Measuring recreation benefits of forest quality change with contingent behavior model

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Introduction

Non-timber functions of forest, such as recreational and aesthetical services, are not traded on ordinary markets and their monetary values are not directly known. The economic methods employed for monetary valuation of non-market goods involve two main categories: stated and revealed preference techniques. When using a revealed preference technique, e.g. travel cost method (TCM), we rely on observed behavior of individuals; stated preference techniques rely on stated behavior of individuals conditional on presented hypothetical situations. Our study combines these two techniques into a joint model.

Generally, there are two main approaches which combine stated and revealed preference data. The first approach is the random utility framework of trip choice modeling (Adamowicz et al. 1995). We employ the second approach, i.e. the contingent behavior model, which combines modelling of actual behavior and contingent behavior of the same individuals, using either pooled or panel data models. Englin and Cameron (1996) were the first to use a panel data approach in a study of the economic benefits of recreational fishing in Nevada. The pooled data model was followed by Eiswerth et al. (2000), who used a Poisson model to estimate the economic benefits of protecting water levels at Walker Lake, Nevada.

In this study, a single site travel cost model is applied to infer recreational values placed by visitors on Jizerské hory Mountains (JH), one of the oldest landscape protected areas in the Czech Republic. Observed and stated behavior of recreationists are analyzed and used to estimate welfare changes associated with four hypothetical programs that improve or degrade the environmental quality in the area. The hypothetical scenarios are (i) decline of the forest quality of the existing spruce wood in the near future because of continuing air pollution (70% of spruce forest destroyed), (ii) change of forestry composition to 80% of broad-leaved trees which are more resistant to air pollution than spruce wood, (iii) the designation of the bird area as a Natura 2000 network which will cover 40% of the area and increases the number of birds, and (iv) charging an entrance fee into the bird area of 30 CZK.

Individual data about respondent's current visit to the area, actual number of trips to the recreation site and stated behaviors expressed as the number of trips realized to the site under hypothetical conditions were obtained by administering an on-survey. The survey incorporated visitors participating in summer recreational activities (hiking and mountain biking) and resulted in 312 completed questionnaires.

Models

Applying TCM, we suppose that the individual's utility depends on the consumption of market goods, the number of trips to the recreation site and the environmental quality of site (Kolstad 2000). We also assume a weak complementarity of the trips and the environmental quality of the recreation site (the individual's utility is not influenced by environmental quality if the individual does not visit the site). Furthermore, the number of visits is increasing with the environmental quality (Alberini & Longo 2005).

Using a recreation demand function based, we can measure the willingness to pay for a change in environmental quality of the recreation site. The model directly incorporates changes in recreation behavior (no. of visits) contingent on four hypothetical scenarios of environmental quality change. The estimated demand function allows us to assess the consumer surplus (CS), which is an approximation of the recreation welfare that is associated with a visit to the recreation site and the welfare change attributed to the proposed variation in environmental quality.

We employ count data models: a Poisson (P) and a negative binomial (NB) specification, and also a more flexible generalized negative binomial model (GNB) that allows the overdispersion parameter to vary according to the characteristics of the visitors.

Results

The count data models were estimated using a maximum likelihood method and are reported in Table 1. The coefficient of the travels cost variable is significant and negative, according to the economic theory. Its magnitude ranges between -0.0015 (P) and -0.0004 (NB). The numbers of trips increase with the respondents' age and decrease with the distance to the substitute recreation site. The visitation is higher for one-day trips compared to overnight (more days) trips. The number of trips tends to be higher among visitors with higher income and lower for people with university degree and for people living in the capital city, Prague. The length of the trip has a positive influence on the number of trips to the JH Mts. With increasing number of people living in the household, the visitation rate to the JH Mts. decreases.

Table 1. Parameter estimates for on-site count data models

Variable	P	NB	GNB
Travel costs	-0.0015***	-0.0004***	-0.0005***
Distance to the substitute recreation site (in km)	-0.0002***	-0.0005***	-0.0005***
One-day trip (binary, 0=overnight trip)	0.3069***	0.5979***	0.5815***
No. of people living in the household	-0.0930***	-0.0520**	-0.0656
Respondents' age	0.0110***	0.0108***	0.0103***
University degree (binary)	-0.1538***	-0.2890***	-0.3020***
Respondent living in Prague (binary)	-0.2903***	-0.3378***	-0.3176***
Individual income (in thous. CZK)	0.0226***	0.0231***	0.0226***
Length of current trip (in km)	0.0114***	0.0132***	0.0142***

Variable	P	NB	GNB
Mountain biker (binary)	0.1523***	0.2084***	0.1850**
Scenario 1 (forest quality decline)	-0.1437***	-0.1943**	-0.1981**
Scenario 2 (broad-leaved trees increase)	0.0094	0.0165	0.0148
Scenario 3 (designation of a bird area)	0.0409**	0.0541	0.0537
Scenario 4 (proposition of entrance fee)	-0.1553***	-0.1226	-0.1183
Constant	2.0289***	1.5601***	1.6460***
Alpha (overdispersion parameter)		1.0988***	1.1551***
No. of children in the household			-0.1451***
University degree (binary)			-0.2410***
Male (binary)			0.1529*
No. of observations	1 475	1 475	1 475
Log-likelihood	-14 610	-5 149	-5 138
Pseudo R2	0.313	0.057	0.059
Chi2(14)	13 331	627	645
AIC	29 250	10 330	10 313
BIC	29 329	10 415	10 414
Notes: P - Poisson model, NB - Negative Binomial, GNB - generalized NB * = p < 0,1; ** = p < 0,05; *** = p < 0,01			

Since there is significant evidence of overdispersion,the NB model is preferred to the Poisson model. The GNB model allows the overdispersion parameter (alpha) to vary according to variables that reflect visitor's characteristics: number of children, university degree and gender. All respective coefficients are highly significant, revealing that the use of the same overdispersion parameter for all observations would be overrestrictive. The GNB model is therefore preferred for the recreation data and is used also for interpretation of the results.

The four binary variables corresponding to the hypothetical scenarios represent the key variables for placing a monetary value on particular changes in environmental quality that were presented to the respondents. As shown in Table 1, the only scenario with a significant influence on the recreation demand in the GNB model is the project affecting negatively the quality of the spruce wood. As expected, its coefficient is negative.

We use the travel cost coefficients reported in Table 1 to calculate welfare measures in terms of the CS users derive from having access to the park. The average CS per season (in 2005 US dollars) associated with an access to the JH Mts. ranges from USD 271 (P) to USD 971 (GNB). The consumer surplus per visit is from USD 29 to USD 90, respectively. The results show that if the spruce wood scenario was implemented, the welfare change based on the GNB estimates would decrease by about USD 200 on average over the sample. The corresponding value per trip and person is of USD 18. The other scenarios do not significantly change the recreation behavior

(Table 1), and the effect on the recreation welfare is therefore not significantly different from zero.

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