

Ronning, Gerd

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A microeconomic study of travelling behaviour

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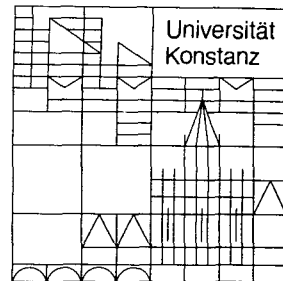
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Sonderforschungsbereich 178
„Internationalisierung der Wirtschaft“

Diskussionsbeiträge



Juristische
Fakultät

Fakultät für Wirtschafts-
wissenschaften und Statistik

Gerd Ronning

**A Microeconomic Study
of Travelling Behaviour**

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A MICROECONOMETRIC STUDY OF TRAVELLING
BEHAVIOUR

Gerd Ronning

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A Microeconomic Study of Travelling Behaviour

Gerd Ronning, Konstanz *

Abstract

The paper reports on an attempt to analyse individual travelling behaviour by discrete choice models. It shows that among the socio-economic variables 'income (of household)' is the variable which influences the decision whether a trip is taken at all whereas 'age' seems to be the most important explanatory variable for the choice among foreign countries. The category-dependent variable 'purchasing power' mostly has the expected positive influence on the decision to travel abroad. The nested logit approach confirms that a simple multinomial logit approach disregards the dissimilarity between the alternative "domestic trip" and the choice set of foreign destinations. All results are based on a set of micro data taken from a German survey ("Reiseanalyse") for the years 1975, 1980 and 1985.

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1 Introduction

The growing availability of leisure in industrialized countries has increased economists' interest in those industries which meet the needs and demands created by leisure such as entertainment, sports and tourism. In particular travelling has become an economic factor and travelling abroad considerably affects balances of payments, at least for European countries. It is therefore of interest to know why people spend their holidays abroad and what explanatory variables direct the demand for foreign tourism. There has been a number of empirical studies related to this question. However, they all used aggregated data. See, for example, O'Hagan and Harrison (1984) and Smeral (1985). These authors used demand systems (Almost Ideal Demand System and modifications) to model the demand for foreign travel. They also pointed out that most consumers will most likely decide in two or even three steps: At first they decide about travelling at all, then they decide about staying in their country or going abroad, and in a third step they decide about the (foreign) destination. However, no attempt has been made to test this assumption.

Analysis of travel demand by means of discrete choice analysis based on micro data is by now a well established branch in econometrics. However, to the author's best knowledge there exist no studies of foreign travel using that approach. In this paper we use micro data from a yearly German survey ('Reiseanalyse'). Section 2 presents the discrete choice model with 'nested' structure and Section 3 contains some empirical results. This paper considers only the qualitative aspects of travelling, that is the choice of destination. One could add the analysis of quantitative components of travelling by considering either expenditure or duration. Such a "mixed" analysis has been suggested by Hanemann (1984). See also Ronning (1988).

2 The Econometric Model

We consider a tourist who has to decide about a holiday trip. Such travel demand will, of course, heavily depend on the socio-economic characteristics of the individual and his/her family and household. Our analysis includes income (of household), size of household (number of persons) and age (of interviewed person). Furthermore, his decision will depend on the characteristics of the different destinations. As the only ‘category-dependent’ variable we use the purchasing power of a German tourist in a foreign country¹ which essentially is a Laspeyres type price index for two regions. As already mentioned above, we assume that the consumer possibly decides about travelling in three steps (see figure 1): Firstly he decides about a trip at all, secondly he decides on going abroad and if he/she does so, he or she then chooses a foreign destination.

We assume that consumers (tourists) face a utility function U_{ij} which is determined by category-dependent variables x and socio-economic variables z together with an error term ε :

$$U_{ij} = x_{ij}\beta + z_i\delta_j + \varepsilon_{ij} \quad (1)$$

for individual i and category j . See, for example, Amemiya (1985, p.296/7). Since a reparametrization of the second term ($z_i\delta_j$) in (1) leads to an expression for the deterministic part which contains category-dependent variables only (see, for example, Maddala 1983,p.74/75), we will henceforth neglect this term and assume that

¹The German Statistical Institute (Statistisches Bundesamt) computes so-called “Reisegeld-Paritäten” for the more important foreign countries twice a year. They are based on a basket of goods and services typical of tourists. For the other countries we used “Verbrauchergeldparitäten” with weights based on domestic consumption.

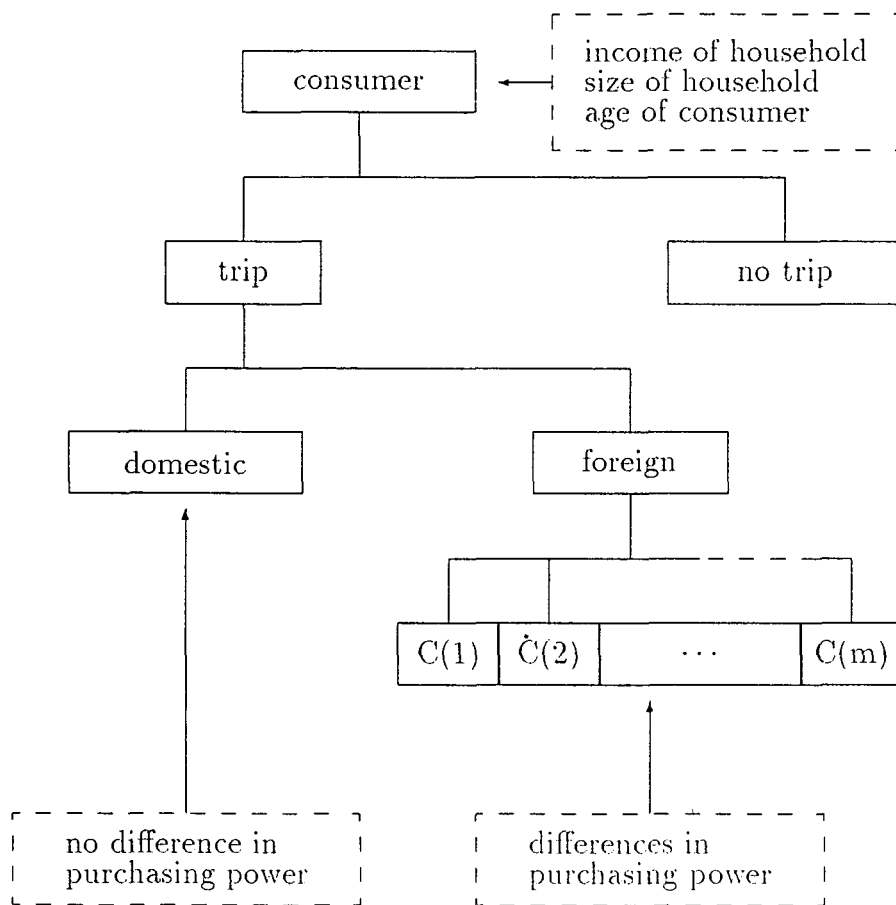


Figure 1: Decision about travelling

$x_{ij}\beta$ also contains the socio-economic variables.² This leads to

$$U_{ij} = x_{ij}\beta + \varepsilon_{ij} \quad (2)$$

Assuming that the ε_{ij} follow an extreme value distribution and that the consumer maximizes random utility, we arrive at the multinomial logit model:

$$p_{ij} = \frac{\exp(x_{ij}\beta)}{\sum_{k=1}^r \exp(x_{ik}\beta)} \quad , \quad j = 1, \dots, r, \quad (3)$$

where p_{ij} denotes the probability that individual i chooses category j and r denotes the number of categories. This model could either analyse travel decisions which disregard the hierarchical structure of figure 1 with $r = m + 2$. Alternately we could use this model to analyse the choice at the three different levels.

To take account of the assumed hierarchical structure we employ the “nested logit” approach. See, for example, Amemiya (1985 chapters 9.3.5 and 9.3.6). The main characteristics are sketched here for the simplest case of a two-level structure: Following Amemiya’s terminology we assume that there are S nodes in the upper level and each j belongs to a set B_s where B_1, \dots, B_S is a partition of the complete choice set. In figure 1 such a situation appears if we assume that a decision in favour of travelling has already been made. Then we have $S = 2$ nodes for ‘domestic’ and ‘foreign’ destination, respectively, and B_1 contains only the own country whereas B_2 contains the m foreign countries. We have to take into account that some explanatory variables vary both over nodes and within subsets whereas other variables vary only over the nodes (and are constant within subsets). Let x_{js} be the vector of variables which vary both over nodes and alternatives within nodes. Furthermore we denote by w_s the vector of variables which vary only over nodes³. We then can

²This elegant way of writing the model sometimes hides the problems in estimation which arise if some variables show no variation over individuals. See Ronning (1987). For example, purchasing power does not vary over individuals, so that x_{ij} is constant with respect to index i .

³As explained in connection with (2) our specifications do not explicitly show the individual-specific variables. The researcher is free to include them both in x or in w . See the discussion of empirical results in section 3.

write the utility function (2) as follows:

$$U_{ijs} = x_{ijs}\beta + w_{is}\alpha + \varepsilon_{ijs} \quad (4)$$

where β and α now are the parameter vectors to be estimated. Assuming the multivariate extreme-value distribution with dissimilarity parameter σ_s under node s for the error terms ε_{ijs} we arrive at the following probabilities (Amemiya 1985 chapter 9.3.5):

$$P_{j|s}(i) = \frac{\exp(x_{ijs}\beta/\sigma_s)}{\sum_{k \in B_s} \exp(x_{iks}\beta/\sigma_s)} \quad (5)$$

$$P_s(i) = \frac{a_s \exp(w_{is}\alpha + \sigma_s I_{is})}{\sum_{t=1}^S a_t \exp(w_{it}\alpha + \sigma_t I_{it})} \quad (6)$$

$P_{j|s}(i)$ denotes the probability that individual i chooses category j in B_s if he has chosen node s , and $P_s(i)$ denotes the probability that node s is chosen. a_s are distribution parameters and the “inclusive values” I are given by $I_{is} = \log(\sum \exp(x_{ijs}\beta/\sigma_s))$ where summation runs over $j \in B_s$. Note that for $\sigma_s = 1$ for all s we are back to model (3).

A generalization of this procedure to the case of three and more levels is possible. See Amemiya (1983 chapter 9.3.6) for the case of three levels. For estimation we use the sequential maximum likelihood procedure⁴ which estimates (5) for each node and then estimates (6) with estimated inclusive values taken from the preceding (lower) level. At each step the usual multinomial logit model can be used. However, as pointed out by Amemiya (1978), the covariance matrix for the estimates from the second and all higher levels has to be derived from a special formula. Moreover, restrictions over different nodes are neglected. See McFadden (1981) for both points.

⁴See Hensher (1986) for recent results from a study which compares sequential maximum likelihood with full information maximum likelihood.

3 Empirical results

Every year the “Studienkreis fuer Tourismus e.V.” at Starnberg/Bavaria sets up a survey about the travel behaviour of Germans. About 6,000 persons are questioned in a personal interview. The stratified sample contains only persons older than 14 years, living in private households. The questions concentrate on the “main” trip which has to span five days at least. Our empirical results are based on the micro data which refer to the years 1975, 1980 and 1985.

In this section we present some estimation results; more complete results are given in Ronning (1989). For the estimation of the nested logit model by sequential maximum likelihood we used our own computer program written in SAS/IML⁵. Table 1 presents results for the year 1975. The specification assumes that besides the difference in purchasing power (PPD) the following socio-economic variables influence the travel decision: income per capita (IPC), Age (AGE) and size of city (NI). We also consider the organisational form of travelling (OF). The three last mentioned variables are dummy variables and income is taken from a grouped distribution⁶. Note that the three socio-economic variables appear at distinct levels. IV denotes the inclusive value.

A * in table 1 indicates that (absolute value of) asymptotic t-ratio is greater than 2.0. (In case of IV we test that the dissimilarity parameter equals 1.) Parameters of the socio-economic variables were set equal to zero for the following categories: ‘no trip’ in top level, ‘domestic trip’ in medium level and ‘USA’ in lowest level.

The estimation results in table 1 indicate the following: Consumers from larger

⁵This program has been written by Angelika Eymann. It uses the covariance formulae from McFadden (1981).

⁶AGE1 < 25, 25 ≤ AGE2 ≤ 39, 40 ≤ AGE3 ≤ 57, 58 ≤ AGE4 ≤ 70 years. NI1 < 5000 inhabitants, 5000 ≤ NI2 < 100000 inhabitants. OF1 = package tour, OF2 = travel organised by travel agency. Income = midst of income interval

Table 1: Estimates for the three-level nested logit model

A. Estimates for the top level					
	Constant	IV	NI1	NI2	
	-0.422	2.982*	-1.151*	-0.410*	
B. Estimates for the medium level					
	Constant	IV	OF1	OF2	IPC
	-4.335*	0.876*	1.559*	0.988*	0.619*
C. Estimates for the lowest level					
	PPD				
	-0.007				
	AGE1	AGE2	AGE3	AGE4	
Norway	-1.285	-1.103	-9.215	-0.746	
Denmark	0.366	0.920	1.019	-0.481	
Sweden	-0.458	-0.276	0.129	-1.999	
United Kingdom	1.101	-0.797	-0.103	-1.826	
Yugoslavia	2.293	1.848*	1.949*	0.146	
Switzerland	0.393	0.470	1.364	0.709	
Italy	2.378*	2.514*	2.965*	2.168*	
Greece	1.549	0.702	0.479	-0.839	
Austria	2.660*	2.624*	3.588*	2.541*	
Netherlands	1.206	0.695	1.165	-0.557	
France	2.332*	1.566*	1.096	-0.157	
Spain	2.786*	2.537*	2.799*	1.499*	
Turkey	-0.009	-0.114	-0.520	-1.549	

towns tend to travel more often. Per capita income and organisational status of the trip influence the decision whether to go abroad. The choice of a certain foreign country is not significantly influenced by the purchasing power whereas age of tourists plays an important role especially for the main foreign destinations such as Austria, Spain and Italy. Similar findings have been obtained from the data sets for 1980 and 1985 which cannot be shown here. The estimated dissimilarity parameters indicate that grouping of alternatives has to be taken into account although a parameter value greater than 1 violates the restrictions of the random utility maximisation hypothesis. This might be seen as an indication of misspecification.

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