Effects of water quality changes on recreation benefits in Finland: Combined travel cost and contingent behavior model

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Valuing the changes in water quality

To improve the information base for the implementation of the EU Water Framework Directive, this study examined the effects of changes in water quality on the recreation benefits obtained from swimming trips in Finland. Traditionally, the benefits of water-related and other outdoor recreation have been estimated with the travel cost (TC) method, in which the variation in travel costs among individuals is used to derive a demand curve for recreation, and the benefits of the recreation are then calculated as a consumer surplus. Travel cost method can be used to value water quality changes by pooling data from sites with different water quality and estimating the effect of variation in water quality on number of trips taken. Water quality may not, however, vary enough between the sites to get policy relevant results, and forecasting recreation behavior beyond the range of observed variation can be problematic (Whitehead et al. 2000). To avoid the weaknesses of travel cost method when estimating welfare effects of environmental quality changes, researches have increasingly applied combined travel cost and contingent behavior (CB) approach. The contingent behavior method elicits information on how many recreation visits respondents would make under hypothetical environmental quality and thus makes it possible to study changes in environmental quality that are beyond the observed levels. Combining the TC and CB data enables estimation of demand curve for swimming as a function of travel costs and water quality and thus the effect of water quality changes on recreation benefits can be calculated (Englin & Cameron 1996; Eiswerth et al. 2000).

In this study respondents were asked how many times they would go swimming in the case that a) water quality improved to a level that bottom of the water could be seen from the surface at a depth of over two meters and if no slime was present and b) water quality decreased so that the bottom could be seen from a depth of less than one meter and there was abundant slime on the rocks and piers.

Methods

The data analyzed in this study comprised one section of the Finnish National Outdoor Demand Inventory 2009–2011 that was carried out in 2009 and 2010 three times per year. Each round included a general part that elicited information on general outdoor recreation behavior and a variable section collecting data on a particular special theme, such as that of water quality changes and swimming behavior investigated here. The data were collected from a sample of 15- to 74-year-olds from the Finnish general population. In total, 1617 respondents participated in the survey round analyzed here, representing a response rate of 40.4%.

The combined data set is in panel format, each respondent represented by three observations: one observation based on actual swimming trips made in the past 12 months and two observations on intended future trips under hypothetical water quality conditions. Since the data is in panel format and the dependent variable can take only nonnegative integer values we estimate the models with negative binomial random effects model.

Results

On the basis of the estimated econometric models (Table 1) swimming trip frequency is affected by water quality as expected. The statistically significant travel cost and TC-water quality variables allow us to calculate the per trip value of swimming and the effects of water quality changes on the value. Other variables found to influence swimming trip demand statistically significantly are household size, having access to a shorefront second home, owning a boat and typical origin of a swimming trip being home or a second home.

We estimate the recreation value of swimming to be about 18 Euros per trip under current conditions. If water quality improved to a level at which respondents perceived visibility of over two meters and no slime, the consumer surplus would be about 46 Euros. In the case perceived visibility decreased to less than one meter and there would be abundantly slime on the rocks and piers or it could be felt on skin when swimming or after swimming the consumer surplus per trip would decrease to seven Euros.

To calculate the aggregate welfare effects of water quality changes, in addition to changes in per trip values, we need to know how visit frequency changes due to water quality changes. The mean predicted number of trips from the RP-SP model is 25 (in the model sample), improved water quality increases it to 33 and decreased water quality, in turn, reduces it to 9 when holding other variables constant. In the data under the current water quality the average number of annual swimming visits was 19, under improved quality 25 and under decreased quality 11. On the basis of the predicted number of trips and the data averages the aggregate recreation benefits of swimming are 1.22–1.66 billion Euros annually under the current water quality. A decrease in water quality so that water clarity was less than one meter and slime was abundant would cause benefits to fall to 0.20–0.24 billion Euros or 80–90%. Increase in benefits due to quality improvement would also be remarkable, benefits rising by more than threefold.

Table 1. Estimated TC-CB model

Independent variables	Coefficient (t-ratio)
Constant	0.725 (1.83[a])
Travel cost	-0.056 (-2.32[b])
Household gross income	$-1.1*10^{-5}$ (-0.50)
Not employed	0.225 (2.30[b])
Household size (persons)	-0.128 (-3.65[a])
Lives in detached house or in a farmhouse	0.292 (2.95[a])
A beachfront summer house available	0.313 (2.88[a])
A boat available	0.261 (2.74[a])
Typically goes swimming from home	0.499 (2.29[b])
Typically goes swimming from a second home	0.466 (2.02[b])
Poor water quality	-0.975 (-13.42[a])
Good water quality	0.279 (5.28[a])
Travel cost - poor water quality interaction	-0.084 (-2.40[b])
Travel cost - good water quality interaction	0.035 (1.66[c])
Alpha	
Number of observations	1135
Number of respondents	470
Log-likelihood	-3848.56
Restricted Log-likelihood (constant only)	-4196.25
Log-likelihood ratio	695.38

[a], [b] and [c] indicate significance at the 1%, 5% and 10% levels, respectively

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