the determined coefficients in the indirect utility equation.

Reference:

(1)小林　潔司：観光サービスの消費行動モデルに関する研究．土木学会第44回年次学術講演会(平成元年10月)．pp.434-35.