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Conflict between Commercial and Recreational Activities on Irish Rivers: Estimating the Economic Value of Whitewater Kayaking in Ireland using Mixed Data Sources

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Abstract

This paper's contribution to the understanding of outdoor recreational pursuits in Ireland comes from the estimation of the first whitewater kayaking demand function. This paper is also unique in that it combines data collected from two different sources; the internet and an on-site survey, thus alleviating the problem of endogenenous stratification that is found when carrying out on-site surveys alone. The Travel Cost Model (TCM) method of estimation is used to put a value on the demand for whitewater recreation on the Roughty river, Co. Kerry, Ireland. Whitewater kayaking is well suited for the use of TCM to estimate recreational values as it is conducted at distinct, identifiable sites, and most paddling trips are single purpose, taken for the sole purpose of recreation at the site (English and Bowker, 1996). With regard to the estimation of our travel cost model, the study found that the mean willingness to pay (i.e. the consumer surplus + travel cost) of the average kayaker using the Roughty river in Co. Kerry was €194 per trip. This result is conditional on the survey sample but still indicates the high value of the Roughty river as a whitewater recreational resource.

JEL Classification: Q51 Q56

Key Words: Travel Cost Model, Whitewater Kayaking, Hydro-Electric Schemes.

1. Introduction

The conflicts between the preservation of natural environmental assets and their development have been one of the longest-standing concerns in environmental economics. Early work by Krutilla and Fisher in the late 1960s explored the trade-offs between the market-valued benefits of developments such as hydro power and commercial ski-ing, relative to the largely non-market benefits of conservation/preservation of sites such as Idaho's Snake River and White Cloud Peaks (Krutilla and Fisher, 1975). In this paper we estimate the non-market benefits accruing from the preservation of "natural" river conditions in Ireland, where the development threat comes from investments in new hydroelectric plants. Such investments are deemed necessary under Irish government targets for increasing the fraction of energy produced from renewable sources, as we explain below. However, hydro developments on some rivers may come at the expense of significant foregone non-market recreation benefits, in terms of the use of "natural" rivers by white-water kayakers.

Whitewater kayaking refers to the sport of negotiating ones way downstream through natural obstacles such as waterfalls, rapids, and boulder gardens on a section of river. The ability to create a mental map of the river ahead, coupled with an ability to make split second decisions is required to choose the best route down. Precise control, endurance, and sustained power are needed to negotiate the best line through the rough water and to overcome the frequently changing water conditions. The kayaker chooses and negotiates a route which is as obstacle free as possible and which utilises the fast current to the best advantage.

Given its mild and wet climate and terrain, it is not surprising that there are a large number of high quality rivers available in Ireland to the whitewater kayaking enthusiast. An increasing number of people are participating in whitewater paddling in Ireland. The present number of whitewater kayakers in Ireland is estimated to be 5000. This figure represents the total number of kayakers that are registered members of the Irish Canoe Union (ICU), the body that represents kayaking interests in

Ireland[1]. An indication of the growth in popularity of the sport is the increasing number of participants on ICU kayak proficiency training courses. Figures from the ICU indicate that participation in these courses has increased by an average of 15% year on year for the last 6 years. However, this rise in demand for suitable whitewater sites has coincided with an increasing call on these natural resources for hydro development. The hydropower industry in Ireland has experienced recent strong growth, and this trend is expected to continue, with the emphasis on small-scale run-of-river projects. In the policy document "Renewable Energy: A Strategy for the Future" (1996), targets have been set to secure an additional 13 MW generating capacity from hydropower in Ireland by the year 2010.

This paper's contribution to the literature is in terms of a first estimation of the demand for whitewater kayaking in Ireland, using a case study of the River Roughty in County Kerry. We use this to investigate the more general conflict between whitewater recreational pursuits and hydro-electric schemes. We also combine data collected from two different sources; the internet and an on-site survey, thus alleviating the problem of endogenenous stratification found when carrying out on-site surveys alone. In what follows, section 2 provides more detail on the conflict between commercial interests and recreational pursuits on Irish rivers. Section 3 briefly outlines the travel cost method of valuation and explains the econometric approach taken. Section 4 outlines the data source for this study and presents summary statistics for the sample dataset. Section 5 investigates if the observations from the on-site and on-line surveys can be pooled into one dataset and reviews the empirical estimation process, with particular regard to the zero-truncated negative binomial model. Model results and estimates of consumer surplus from whitewater recreation on the Roughty river are presented in section 6. Finally, section 7 concludes with a discussion of the policy implications of our results and some recommendations for further research.

[1] This figure includes 2500 individually registered members plus an additional estimated 2500 kayakers who are members of the 100 clubs that are registered with the ICU. Not all kayakers are registered with the ICU or an affiliated ICU club so the figure of 5000 can be considered a lower bound estimate of the total whitewater kayaking population in Ireland.

2. The Conflict between Commercial Interests and Recreational Pursuits on Irish Rivers.

At the same time as the sport of kayaking grows in popularity, Irish rivers are coming under increasing threat from development of many kinds: pollution and water abstraction from new housing, mining, forestry; hydro-electric schemes; and non-point pollution from farming. Hydro-electric schemes are a particularly acute problem from the point of view of whitewater recreational activities as they alter the dynamics of a river.

The hydro-power available at any site on a river is directly proportional to the fall at that site and to the flow of the river. The quality of a whitewater kayaking site is also directly proportional to the fall and flow at the site. Thus, hydro-electric schemes and whitewater kayaking are in direct hydrological competition. Depending on their mode of operation, hydro-electric schemes are classified as reservoir or run-of-the-river schemes. Run-of-the-river schemes operate in response to the natural variation of river flow: when flow is low, power production is reduced. Because of cost considerations, most recent and planned developments in Ireland are run-of-the-river schemes, employing a low dam or diversion weir of simple construction. This is the mode of operation that has been under consideration for the Roughty river, our case study site.

As a result of the proliferation of small hydro-electric schemes on Irish rivers the number of unspoilt whitewater rivers – rivers with variable and challenging levels of whitewater suitable for kayaking - are being significantly reduced. Table 1 highlights the number of rivers in the country that are regarded by the Irish Department of Energy (1985) as having hydro-power potential. Of these 273 rivers, 95 are listed in The Irish Whitewater Guidebook (MacGearailt, 1996) as being of a paddling quality of grade two or higher.

Much of the hydropower from small-scale hydro schemes in Ireland is supplied to the Electricity Supply Board (ESB). The growth in utility purchases from private small hydro schemes has increased significantly over the last 20 years. In 1981, 3.8GWh of power from this source was been supplied to the ESB. By 1991 this figure had increased to 22.6GWh and in 2003, 32.4GWh of hydro-electric energy was being purchased by the ESB. Currently there are 16 small hydro-electric schemes in operation on Irish rivers (www.irish-hydro.org).

Some of the hydro-potential outlined in Table 1 is being developed through the Alternative Energy Requirement (AER) program - a series of competitions in which prospective renewable energy generators tender for contracts to sell electricity to the ESB. In 1995, 10 proposals for hydropower projects totaling 4 MW capacity were approved under the first of these competitions, scheduled to match demand. The latest Alternative Energy Requirement competition, AER V, was launched in May 2001 and the results were announced in February, 2002. The target is for 5MW capacity to come from small-scale hydro operations. AER V aims to ensure that the 500 Megawatt target for renewable based electricity-generating capacity, established in the 1999 Green Paper on Sustainable Energy, is reached by 2005 (Department of the Environment, 1999).

To make a whitewater kayaking trip worthwhile, a river with numerous rapids with irregular waves and broken water is required. On the other hand, the operation of a small hydro-electric scheme on a river requires only one section of fast flowing water or a single fall of water. For this reason the number of rivers suitable for hydro-electric schemes (273) are far greater than the number suitable for whitewater kayaking. This would seem to suggest that a substantial middle ground is available where hydro electricity and whitewater kayaking can exist without coming into direct conflict. However, in other cases, sites which are attractive from a electricity generation viewpoint will be those most valued by kayakers for recreation. Recognising the non-market benefits foregone should development go ahead is essential for efficient management of this potential conflict in the use of this natural resource.

The Roughty river in Co. Kerry is considered one of the classic grade 4 whitewater runs in the country[2]. It has a huge variety of waterfalls and rapids and is described in

[2] As well as being an excellent whitewater resource, the Roughty river is also very highly prized as a fishing river in its own right.

The Irish Whitewater Guidebook (1996) as "an excellent paddle with frequent rapids of varying difficulty". However, it is currently being considered for development of its hydro-power potential. We therefore take this river as our case study site. We now describe the procedures adopted for estimating the non-market benefits of preserving the Roughty for whitewater kyaking.

3. Choice of Methodology and Model Specification

In this paper the Travel Cost Model (TCM) method of estimation will be used to put a value on the demand for whitewater recreation on the Roughty river. Whitewater kayaking is well suited for the use of the TCM as it is conducted at distinct, identifiable sites, and most paddling trips are single purpose, taken for the sole purpose of recreation at the site (Bergstrom and Cordell, 1991; English and Bowker, 1996; Bowker et al. 1996). The price faced by whitewater recreationists (herein referred to as kayakers) is the cost of access to the recreation site (mainly the time and money costs of travel from home to site), and the quantity demanded per year is the number of recreation trips they make to the Roughty river per year. The count data version of the TCM, which allows for the integer nature of the trips data has been widely used to estimate demand for recreational amenities (Hanley, Shaw and Wright, 2003). Examples include Loomis *et al.* (2000) for whale watching; Chakraborty and Keith (2000) for mountain biking; Font (2000) for national park recreation; Curtis (2002) for recreational fishing; Offenbach and Goodwin (1994) for hunting; and Shaw and Jakus (1996) for rock climbing. No applications have so far been made to whitewater kayaking that we are aware of.

The number of trips to a whitewater kayaking site taken in any given year is reported as a discrete, non-negative integer value. Following the work of Creel and Loomis (1990), Grogger and Carson (1991) and Gomez and Ozuna (1993), we assume that a model of recreational demand can be estimated assuming either a Poisson or a negative binomial distribution for the dependent variable. The Poisson model has been criticised because of its implicit assumption that the conditional mean of T_i (in our case the expected number of trips to the river per year) is equal to the variance

(Greene, 1993). This mean-variance equality has proven problematic in applied work since real data frequently exhibits “overdisperion”; that is where the conditional variance is greater than the conditional mean (Cameron and Trivedi, 1986).

The Poisson distribution has been generalized to take into account this problem of over dispersion. The generalization most often used in the literature is the negative binomial probability distribution (Grogger and Carson, 1991; Englin and Shonkwiler, 1995; Curtis, 2002) where an individual, unobserved effect is introduced into the conditional mean. This probability distribution, used to develop the current TCM can be written as:

$$\Pr(T_i) = f(T_i) = \frac{\Gamma(T_i + 1/\alpha)}{\Gamma(T_i + 1)\Gamma(1/\alpha)}(\alpha\lambda_i)^{y_i}(1 + \alpha\lambda_i)^{-(T_i + 1/\alpha)} \qquad (1)$$

where there are i = 1, 2, …, n observations, T_i is the number of trips to the river for individual i and λ_i is some underlying rate at which the number of trips occur, such that we expect some number of trips in a particular year i.e. the mean of the random variable T_i ($E(T_i|X_i)$) is given by λ_i and $\lambda_i = \exp(X_i`\beta)$. The variance of y_i ($var(T_i|X_i)$) is given by $\lambda_i(1 + \alpha\lambda_i)$. The vector X_i represents the set of explanatory variables reported for each individual i. It is a 1 by k vector of observed covariates and β is a k by 1 vector of unknown parameters to be estimated. The scaler α and the vector β are parameters to be estimated from the observed sample. Γ in equation (1) indicates the gamma function that distributes λ_i as a gamma random variable. Finally α is a nuisance parameter to be estimated along with β. Larger values of α correspond to greater amounts of overdispersion. The model reduces to the Poisson when $\alpha = 0$ as $E(T_i|X_i)$ is again equal to $var(T_i|X_i)$).

Curtis (2002) points out two possible problems with the usual negative binomial probability distribution, which are relevant for the current study. Firstly the dataset contains information on active kayakers only and is therefore truncated at positive demand for kayaking trips (we do not observe people who take zero trips in the survey period, even though they may have taken trips in previous years, and may again in the future). Such an occurrence is not uncommon in recreation demand modelling and models to take into account this truncation have been developed (Shaw, 1988). Secondly, an on-site survey is subject to the problem of endogenous stratification. Due to the method of data collection the likelihood of being sampled depends on the frequency with which an individual visits the river. However. if data from an on-site survey can be pooled with a non-site based survey - in our case, via the internet - then the problem of endogenous stratification may be avoided.

4. Sample characteristics

The data for this analysis was collected from a survey distributed to whitewater kayakers in and around the study area on the weekend of the 18th and 19th of February 2003. The survey was also made available on the homepage of the main Irish whitewater kayaking website (www.irishfreestye.com). Kayakers who had used the river in the previous year and who had not already filled out a questionnaire on site were asked to download the questionnaire and return it via email. A total of 82 surveys were collected at the river, with a further 78 being returned via the internet. Out of a total of 160 returned questionnaires 144 were usable in the analysis. Internet surveys are a useful means of acquiring responses from the general public, although clearly cannot be expected to yield representative samples due to uneven access to the net (Berrens et al, 2004). In Section 5 we also show that the data collected from our two different sources can be pooled together.

The survey instrument included questions about the frequency and costs of kayaking trips to the Roughty river. Specifically, respondents were asked how many paddling trips they had taken in the previous 12 months. Focusing on each respondent's most recent trip, additional information was collected about the number of miles traveled, and the time required to complete the trip. Also contained in the survey were questions regarding each kayaker's age, occupational status and income. The question regarding income requested that the respondent indicate which of six categories reflected their before-tax household income. The midpoint of each category was then taken as the best estimate of the respondent's income[3].

Figure 1 shows the distribution of trips to the Roughty River in our sample. The average number of trips taken to the river in one year was 3.24 but the variance was more than double that at 7.27, indicating that our dependent variable (trips) was indeed over-dispersed. Table 2 summarizes the survey responses for some key variables.

Count data models of recreation demand work by assuming a negative relationship between the costs of trips and the number of trips made to a site. Here, costs in principle include all the marginal costs of making a visit, comprising both petrol ("out-of-pocket") costs and the costs of travel time. In calculating the travel cost to the river we use the Automobile Association (AA) of Ireland's calculations for the marginal costs of motoring for a car of average size of €0.25/mile. Lacking adequate data on respondents' labour market situations, we omit any monetary valuation of leisure time in the travel cost calculations. This likely biases our consumers' surplus estimates downwards (Smith and Kaoru, 1990).

5. Model estimation

When the observations under study are derived from two different sources (in our case the on-site survey and the internet based survey, both of which used the same questionnaire), the question arises as to whether or not the datasets can be pooled. This has very important implications for recreational demand studies such as the one being carried out here. Most outdoor pursuits have numerous dedicated websites associated with them. Like-minded recreationists use these sites on a regular basis to communicate with each other and find out the latest news regarding their particular outdoor pursuit. If researchers can use these internet based resources to collect data in conjunction with on site surveys, as was done in this paper, then not only can the size

[3] The questionnaire solicited gross personal income in classes as follows: under €10,000; €10,000 - €19,9994; €30,000 - €49,999; €50,000 - €74,999; €75,000 and over.

of the response to a survey be increased with relative ease and at less cost, but also the problem of endogenous stratification is reduced by a significant margin.

To test this we use a Wald test (Agresti, 1990; Judge et al., 1985). To test the equality of regression coefficients that are estimated on two different samples you must set up your data and regression model so that one model is nested in a more general model. For example, suppose you have two regressions, one for your on-site dataset and the other for your internet-based sample,

$$y = a1 + b1X \quad (3)$$

and

$$t = a2 + b2X \quad (4)$$

We rename t to y and append the second dataset onto the first dataset. Then, we generate a dummy variable; call it d, that equals 1 if the observation came from the internet dataset and 0 if the data came from the on-site dataset. We then generate the interaction between x and d, i.e., $w = dX$. Next, you estimate:

$$y = a1 + a2d + b1X + b2w \quad (5)$$

You can now test whether $a1$ and $b2$ are separately or jointly zero. This is done using a Wald test. The Wald test is a way of testing the significance of particular explanatory variables in a statistical model. In our model we have a discrete dependent variable and 11 explanatory variables.

For the aforementioned testing procedure we will also have 11 dummy variables nested into our more general model. For each explanatory variable in the model there is an associated parameter. The Wald test, described by Agresti (1990) and Judge et al. (1985), is one of a number of ways of testing whether the parameters associated with our explanatory variables are zero. If, for our group of dummy explanatory variables, the Wald test is significant, then we would conclude that the parameters associated with these variables are not significantly different from zero. Therefore the variables should not be included in the model. This would indicate that our data from the separate data sources can be pooled. If on the other hand, the Wald test is significantly different from zero then these explanatory variables cannot be omitted from the model. This would indicate that the data from both sources cannot be pooled.

Our null hypothesis is:

$$Ho : Rb = r \tag{6}$$

where R is a q x k (q < k) matrix of known constants and r is a q x 1 known vector. More specific to our case we want to test if our interaction dummy variables are significantly different from zero, i.e. r is 0.

The Wald statistic is (Judge et al. 1985):

$$W = (Rb - r)'(RVR^{-i})^{-1}(Rb - r) \tag{7}$$

where the estimated coefficient vector is b and the estimated variance –covariance matrix is V. Rb = r is the set of q linear hypotheses to be tested jointly (the interaction dummies nested into our general model). Given our estimation procedure reports significance levels and confidence intervals using z statistics, our Wald test result is reported using a χ^2 distribution with q degrees of freedom.

$$W \sim \chi_q^2 \tag{8}$$

Having carried out our testing procedure, a χ^2 statistic (with 10 degrees of freedom[4]), of 15.61 was reported. The significance level associated with our 11 coefficients being zero, is 11.12%. We find that we cannot reject our null hypothesis, or at least cannot reject it at any significance level below 11.12%. This indicates that the observations from our two data sources can be pooled. Even though part of our sample involved an on-site survey the issue of endogenous stratification is, therefore, not seen to be a problem. The reason for this is the fact that just under half of the total sample were collected from respondents via the internet, who had utilized the river for

[4] The constraint of dummy*y2 was dropped by Stata during the running of the Wald test, hence q is equal to 10 rather than 11.

kayaking purposes in the previous year, (see the data section for more information). Having confirmed that our two data sources can be pooled, our full dataset now contains information on individuals other than those present on the survey weekend and the likelihood does not depend on the frequency with which an individual visits the river.

The other major problem to be tackled with site survey-based recreation demand data is that no observations exist for individuals who made zero trips to the river during the sampling period. Exclusion of individuals who chose not to make a trip implies that the data have been systematically truncated. If this truncation is not recognized, the resulting parameter estimates will be biased in terms of inferences drawn about the population of potential beneficiaries from conserving the option to kayak on the river in the future. This bias will extend to the estimates of consumer surplus that are derived from these parameters. To avoid this problem, one must modify the negative binomial distribution to reflect the fact that T_i is only observed when $T_i > 0$. Following Grogger and Carson (1991), the negative binomial probability distribution is adjusted to account for truncated counts. This probability model can be written as:

$$\Pr(T_i) = f(T_i) = \frac{\Gamma(T_i + 1/\alpha)}{\Gamma(T_i + 1)\Gamma(1/\alpha)}(\alpha\lambda_i)^{T_i}(1 + \alpha\lambda_i)^{-(T_i + 1/\alpha)}[1 - f(0)]^{-1} \qquad (9)$$

The truncated probability function differs from the standard probability function by the factor $[1 - f(0)]^{-1}$. Since $f(0)<1$, multiplication of the usual probabilities by $[1 - f(0)]^{-1}$ inflates them, accounting for the unobserved zeros. Estimation of the resulting truncated negative binomial model relies on standard maximum likelihood techniques. The log-likelihood function for the truncated model can be written as follows:

$$\begin{aligned}\ln L = \sum_{i=0}^{N} &\ln\Gamma(T_i + 1/\alpha) - \ln\Gamma(1/\alpha) + T_i\ln(\alpha\lambda_i) - (T_i + 1/\alpha)\ln(1 + \alpha\lambda_i) \\ &- \ln[1 - (1 + \alpha\lambda_i)^{-1/\alpha}]\end{aligned} \qquad (10)$$

where N corresponds to the size of the truncated sample. The conditional mean and variance of this model is given by:

$$E(T_i \mid X_i, T_i > 0) = \lambda_i[1 - f(0)]^{-1} \tag{11}$$

and

$$\text{var}(T_i \mid X_i, T_i > 0) = \frac{E(T_i \mid X_i, T_i > 0)}{f(0)^{\alpha}}\{1 - [f(0)]^{1+\alpha} E(T_i \mid X_i, T_i > 0)\} \tag{12}$$

For comparison purposes, the demand model was also estimated under the less restrictive assumptions imposed by use of the non-truncated negative binomial distribution. A truncated Poisson distribution can also be used to model the data generating process that underlies the discrete, nonzero values observed in the sample. Although this model can be somewhat easier to estimate, it once again imposes the restriction that the conditional mean of the dependent variable, λ, is equal to the conditional variance.

6. Results

Parameter estimates for the kayaking TCM are presented in Table 3. Several alternative specifications of the demand equation were estimated. These included the standard and truncated Poisson models and the standard negative binomial model. Although these alternative models gave results similar in magnitude and with the same signs, they were rejected in favour of the truncated negative binomial model, as this was found to best fit the data in terms of the log likelihood value. This model's estimate of the mean number of whitewater recreation trips demanded is 2.83. This is a slight underestimate of the actual mean of 3.24 trips observed in the sample.

In the preferred model, α, the overdispersion parameter is quite small at 0.242. It is however positive and significant, indicating that the data is overdispersed. In order to test the hypothesis that α = 0 (and therefore indicating that the Poisson model would be more appropriate) a likelihood ratio-test was performed. The χ^2 value of 51.66 implies that the probability that one would observe these data conditional on α = 0 is virtually zero.

The marginal effect of covariates on mean whitewater trips taken is given by:

$$\frac{\partial E(T \mid X)}{\partial x_i} = (1+\alpha)\lambda_i \beta_j \qquad (13)$$

For every €20 increase in the travel cost of a trip, the number of whitewater trips demanded falls by 0.84 or approximately 29%. The estimated coefficients for both travel costs and discretionary time available (DT) are of the expected sign and significant at the 95 percent level of confidence. For each additional day of discretionary time available to kayakers, 0.014 more trips to the Roughty river are demanded. The income coefficient is also significant and has the expected positive sign but is very small at .0000271. While this result may appear strange it is not uncommon to encounter small (and in some cases negative) income effects in recreational travel cost demand models (Chakraborty and Keith, 2000 and Curtis, 2002). The variable denoting income squared (Y2) is significant at the 1% level but is very small in magnitude. Its significance shows a quadratic relationship between trips to the Roughty river and income. The variable denoting the relative importance of kayaking as a recreational pursuit (Importance) was found to be insignificant, even though it had the anticipated sign. Kayaking experience has a significant (at the 1% level) impact on the demand for whitewater kayaking trips, showing that the number of whitewater trips demanded increases by 0.52 or 18.5% for each additional year of experience. A priori, this is what one would expect considering the somewhat technical nature of the Roughty river. This agrees with the result obtained by Munley and Smith (1976), who also concluded that experience had a positive impact on the willingness to pay for whitewater recreation.

The dummy variables measuring proficiency level in a kayak indicate whether a respondent classifies him/herself as being a basic, intermediate or advanced paddler. This is an excellent indicator of the skill level of each kayaker. Compared with basic proficiency level kayakers, intermediate paddlers are predicted to make 3.47 more trips to use the Roughty river, with advanced proficiency level kayakers likely to demand 3.83 more trips than their basic proficiency counterparts. Very few basic proficiency kayakers would consider kayaking on a river with a difficulty rating of greater than grade 3. Considering the Roughty is classified as a grade 4 river the coefficients on the dummy variables measuring proficiency level are of the expected sign and magnitude. The other variable in our model, age, is insignificant but of the expected sign. As paddlers get older less trips are demanded.

Consumers' surplus was estimated following McKean and Taylor (2000) and Hellerstein and Mendelsohn (1993), for consumer utility maximization subject to an income constraint, and where trips are a nonnegative integer. Hellerstein and Mendelsohn show that the conventional formula to find consumer surplus for a semi-log model also holds for the case of the integer constrained quantity demanded variable. They show that the expected value of consumer surplus, $E(CS)$, derived from count models can be calculated as $E(CS) = E(T_i|x_i)/\beta_p = \hat{\lambda}_i/(\beta_p)$ where $\hat{\lambda}_i$ is the expected number of trips, and β_p is the price (*i.e.*, travel cost) coefficient. The per-trip $E(CS)$ is simply equal to $1/-\beta_p$. In the preferred model, this implies that consumers' surplus per trip is €83.3. The population estimate of per-trip consumer surplus is estimated with 95% confidence to be between €62.5 and €125. The estimated average whitewater trips per year in our full 143-person sample were 2.83. Total consumer surplus per kayaker per year is average annual trips x surplus per trip or 2.83 x €83.3 = €235.74 per year. This implies that the annual whitewater value of the Roughty river for our sample of kayakers or willingness-to-pay by those in our sample of 143 paddlers is 143 x 235.74 = €33,711 per year.

Since this study on whitewater recreation is one of the first of its type done in Europe, the comparisons here are with similar studies on whitewater recreational sites carried out in the United States[5]. Johnson et al. (1990), in a contingent valuation study, obtained estimates of mean willingness to pay for a permit for access to a controlled whitewater river in Oregon of €39.73 and €64.39, depending on the question format used. Bergstrom and Cordell (1991) estimated much lower values for consumer surplus per trip at €24.01 for canoeing and kayaking. English and Bowker (1996) obtained estimates of per-trip surplus for commercial rafting in Northern Georgia of €131.90. In a more recent study on whitewater recreation on the Gauley river in West Virgina by Ready and Kealage (1998) consumer surplus per trip estimates of €84.42 were calculated. However, such simple comparisons are somewhat hard to interpret,

[5] All figures have been converted into 2003 euros.

since methodology and context vary greatly between these earlier studies and that reported here.

7. Conclusions

This paper has attempted to highlight the conflict between commercial interests and recreational pursuits on Irish rivers. In this paper we have contributed to the understanding of outdoor recreational pursuits in Ireland by estimating the first whitewater kayaking demand function for an Irish river. We found that data collected over the internet could be pooled with data from an onsite survey. If this finding could be generalised to other contexts, then it would have important implications for the cost and time spent in carrying out field surveys, and the problem of endogenous stratification.

With regard to the estimation of our travel cost model, the study found that the mean consumer surplus of the average kayaker using the Roughty river in Co. Kerry was €235 per year. In a recent poll looking at river usage in Ireland carried out on the internet site, www.irishfreestyle.com, it was found that 43% of the respondents had paddled the Roughty river. Taking this as an estimate of the proportion of the population of intermediate or advanced kayakers in the country, that paddle the Roughty river an estimated average of 2.83 times per year, this would mean an estimated 7075 trips in aggregate to the Roughty river per year. This indicated a total consumer surplus figure of €0.589 million for the kayaking population using the Roughty river in Co. Kerry. The population estimate of total consumer surplus is estimated with 95% confidence to be between €0.442 and €0.884 million This result indicates the high value of the Roughty river as a whitewater recreational resource.

This study is limited in the sense that the sample size is quite small. Also, since we focussed on one site only, the opportunity cost of hydro developments on the Roughty will be over-estimated due to the omission of substitute sites from this study. Estimating the preferences of kayakers for alternative whitewater rivers as a function of site characteristics and kayaker characteristics is an obvious extension of this work. It would also be interesting to investigate the impacts on welfare and trips of alternative rationing mechanisms such as the imposition of car-parking fees and measures to increase access time (Shaw and Ozog, 1999 and Hanley et al. 2002)

In the debate on using the natural flows of rivers such as the Roughty for hydro-electric power much emphasis is placed on the value of electrical power that will be generated. Losses to society are often put in terms of the loss in the scenic value of the river, loss in terms of a fishing resource, the impacts on the indigenous flora and fauna and perhaps the impacts on local residents. Little if anything is said in terms of the whitewater recreational value of such a river system at the planning application stage for such hydro-electric schemes[6]. Though we do not comment on the value of the Roughty from a hydro-electric viewpoint, the welfare estimates presented here confirm the significant opportunity costs of allowing such developments on popular kayaking rivers. Unspoilt rivers such as the Roughty that can be used for whitewater recreation are indeed becoming more and more of a rarity. The nearby River Sheen in Kenmare, Co. Kerry has had a hydroelectric plant build on it. It has also had its rapids altered and new weirs built to facilitate fisheries. These features, as well as being unsightly, make the river more dangerous and less suitable for kayaking. Many other Irish rivers have suffered a similar fate, the Liffey, the Erne, the Lee, the Dodder and the Boluisce to name but a few. Planning authorities thus need to consider Irish rivers not just for their economic potential from a hydroelectric viewpoint but also for their whitewater recreational value, and as environmental amenities valued by other outdoors enthusiasts such as fishermen, canoeists, hillwalkers and canyoneers. Although the value of hydro-power as a renewable energy source is recognized by many, efficient policy decisions impacting access to and the quality of Irish whitewater rivers require reliable estimates of consumer surplus values accruing to recreationists under a "conservation scenario".

[6] Prior to the completion of this study An Bord Pleanála refused planning permission (on appeal, since it was initially granted by Kerry county council – planning registration reference number: 3566/01) for development of a small hydro-power scheme, the design of which would have incorporated a river intake, pipeline and powerhouse building (at Morleys bridge) on the Roughty river. In its final decision it was deemed that "The Roughty River is an important salmonid habitat of considerable value in terms of fish spawning, angling and tourism. The proposed development would, therefore, seriously injure the amenities of the area and be contrary to the proper planning and development of the area." No mention was made in An Bord Pleanála written decision, to the value of the Roughty river as one of the best whitewater resources in the country.

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Figure 1. Distribution of Whitewater Recreation Trips to the Roughty River

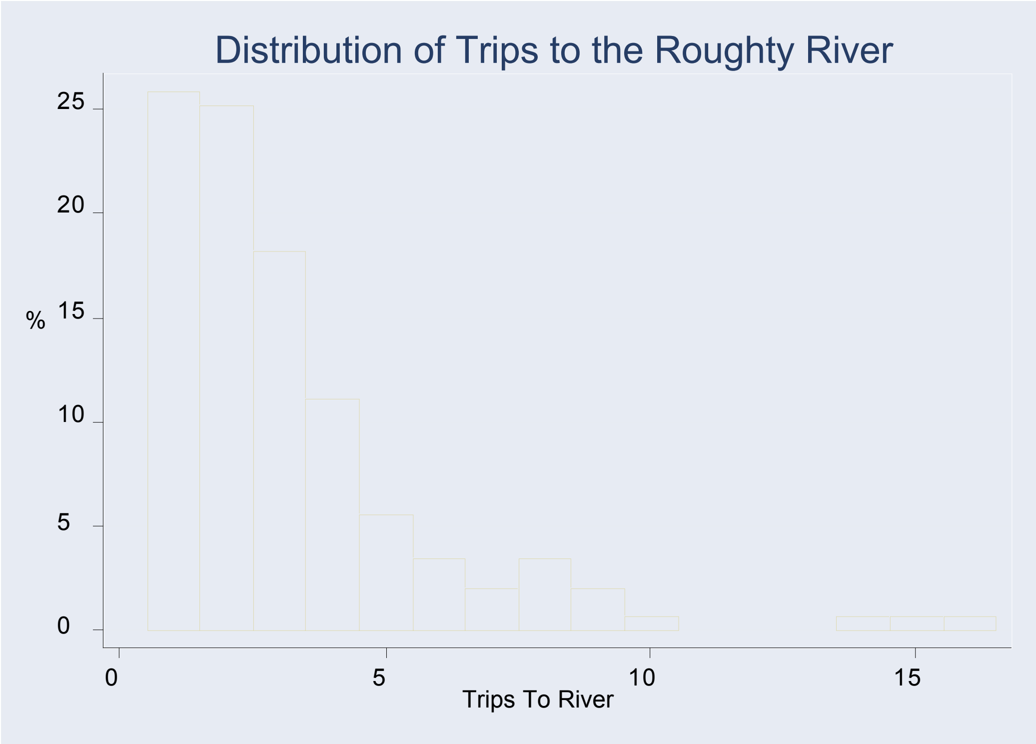

Table 1: The Number of Unspoilt Rivers per County with "Hydro-Power Potential" and the Number of these Rivers that are Classified as Two Star or Higher Whitewater Kayaking Rivers

COUNTY	NO. OF SUITABLE RIVERS	NO. OF THESE RIVERS IN WHITEWATER GUIDEBOOK	COUNTY	NO. OF SUITABLE RIVERS	NO. OF THESE RIVERS IN WHITEWATER GUIDEBOOK
CARLOW	9	2	LONGFORD	3	1
CAVAN	9	4	LOUTH	7	1
CLARE	5	2	MAYO	12	4
CORK	30	5	MEATH	12	3
DONEGAL	29	10	MONAGHAN	8	2
DUBLIN	8	3	OFFALY	5	2
GALWAY	8	5	ROSCOMMON	6	0
KERRY	31	17	SLIGO	11	5
KILDARE	5	2	TIPPERARY	12	3
KILKENNY	9	2	WATERFORD	6	2
LAOIS	5	2	WESTMEATH	5	1
LEITRIM	12	6	WEXFORD	10	1
LIMERICK	7	3	WICKLOW	9	7

Figures adapted from "Small-Scale Hydro-Electric Potential of Ireland", (1985) and "The Irish Whitewater Guidebook", (1996)

Table 2: Summary Statistics

Variable	Mean	Std.Dev	Min	Max
Annual Number of Trips to River	3.24	2.70	1	16
Distance Travelled from Home to River	138.37	79.27	15	350
Cost	69.19	39.64	7.5	175
Kayaking Proficiency Level	2.52	0.63	1	3
Discretionary Time (DT) Available	114.33	69.73	12	365
Age	26.00	5.54	16	41
Income	29335.66	23513.84	5000	85000
Experience	7.41	5.14	1	26
Importance of Activity	1.342	0.74	1	4

Definition of variables

Trips	Annual number of trips from home to the Roughty river (dependent variable).
Miles	Distance traveled from home to the river (one-way)
Cost	Cost of traveling (return journey) to the Roughty river (euros).
Income	Annual income (euros).
Proficiency	Individuals proficiency in handling a kayak, can be basic, intermediate or advanced.
DT	Kayaker's discretionary time available per year (days).
Experience	Kayaker's total number of years kayaking
Age	Age
Importance	Importance of kayaking when ranked against individuals other main interests. 2 indicated kayaking is 2nd most important activity, 3 indicates 3rd most important and 4 indicates that kayaking is just one of many outdoor recreational activities pursued by the respondent.

Table 3: Parameter Estimates for the Different Specifications

Parameter	Poisson	NB	Truncated Poisson	Truncated NB
Constant	0.583	0.298	0.2	0.199
	-1.26	-0.57	-0.32	-0.32
Income	0.00002	0.00002	0.00002	0.000003
	(2.23)*	(2.87)**	(2.37)*	(2.37)*
Travel Cost	-0.009	-0.011	-0.012	-0.012
	(5.75)**	(7.20)**	(5.65)**	(5.65)**
Discretionary Time Available	0.003	0.004	0.004	0.004
	(4.07)**	(5.21)**	(4.08)**	(4.08)**
Intermediate Proficiency	0.737	1.02	0.987	0.987
	(2.39)*	(2.61)**	(2.16)*	(2.16)*
Advanced Proficiency	0.838	1.126	1.093	1.093
	(2.46)*	(2.71)**	(2.21)*	(2.21)*
Importance of Activity to Individual	-0.1	-0.14	-0.195	-0.195
	-1.08	-1.42	-1.45	-1.45
Years of Experience	0.084	0.122	0.149	0.149
	-1.69	(2.27)*	(2.08)*	(2.08)*
Age	-0.018	-0.024	-0.026	-0.026
	-1.41	-1.86	-1.61	-1.61
Income Squared	0	0	0	0
	(2.22)*	(2.86)**	(2.30)*	(2.30)*
Years of Experience Squared	-0.003	-0.005	-0.007	-0.007
	-1.49	(2.06)*	-1.91	-1.91
α		0.096		0.242

Absolute value of z statistics in parenthesis.
** indicates significance at 5%
* indicates significance at 1%

For definition of variables, see Table 2.

NB stands for the Negative Binomial model. Notice that there are very little differences between the coefficients and the standard errors of the Poisson and Negative Binomial model and similarly between the coefficients and the standard errors of the Truncated Poisson and Truncated Negative Binomial model. Never the less the zero-truncated Negative Binomial model (last column in the table) is the best fit, displaying the lowest value for the maximum log-likelihood.

Appendix A.

Roughty River Kayaking Survey

Q1. Compared to your other outdoor recreational activities (such as hill-walking, mountain biking, surfing etc.) how would you comparatively rate kayaking?

1. Your most important outdoor activity
2. Your second most important outdoor activity
3. Your third most important outdoor activity
4. Only one of many outdoor activities

Q2. Would you describe your proficiency level in a kayak as:

1. Basic 2. Intermediate 3. Advanced

Q3. How many years have you been paddling for?

_____________ YEARS

Q4. In the past 12 months, including today, how many trips away from home to the Roughty river did you make for the specific purpose of Kayaking?

_____________ TRIPS

Q5. How many miles (one-way) did you travel from your home to the Roughty river to go kayaking?

_____________ MILES

Q6. About how long did it take you to get from your home to this river?

_____________ HOURS _____________ MINUTES

Q7. Approximately, how many days per year are you free from other obligations so that you may undertake whitewater recreation?

_____________ DAYS

Q8. Did you come to this area:

1. With the specific purpose of kayaking
2. On other business and kayaked because the opportunity arose

Q9. What is your age?

_____________ YEARS

Q10. Are you:

1. Male 2. Female

Q11. What is your approximate total income before taxes? (Circle one)

1.	Less than €10,000	4.	€30,000 - €49,999
2.	€10,000 - €19,999	5.	€50,000 - €74,999
3.	€20,000 - €29,999	6.	Over €75,000

Q12. Are you currently employed?

1. YES 2. NO

Q13. Are you:

1.	A Student	5.	Employed by a private firm
2.	A civil servant	6.	Self-employed
3.	Professional	7.	Housewife
4.	Other (Please state)		