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# Measuring the Opportunity Cost of Time in Recreation Demand Modelling: An Application to a Random Utility Model of Whitewater Kayaking in Ireland

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## Abstract

The treatment of the opportunity cost of travel time and the measurement of travel costs in recreational demand modelling has been a contentious issue for many decades. This paper demonstrates how a potential wage rate can be used in the measurement of the opportunity cost of travel (leisure) time in order to calculate the travel costs associated with a recreational activity. Most recreation demand studies use a fraction of the wage rate extracted from the gross income variable for the sample population, in calculating the opportunity cost of travel time and each individuals overall travel cost. However, we use each individuals potential hourly wage, as predicted by an earnings model from a secondary dataset, based upon that persons actual socio-economic characteristics. These travel cost estimates are then used in a multi-nomial logit random utility site choice model to calculate the demand for whitewater kayaking in Ireland. We also use the whitewater site choice models to estimate the welfare impacts of a number of different management scenarios.

**JEL Classication:**

**Keywords:** Whitewater kayaking, Random Utility Model, the opportunity cost of time, potential hourly wage.

# 1. Introduction

The treatment of travel cost and travel time in recreational demand modelling has been a contentious issue for many decades. The problems, which arise when dealing with the issue of time in recreation demand modelling, were first discussed by Clawson and Knetsch (1966). Ward and Loomis (1986) later emphasized the need for continued research on the valuation of travel time in order to evaluate the effects of different assumptions and to establish greater consensus on best practices. Shaw (1992) and Feather and Shaw (1999) also raised the question of the appropriate monetary value of leisure time. Eighteen years after Ward and Loomis's paper these same sentiments are still being expressed by Phaneuf and Smith (2004), who believe that "time, its opportunity costs, and its role in the demand for trips remain unresolved questions in recreation modeling". This paper provides an application of the RUM (discrete choice) model using data from a survey of kayaking trips to eleven different whitewater sites in Ireland and outlines a new method to calculate the opportunity cost of leisure time by utilising information from a secondary micro level data set, the European Community Household Panel (ECHP).

In Ireland, outdoor recreation activities are an important part of many people's daily lives. With its abundant amount of rainfall and mountainous terrain, there are numerous rivers and lakes that can be used for recreational pursuits. In addition to this, open access to almost all rivers (for navigation purposes), interesting scenery, excellent water quality and generally uncrowded rivers means that the sport of whitewater kayaking is one of those outdoor recreation activities that has become increasingly popular in Ireland. Figures from the Irish Canoe Union (ICU), the body that represents kayaking interests in Ireland, indicate that participation in kayak proficiency training courses has increased by an average of 15% year on year for the last 6 years and the present number of whitewater kayakers in Ireland is estimated to be 5000.[1]

[1] This figure includes 2500 individually registered members of the Irish Canoe Union 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.

Whitewater kayaking may be defined in terms of the equipment used. In nearly all cases it requires the use of a decked kayak, a paddle, a buoyancy aid, a helmet and some form of waterproof clothing. Whitewater kayaking involves negotiating ones way through whitewater rapids on a section of river. It could alternatively involve what is referred to as “park and play”; paddling at one particular site such as a play hole (e.g. Clifden) or a standing river wave (e.g. Curragower wave on the Shannon). A paper by Hynes and Hanley (2004), estimated the first whitewater kayaking demand function for an Irish river. Their results indicated the high value of the Roughty river in Co. Kerry as a whitewater recreational resource, even ignoring non-use values from preservation. They estimated a consumer surplus figure of €83.3 per kayaker per trip. A total consumer surplus figure of €0.589 million was calculated for the kayaking population using the Roughty river in Co. Kerry. Our current study builds on this previous work by expanding the number of whitewater sites under investigation and by also looking at the decision making process of the Irish kayaker when it comes to deciding which site to visit.

Rivers that may be kayaked in Ireland and Britain are classified by a five-grade system. This numerical grading system gives an idea of the technical difficulty of the rapids on the river or whitewater site. A grade of one indicates an easy run with occasional small rapids with regular and low waves whereas grade five indicates extremely difficult rapids with completely chaotic water making kayaking route choices completely academic. The kayaker’s reactive skills must be of the highest order. In this paper we are concerned with kayaking on moving water of grade two or above. It is worth noting however, that kayakers appreciation of a kayaking site extends beyond that of its grade or star rating to include aspects such as the scenic quality of the whitewater site and the degree of crowding on the water. As such, one may think of individual whitewater sites as different bundles of a given set of attributes. Taking these attributes into account, kayakers make choices from the set of all whitewater sites in Ireland in deciding on where to go on a particular kayaking trip. Given this fact, one obvious way to model this choice problem is to make use of random utility theory.

In the next section we review some of the arguments and methods used in the literature in regards to the measurement of the opportunity cost of time in travel cost studies. In section 3 we develop a formulation of the demand for a kayaking site’s services using a household production framework designed to consider the opportunity cost of time. Section 4 then describes the design of our survey and summarises some sample characteristics. In section 5 we review the empirical estimation process, with particular regard to the Random Utility Site Choice (RUSC) model and our treatment of travel cost. Model results are presented in section 6 while section 7 presents estimates of consumer surplus from whitewater recreation on Irish rivers and a discussion of the policy implications of our results. Finally, section 8 concludes with some recommendations for further research.

## 2. The treatment of travel cost and the opportunity cost of travel time

The standard method of calculating travel cost in recreational demand studies is to multiply the distance to the different sites with a per kilometer price, usually calculated on the basis of marginal vehicle operating costs, petrol price, etc. To this cost, a cost taking into account the opportunity cost of leisure time is added. Despite the difficulty of extrapolating the simple flexible leisure/work model[2] to many individuals in a recreation data set, the most common practice in the treatment of the opportunity cost of time (in recreational demand modelling) is to value it at the wage rate or some fraction thereof (Train, 1998). There has been and continues to be criticism of this wage-based approach (Smith et al., 1983, Shaw and Feather, 1999), as well as alternative suggestions (e.g. Bockstael et al., 1987 and Feather and Shaw, 1999), but little consensus on how this practice should be replaced.

For people in full time employment, most studies calculate an hourly wage using annual income. Reported annual income is then divided by the number of hours worked in a year, a number usually in the range of 2000 to 2080. Another approach is to calculate

[2] In theory, an individual increases the number of hours worked until the wage at the margin is equal to the value of an hour in leisure. Multiplying the hourly wage times travel time, in this case, is a fair estimate of the opportunity cost of time. Unfortunately, the simple leisure/work trade off does not apply to individuals working a fixed 35-hour week job for a salary. These individuals do not have the flexibility to shift time in and out of work in exchange for leisure. The tradeoff is also implausible for retired individuals, homemakers, students, and the unemployed. In this paper we make the assumption that all respondents are flexible in their work schedules.

respondents hourly wage using a simple wage regression over the subset of individuals in the sample earning an hourly wage (Smith, et. al. (1983)). In this case, the wage rate is regressed on income and a vector of individual characteristics such as age, gender, and education. The fitted regression is then simulated over non-wage earners to impute a wage[3]. As already mentioned, it is also common to see some fraction of the imputed wage used to value time, anywhere from 1/4 of the wage to the full wage. According to Feather and Shaw (1999), this practice stems from early transportation literature wherein analysts had imputed the time cost in empirical travel studies in this range.

Cesario (1976) is credited with first suggesting approximating the opportunity cost (value) of time as a fraction of an individuals wage rate. Despite the evident problems with so doing it remains, for practical reasons, the most popular approach. The appropriate fraction to choose is, as already mentioned the subject of much debate. Thirty-three percent has probably been the most often chosen (Coupal et al. (2001) and Englin and Cameron (1996), being just two examples). In other travel cost studies Benson and Willis (1992) and Garrod and Willis (1992) used 43% of the hourly wage rate in calculating the opportunity cost of time. This was the figure recommended by the British Department of Transport at the time. In other studies Hanley (1989) and Bateman *et al.* (1996) found that using 0% and 0·025% provided them with the 'best' fit for their data. Indeed, Ward and Beal (2000) also consider the use of 0% appropriate. They considered the opportunity cost of time to be irrelevant because individuals were assumed to travel for leisure and recreation during their holidays when there is no loss of income.

According to Parsons et al. (2003), the recreation demand literature has more or less accepted .25 as the lower bound and the full wage as the upper bound, but neither is really on firm footing. As an example, he cites Feather and Shaw (1999) who show that, in theory, for those on a fixed work schedule it is possible for the value of time to be greater than the wage. It should also be noted that there have been other approaches used that infer values of time from market data (Bockstael et al., 1987 and Feather and Shaw, 1999).

[3] This regression-based approach can also be found in a report by McConnell and Strand (1994). Here the authors demonstrate a methodology for estimating a factor of proportionality between the wage rate and the unit cost of time within the travel cost model.

Feather and Shaw (1999) estimate the shadow wage by using contingent behavior questions about respondents' willingness to work additional hours along with actual working decisions. The relationship between the wage and shadow wage is determined by categorizing each individual's work schedule. With flexible work schedules, hours are adjusted until the shadow wage is equal to the market wage. The relationship between the shadow and actual wages is then translated to a probability statement, and with contingent choice data, it is possible to use a maximum likelihood estimator to recover the structural parameters of the shadow wage equation. Feather and Shaw use predictions for each individual's hourly opportunity cost of time to construct the time cost component of prices to recreation sites.

Another study by Englin and Shonkwiler (1995) treat the various determinants of site visitation costs as components of a latent variable. The latent cost variable is estimated using distance converted to money travel costs, travel time, and the wages lost in travel as indicator variables. The approach uses factor analysis to estimate travel costs. Englin and Shonkwiler are one of the few in the literature to provide evidence empirically that using a fraction of the hourly wage (in their case 33%) may be appropriate in measuring the opportunity cost of time. Shaw (personal correspondence) uses this fact to point out that using the "fractional" wage rate is an ad hoc approach and recommends instead the use of the total hourly wage in calculating the opportunity cost of time.

Both Feather and Shaw's (1999) and Englin and Shonkwiler's (1995) approaches find results close to the simpler strategy of valuing the opportunity cost of time as some fraction of the average industrial wage. With Englin and Shonkwiler the estimates for opportunity cost of time are close to one-third of the wage rate. For Feather and Shaw the shadow values are closer to the market wage. However both of these approaches are hard to implement in the field. One of the main advantages of the approach we take in this study is the ease with which it can be implemented. Although, as can be seen from the review above, some progress has been made in estimating individual's opportunity costs of time, Phaneuf and Smith (2004) point out that we still lack a compelling replacement for the somewhat dubious strategies that dominate most recreation demand applications. In what follows we hope to provide a useful, more reliable framework that researchers can use in future travel cost studies to measure the opportunity cost of leisure time.

Our study adds to the literature by (i) outlining a new approach to measuring the opportunity cost of travel time that has a distinct advantage over the approaches used in most other travel cost studies in regards to its ease of implementation and (ii) by comparing two RUSC models which differ in their treatment of travel cost. The study is also the first application of the Random Utility Model to any outdoor recreation pursuit in Ireland. Finally, we use our models to produce estimates of welfare change that are of potential relevance to any policy-making that has an impact on whitewater kayaking sites in Ireland. In the next section we develop a formulation of the demand for a kayaking site's services using a household production framework designed to take into account the opportunity cost of time.

## 3. Theoretical Framework

The household production approach provides us with an appropriate microeconomic framework for analysing the allocation of time by recreational kayakers. This approach was first introduced by Gary Becker (1965). He postulated that the utility a household obtains is generated merely by commodities that are produced by combining market goods and "auxiliary" goods, with time in a household production function. The outputs of this production process are the utility generating commodities. The striking feature of the model is that a consumer's demand for market goods is a derived demand, in the same manner that firms have a derived demand for the factors of production. In what follows we extend the household production framework in order to model kayak recreation decisions. The model outlined below is based on the earlier work of Dekay and Smith (1977) and Smith et al. (1983).

To begin with, we introduce two groups of inputs into the kayaker production process that yield commodities. One group of inputs, denoted $I_k$, refers to a kayaking commodity (or what can be thought as the service flows of kayaking activity). Kayakers may utilise the inputs of time, market goods such as kayaking equipment, transport vehicles, petrol, etc. and the services of the river being visited in producing kayaking service flows. The quantities of market goods used in producing kayaking service flows are expressed by

$q = (q_1, q_2, q_3, ..., q_K)$. Each input alternative, $q$, is characterized by the pecuniary price $P_k$.

Another group of inputs consists of non-kayaking related consumption goods traded in markets. $I_c$ denotes this non-kayaking composite commodity. The quantities of these inputs are expressed by $x \equiv (x_1, x_2, x_3, ..., x_c)$. Each good is traded at the price $P_c$, and its consumption activity takes the time $t_c$. The consumption time, $t_k$, represents the time it takes, in hours, to get to and from the whitewater kayaking site[4]. Every kayaker is assumed to produce both the kayaking and composite types of commodities.

The production function of the kayaking commodity, denoted by $F_k$, is then expressed as:

$$I_k = F_k(q_k, t_k, S_k) \tag{1}$$

where $S_k$ is the characteristics of the kayaking site, such as scenery quality, water quality, level of crowding, star rating of the whitewater, etc. The production function of the composite commodity, denoted by $F_c$, is expressed as:

$$I_c = F_c(x_c, t_c) \tag{2}$$

A kayaker is assumed to be a utility maximiser satisfying the following three conditions:

1. The kayaker's utility is a function of commodity bundles $I_k$ and $I_c$, and is strictly concave and differentiable with respect to the quantities of $I_k$ and $I_c$ consumed.

$$U = U(I_k, I_c) \tag{3}$$

[4] In much of the travel cost literature $t_k$ is separated out into the components of travel time and on-site time (Smith et al.,1983, Shaw, 1992 and McConnell, 1992) but for our purposes we ignore the latter and concentrate solely on travel time. Having said this the general conclusions of our theoretical framework would still be applicable if the analysis was extended to include on-site time.

2. The commodity bundles consumed are produced under constraints on monetary income and available time. The constraint for the pecuniary income is:

$$\sum_k P_k q_k + \sum_c P_c x_c = M_0 = A + wT_w \tag{4}$$

where $M_0$ is monetary income, $A$ is non-labor income, $w$ is the net wage rate, and $T_w$ is working time. In order to simplify matters we will assume that non-labour income is zero (also no information was collected in our kayaker dataset in relation to unearned income). Therefore:

$$\sum_k P_k q_k + \sum_c P_c x_c = M_0 = wT_w \tag{5}$$

The constraint for the available time is:

$$T_A = \sum_k t_k q_k + \sum_c t_c x_c = T_o - T_w \tag{6}$$

where $T_o$ refers to total time available for all activities. For example, $T_o$ is 24 hours, if the period is 1 day and only one kayaker is involved. Typically $T_o$ discounts sleep and eating hours, so is about 100 hours per week.

3. The kayaker makes earnings at the wage rate $w$ without any binding constraint on working hours $T_w$. This assumption ensures that the marginal value of time is equal to the wage rate.

We now formulate the choice decision problem of a kayaker in terms of the Lagrangian, denoted by:

$$
\begin{aligned}
L_0 \equiv \max U(I_k, I_c) + \lambda_1 (wT_w - \sum_k P_k q_k - \sum_c P_c x_c) \\
+ \phi_1 (I_k - F_k(q_k, t_k, S_k) + \phi_2 (I_c - F_c(x_c, t_c)) \\
+ \lambda_2 (T_o - T_w - \sum_k t_k q_k - \sum_c t_c x_c)
\end{aligned}
\tag{7}
$$

where $\lambda = (\lambda_1, \lambda_2)$ and $\phi = (\phi_1, \phi_2)$ are non-negative Lagrange multipliers.

By condition 3, the working hour, $T_w$, is an independent decision variable for our kayaker. With respect to this variable, the first order condition of the kayaker's lagrangian maximization problem yields $w\lambda_1 = \lambda_2$. Therefore, we can merge the two constraints in equations (5) and (6) into one equation:

$$
\sum_k (p_k + wt_k) q_k + \sum_c (p_c + wt_c) x_c = \sum_k mc_k q_k + \sum_c mc_c x_c = wT_w \tag{8}
$$

The assumption that the marginal value of time spent kayaking or consuming goods is linearly proportional to the wage rate *w,* and the modified constraint of equation 8 implies the relationships in equations (9) and (10). Accordingly, the marginal price of a kayaking trip, $mc_k$, to whitewater site *i* is:

$$
mc_k = p_k + wt_k \tag{9}
$$

Similarly, the marginal price, $mc_c$, of a composite good, *c*, is:

$$
mc_c = p_c + wt_c \tag{10}
$$

Equation 9 illustrates that there are two major components that contribute to the cost of a kayaking excursion. Firstly, there is the monetary (marginal) cost of consumption of kayaking related products for the whitewater trip; the main ones being the vehicle-related travel costs (i.e. petrol for the trip, operating costs of the vehicle, etc). Secondly, there is the opportunity cost of travel time, which is proportional to the wage rate *w.* Our model suggests that an empirically desirable approach for the treatment of travel costs is to use each individuals actual hourly wage rate as the appropriate measure of the opportunity cost of leisure time within the travel cost calculation rather than a fraction thereof. In fact, we would argue that this may even be a lower bound estimate of the true opportunity cost of time. In a world of incentive-based pay structures such as overtime, piece-work and performance related pay regimes an individuals opportunity cost of time may actually be higher than his or her basic net hourly wage[5]. For those individuals who work a basic number of hours per week and who have the choice of working additional hours at a higher rate of pay due to an incentive based pay system, the opportunity cost of leisure time will in fact be greater than their average wage rate (or what we will be referring to as their potential wage rate), $w$. Estimating this wage rate from a secondary data source is one key element of the empirical work reported below.

In much of the travel cost literature the average wage is taken as the upper bound estimate of the opportunity cost of time. We argue that the use of the "fractional" wage may be underestimating the true opportunity cost of leisure time. The "fractional" wage method may have been appropriate in the seventies and eighties but the movement towards incentive based pay structures in the past two decades means that this is no longer the case. This is particularly true for a country such as Ireland where incentive based pay schemes have recently gained in popularity due to a rapidly changing economic environment under globalisation, a tight labour market and the high influx of foreign direct investment in the sectors of electronics and pharmaceuticals. The possibility that the wage rate may be a lower (rather than an upper) bound estimate of the opportunity cost of travel time is an issue that has not been considered in the literature up until this point. Only Feather and Shaw (1999) highlight the possibility that the value of time may be greater than the wage for those individuals on a fixed work schedule.

## 4. Study design and sample characteristics

The initial steps in this study were to identify the choice sets and their relevant attributes. To accomplish this, focus groups were conducted with kayakers from the university kayak club in Galway and a second group consisting of 7 kayakers who had no

[5] It is apparent that the use of incentive programs is becoming more commonplace. The National Association of Manufacturers in America surveyed 4,500 companies examining skill level of workers and common human resource practices. They found that 54% of these companies offered some type of bonus plan and another 35% offered some type of gainsharing or pay for performance program (Micco, 1997).

affiliations with any particular kayak club[6]. Discussions with the Irish Canoe Union (ICU), and the experience of one of the authors (Hynes) with kayaking, also helped in this process. Eleven principal whitewater sites were identified. These were; the Liffey, Clifden Play Hole, Curragower wave on the Shannon, the Boyne, the Roughty, the Clare Glens, the Annamoe, the Barrow, the Dargle, the Inny and the Boluisce.

In regards to the site attributes we had to decide whether to use a subjective or an objective measure of each characteristic. Objective measures value characteristics using external sources of data whereas subjective measures allow the respondent themselves to place a value on the attributes of each alternative site. Following the approach adopted by Hanley et al. (2001) we use the respondents perceived or subjective measure for all attributes other than travel cost. This approach is in contrast to that used in much of the random utility literature where attribute measures are sourced externally from the respondents. For example, Parsons and Massey (2003) use a variety of external data sources such as travel guides, field trips, interviews with resource managers and geological maps to compile a dataset of characteristics in relation to 62 beaches in the mid-Atlantic region of the USA. However, we assume most kayakers have, through personal experience, a good knowledge of major whitewater kayaking sites and therefore allow them to use their own judgment to rank each alternative site in terms of the following attributes:

- Average quality of parking at the site (measured on a Likert scale, from 1 to 5 where 1 indicates poor safety and quality of parking to 5 indicating excellent safety and quality of parking).
- Average crowding at the paddling site which indicates how many other kayakers are expected on the water where and when the respondent is paddling (measured on a Likert scale, from 1 to 5 where 1 means very crowded to 5 meaning uncrowded).
- Average quality of the kayaking site as measured by the star rating system used in The Irish Whitewater Guidebook (where no stars is the lowest quality and 3 stars is the highest).

[6] Much of the kayaking population in Ireland are not affiliated with any particular club. Individuals have their own equipment and paddle rivers in groups of three or four. As such, it was felt necessary to get the opinions of non-club affiliated kayakers as well as club affiliated ones.

- Average quality of the water (measured on a Likert scale, from 1 to 5 where 1 means extremely polluted to 5 meaning unpolluted).
- Scenic quality of the kayaking site (measured on a Likert scale, from 1 to 5 where 1 means not at all scenic to 5 meaning very scenic).
- Reliability of Water Information (measured on a Likert scale, from 1 to 5 where 1 indicates that before visiting the site, a kayaker is completely unsure of the water level at the site and 5 indicates that the kayaker has no uncertainty about water level at the site prior to the commencement of the journey).
- Number of other kayaking sites within 10 miles proximity of this site (measuredon a Likert scale, from 1 to 5, where 1 is none and 5 is many)[7].
- Travel Distance to whitewater site (measured in miles).
- Travel Time (minutes taken to get from home to whitewater site).

The sampling frame was provided by two Irish kayaker email lists obtained from the Outdoor Adventure Store (one of the main kayak equipment outlet stores in Ireland) and the Irish kayaking instruction company, H2O Extreme. A random sample of these email addresses was selected, and questionnaires were emailed to these individuals, who were asked to complete and return the questionnaire via email. As an incentive to get people to return the questionnaires a raffle was organized with €500 worth of kayaking equipment as prizes. Everyone who returned a completed questionnaire had their names entered into the draw. To widen the sample in terms of representativeness and increase the number of completed surveys, the questionnaire was also posted up on the homepage of the Irish Canoe Union website (www.irishcanoeunion.com) and administered at an organized kayaking meet on the Liffey river in January 2004. A sample of 279 useable responses from kayakers was eventually acquired.

The survey instrument included questions about the frequency and costs of kayaking trips to the 11 different kayaking sites. Specifically, respondents were asked how many paddling trips they had taken in the previous 12 months to each of the 11 areas; to score each area in terms of the 9 attributes used; to provide a ranking of attributes; to provide

[7] This attribute was not included in the final estimation as it was assumed that the value of other sites near by was already captured in the RUM model through the travel cost variable and the site dummy variables.

information on spending related to kayaking and to provide information on their kayaking abilities and experience. Other questions that were asked in the questionnaire, that were important for the analysis in this paper related to standard socio-economic information such as before tax income levels, employment status, age, etc. Respondents were also asked to indicate what their main occupation was, if they were not currently in full time education. All this socio-economic information allowed us to estimate a potential hourly wage rate for each respondent, using data on the Irish labour force from the European Community Household Panel dataset (ECHP). The ECHP is a comparative household panel data set covering European Union Member States. It contains sampled micro-data at individual and household level. The survey includes information on personal demographics, income, employment status, education, health, social relations, migration and satisfaction. In addition, at the household level it contains information on the financial situation of the household, accommodation, durables and children. The ECHP is a household-level survey and therefore collects information on all members of responding households.

The data set for Ireland extracted from the ECHP and used to estimate a potential hourly wage rate for our survey respondents consists of 2090 individuals for the year 1999. The hourly earning figures in the ECHP for this year have been adjusted to 2003 earnings using the Central Statistics Office (CSO) Irish industrial earnings index. The estimation procedure for the potential hourly wage rate and how it is then used in estimating travel costs to the whitewater sites in our survey will be expanded upon in the next section.

### 4.1 Descriptive statistics for the sample

Some 43% of all kayakers questioned were in the 16-25 years age bracket, which was the largest percentage of any of the age groups. 37% and 9% of the kayakers were in the age brackets 25-35 years and 35-45 years respectively. Only 3% of the kayakers questioned were aged over 45 years. The majority of responded were male (78%). 70% of the sample were single, whilst 13% of those interviewed had children. The majority of kayakers (75%) were either degree/diploma holders or were presently attending a third level institution, while 23% had left the education system on completion of secondary level. The mean income before tax was €27,634[8].

Over 44% of kayakers had been paddling for 5 years or less, with another 15% and 19% indicating they had been kayaking for between 5 and 10 years and between 10 and 20 years respectively. Overall respondents had been kayaking for a minimum of 0.5 years, a maximum of 36 years with the mean at 7.4 years. In terms of participation, 39% of all respondents completed 20 kayaking trips or less in a year, with the next largest group being 23% of respondents, completing from 30 to 50 kayaking trips in the year. Overall the mean number of kayaking trips completed in the previous year was 38, with the median at 26. Table 1 gives a picture of kayaking activity during the 12 months prior to the completion of the survey. Kayakers were also asked how many of a sample of the eleven key Irish kayaking sites they had visited at any time in the past. As indicated in Table 2, the kayaking site visited by most respondents at some point in the past was the river Liffey, followed by the Boyne, the Annamoe and then Curragower wave on the Shannon. The Barrow and the Dargle were the two least visited sites with only 36% of respondents having visiting either at any time in the past.

Respondents, as mentioned above, were also asked both to (i) rank attributes in terms of importance; and (ii) score each of the 11 whitewater kayaking sites on these attributes. The relevant information is given in Tables 3-5. As indicated in table 3, the majority (60%) of respondents ranked the star rating of the whitewater site as the most important attribute. Scenic quality of the kayaking site was ranked the least important attribute by 32% of respondents. Many respondents identified further factors, which they considered important. These included, the weather and the personality, skill and experience of the people they were kayaking with. Remoteness of the whitewater site and the kayaking experience was also a plus factor for many respondents. Tables 4 and 5 give the mean attribute scores by whitewater site. Finally, table 6 outlines respondents' personal expenditure on kayaking over the previous 12 months. The high proportion of expenditure that is spent on travel cost (petrol expenses), food, accommodation and socialising in the area of the whitewater sites is an indication of the economic

[8] This figure includes average student income of €5000

contribution that is made by the Irish kayaking community in what is usually rural, sparsely populated areas.

## 5. The estimation of the opportunity cost of travel time and RUM methodology

In the papers discussed in section 2, the main interest was with how to best estimate the opportunity cost of time. What is of concern to us in this paper is, firstly, to develop an appropriate method to calculate the wage rate of those labour force participants in our sample so that we can then calculate the true opportunity cost of leisure time. We make the standard assumption of the human capital literature that the opportunity cost of other activities is the marginal wage rate. By estimating a wage rate for each respondent using a large panel data set of individuals in the Irish labour market we are highlighting the fact that instead of participating in the recreational activity of kayaking our respondents could be working in the job they already have or alternatively they could be doing alternative work suitable to their occupation, education, age, etc. We take this into account by using a potential hourly wage figure for each respondent (rather than his or her hourly wage derived from gross earnings) in the calculation of each kayakers opportunity cost of time.

Simply using a derived hourly wage calculated from respondents' gross earnings does not take into account individuals unique circumstances or the fact that different individuals work different hours and could potentially work in alternative employment during their free time. In addition, using this derived hourly wage only supplies a potential wage rate for those respondents in an employed state. Respondents who are in full-time education but who could potentially work part-time and respondents who are not in education but still working part-time are not supplied with potential wage rates using this method[9]. Because (a) individuals are reluctant to respond to questions about pay in surveys of this kind, (b) because they tend to mis-report the pay they receive and the hours they work, (c) because they tend not to report the "true" opportunity cost of pay which may include bonus and other types of payment methods and (d) to predict potential hourly pay for those who are not in work such as students or unemployed, we prefer to utilise externally

[9] Dividing the gross earnings of part-time workers by 2000 hours or some similar figure will greatly underestimate these individuals' hourly wage rates.

estimated hourly wage variables from a dedicated income survey, which relies upon pay slip information, in this case the European Community Household Panel Survey.

Also, since the use of environmental services such as kayaking on a river or hill walking are considered luxury goods we would expect those individual from the labour force who participate in these outdoor activities to be on higher income. Indeed, for our sample of kayakers, those who declared themselves “employed” had an average gross income of €39,827 compared to the average Irish annual industrial wage of €29,574[10]. Dividing respondents annual wage rate by 2000 or some similar figure, as is done in much of the literature, may therefore underestimate the true hourly wage rate of respondents. This will have the effect of underestimating the size of the opportunity cost of time no matter what technique the researcher uses to calculate it. Also, survey respondents cannot be asked directly what their hourly wage rate is as those on a salary would have very little idea. By using a potential hourly wage for each respondent predicted with an earnings model from a secondary dataset of the general Irish labour force and based upon each respondent’s actual socio-economic characteristics we hope to demonstrate that the wage estimates used in our model is a truer reflection of each respondent’s actual opportunity cost of time.

In this paper, a potential hourly wage function (equation 18) was estimated from the Irish ECHP panel dataset. A Mincerian earnings equation was derived and estimated with the log of the net hourly wage rate as the dependent variable and schooling dummies, occupation dummies, experience, experience squared, a public sector worker dummy and a region dummy as explanatory variables. The results of this estimation process can be found in table 7. We estimate four hourly wage functions, one for full-time men, one for full-time women, one for men who are working part time but are in full-time education and finally one for women who are also working part time but are in full-time education.

The wage equation we use is based on Mincer’s (1974) earnings function. The study of the effects of investment in schooling and on-the-job training on the level, pattern and interpersonal distribution of life-cycle earnings was first pioneered by Becker (1964) and

[10] This average Irish industrial earnings figure for 2003 and was taken from the Irish Central Statistics Office (CSO) website http://www.cso.ie/schools/earnings.html.

Mincer (1962). The Mincer equation captures four important empirical regularities. The first is that earnings increase with schooling. Secondly, there is concavity of log earnings in experience. Thirdly, there is parallelism in log earnings experiences profiles for different education groups (ratio of earnings for persons with education levels differing by a fixed number of years is roughly constant across schooling levels) and fourthly there is U-shaped interpersonal variance in earnings. Following Mincer's example we use an Experience variable that is equal to Age minus Schooling minus 5, (E=A-S-5), to capture the interaction between schooling and experience. Since the ECHP is a panel dataset that follows the same individuals over time we fit a random effects cross-sectional time-series regression model. Our potential wage equation is therefore as follows:

$$\begin{aligned}\ln w_{it} &= \beta_0 + \beta_1 Univ_{it} + \beta_2 up\sec_{it} + \beta_3 E_{it} + \beta_4 E_{it}^2 + \\ &\beta_5 Occ_{it} + \beta_6 Year_{it} + \beta_7 Public_{it} + \beta_8 \operatorname{Re}gion + \mu_i + \upsilon_{it},\end{aligned} \tag{11}$$

where $\ln w_{it}$ is the log of the hourly wage for individual *i* in year *t*, *Univ* is a dummy variable indicating individual is a university graduate, *Upsec* is a dummy variable indicating individuals highest level of educational achievement is upper secondary level, $E$ is experience, $E^2$ is experience squared, O*cc* is an occupational dummy, *Year* is a dummy variable indicating the years in our ECHP dataset, *Public* is a dummy variable indicating individual is a public sector worker, region indicates where in Ireland the individual is from and $\varepsilon$ is a random error reflecting unmeasured factors that affect *w*. In our Random Effects wage model, $\varepsilon$ is made up of two parts, the component $\mu_i$ is the random disturbance characterising the ith individual and is constant through time (called the permanent effect). $\upsilon_{it}$ is the random component that varies both across individuals and across time (called the transitory effect). When we use equation 11 to predict hourly wages for our sample of kayakers the coefficients for all the year dummies, are set to 0 as our kayaking dataset is a cross-sectional dataset for 2003. The wage rate for all years in the ECHP have been adjusted to reflect 2003 prices using the average industrial hourly wage index from the Irish Central Statistics Office (http://www.cso.ie/schools/earnings.html).

Almost all empirical studies find that schooling has a positive and significant effect on earnings. We would therefore expect to find $\beta_1 > 0$ and $\beta_2 > 0$. We would also expect that earnings are a concave function of labour market experience (i.e. $\beta_3 > 0$ and $\beta_4 < 0$). As already stated our wage equation includes a dummy variable for occupation. This could pose the problem of endogeneity if we were trying to use our wage equation to explain the variation in the wage rate for our sample. Statistical endogeneity of occupation in the wage function may result from (1) unobserved determinants of occupation that also influence wages and/or (2) measurement error. However, since we are only concerned with predicting a potential wage rate for our sample of kayakers and not the explanation of the variation in their earnings, the inclusion of the occupation dummies as explanatory variables is not seen to be a problem. In any case the schooling variables are more likely to be endogenous than the occupational variable. Because of the significance of the unobserved effects (as found by using the Breusch-Pagan Lagrange Multiplier Test ) we chose the random effects model over the pooled cross-section model. Although our random effects model is rejected by the Hausmann test, we still choose to use the random effects model rather than the fixed effects model as we wish to predict earnings for another sample.

In the literature, the opportunity cost of travel time is usually assumed to be a fixed proportion, $\omega$, of an individuals predicted potential hourly wage. Clear guidance does not exist for choosing a value of $\omega$, though, as already mentioned, other studies have used values in the range of 0.25 (Needelman and Kealy, 1995) to 0.333 (Loomis etal.,1995). Lower values of $\omega$ tend to give more conservative estimates of the value of a site. However, having reviewed the criticisms of this approach in the literature and the already discussed impacts of incentive based pay structures we use the full wage rate rather than a fraction thereof, for this study. Once we have calculated the opportunity cost of leisure time, the total travel cost is then calculated by:

$$TC_{ij} = ((2^* (\text{distance} * €0.25))/2.3) + ((\text{travel time}/60) * HW_i) \quad (12)$$

Where $TC_{ij}$ is the travel cost of kayaker i to whitewater site j and $HW_i$ is the predicted potential hourly wage rate of kayaker i. In calculating the travel cost to each whitewater site 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[11]. It is usual for the petrol expenses of a kayaking trip to be divided amongst all the participating passengers in the vehicle traveling to the whitewater site. In a recent poll looking at river usage in Ireland carried out on the internet site, www.irishfreestyle.com, online users were asked how many kayakers travelled in the vehicle they were in, on the last river trip they were on. It was found that the average number of kayakers per vehicle was 2.3 individuals. A similar figure of 2.5 individuals per vehicle was used in another travel cost study that looked at kayaking on the Gauley river in West Virginia (Ready and Kemlage, 1998). Given this finding we divide the round trip petrol expense portion of equation 12 by 2.3 making the assumption that kayakers share the petrol cost of a kayaking excursion. To the extent that this estimate is too high (low), the per-trip consumer surplus will be underestimated (overestimated).

Our approach to measuring the opportunity cost of travel time has a distinct advantage over most other travel cost studies. Whereas these other studies simply use a fractional wage rate extracted from the gross income variable for the sample population in calculating the opportunity cost of travel time (see for example Cesario and Knetsch, 1976 and Loomis et al., 1995) we use each individuals potential hourly wage as predicted by our earnings model from the ECHP dataset and based upon that persons actual socio-economic characteristics. This should give a much better indication of the true opportunity cost facing each and every kayaker in our sample when they are deciding on which whitewater site to visit. Also since large panel data sets with excellent labour market information have become much more available in recent times, our approach can be replicated in recreation travel cost studies for almost any site in all developed (and some less developed) countries[12].

[11] Due to the fact that the distance variable in our dataset is only for the "one way trip to the river or whitewater feature" we multiply by the number 2 to take account of the fact that the kayaker makes a return journey from his or her place of origin and the costs associated with this return journey are what influence the choice of site to kayak at.

[12] The ECHP dataset contains data on individuals in twelve member states: Germany, Denmark, Belgium, the Netherlands, Luxembourg, the UK, France, Ireland, Italy, Greece, Spain and Portugal. Other countries have joined the survey since 1994: Austria in 1995, Finland in 1996 and Sweden in 1997. Also, Britain have the New Earning Survey and the British Household Panel Study. In Germany they also have the German Socio-Economic Panel, Canada has the Statistics Canada Tax Database maintained by Revenue Canada and in the United States they have numerous panel datasets, one such being the US Study of Income Dynamics started in 1968.

Following the calculation of the opportunity cost of time, the next stage of our analysis involves modeling the kayaker's decision-making process in terms of choices over alternative, substitute whitewater sites. The valuation of the recreational use of an environmental amenity attempts to estimate the economic value, in monetary terms, that members of society receive from uses of natural resources that cannot be efficiently allocated through markets due to their public good characteristics such as being nonrival (one person's use of a river system to kayak on does not diminish another kayakers's use of the same river[13]) and nonexcludable (once water quality is improved for one kayaker at a particular kayaking site, another kayaker cannot be precluded from enjoying this same improved level of water quality). Yet kayaking or canoeing in a river of improved water quality should provide an economic benefit to the kayaker even if a formal market does not exist. It is a benefit for which they would, if they had to, pay some monetary amount, perhaps a riverside parking fee or a kayak launch fee. The fact that they do not have to pay (in most cases) anything, results in the kayaker retaining a ''consumer surplus'' as extra income (Loomis, 2000).

In this paper, we use the Random Utility Site Choice (RUSC) or Random Utility Model (RUM) approach first put forward by Bockstael et al. (1986) and later developed by Yen and Adamowicz (1994) to model kayakers' decision-making process in terms of choices over alternative, substitute whitewater sites. Modeling recreation demand with random utility models (RUM) assumes site selections are made for each choice occasion independently. Choice occasions are single days or weekends. Because this structure is held constant across individuals, neither past history nor future prospects are relevant for models of site decisions. As Smith (1997) points out this has resulted in little attention being given to time constraints in RUM. Of course, using the RUM methodology does not limit the effects of time on actual behavior. Which site to visit on any one choice occasion still involves considering ones opportunity cost of travel time.

[13] Even though it is true to say that a kayakers use of a river is, in general, non-rival in consumption, it could be argued that kayaking at a "park and play" site is rival in consumption as large queues of kayakers waiting to get on the wave or into the play hole may diminish a kayakers utility level. Also, if remoteness is something that acts positively on an individual's utility function then extra kayakers on the water may lessen this aspect of the kayaking experience.

The RUM approach models the choice of a recreation site from among a set of alternative sites as a utility-maximizing decision, where utility includes a stochastic component. RUM models emphasize the impact of site quality on recreation demand and are typically estimated using either multinomial, nested logit or random parameter models (Train, 1998). Examples include Hanley et al. (2001) for rock climbing and Kaoru and Smith (1995) for saltwater fishing. The main idea of the RUM model is that the consumer chooses from a number of alternatives (e.g. whitewater sites) and picks the one that yields the highest utility level on any given choice ocassion. Just like consumer theory assumes that the consumer is rational so does discrete choice theory, the theory on which the RUM model is based (Ben-Akiva and Lerman, 1985). Even though it is possible to derive a demand function from the utility maximisation problem when choices are discrete (Anderson et al., 1989), discrete choice theory usually implies working directly with the indirect utility functions. The basic choice model for our kayaker is given by:

$$U_i = V_i(X_i, y - p_i) + \varepsilon_i \tag{13}$$

$U_i$ is the indirect utility from visiting whitewater site *i*. $V_i(.)$ is the deterministic part of the indirect utility function and $\varepsilon_i$ is the stochastic part. $X_i$ is a vector of site attributes, y is income and $p_i$ is travel cost. Whenever the utility from visiting site *i* is greater than the utility from visiting all other sites *k*, site *i* will be chosen, i.e. if

$$V_i(X_i, y - p_i) + \varepsilon_i \geq V_k(X_k, y - p_k) + \varepsilon_k \quad \forall k \tag{14}$$

then site *i* will be chosen. The RUM model just described is a utility maximization model attributable to McFadden (1974). Randomness occurs due to omission of explanatory variables, random preferences and errors in measuring the dependent variable. The individual is believed to know her preferences but from the point of view of the investigator, preferences are random variables. The RUM model can be specified in different ways depending on the distribution of the error term. If the error terms are independently and identically drawn from an extreme value distribution, the RUM model is specified as multinomial (conditional) logit (McFadden, 1974). This implies that the probability of choosing site i is given by:

$$pr_i = \frac{\exp(V_i)}{\sum_{k=1}^{N} \exp(V_k)} \tag{15}$$

where $pr_i$ is the probability that site i is chosen. If $V_i$ is written as $V_i = \beta X_i$, where $X_i$ is a vector of characteristics of whitewater site *i* (parking quality, crowding, star rating, water quality, scenic quality, water reliability and travel costs) and $\beta$ is the associated parameter vector, then the conditional logit model can be expressed as:

$$pr_i = \frac{\exp(\beta X_i)}{\sum_{k=1}^{N} \exp(\beta X_k)} \tag{16}$$

The decision to visit a recreational site, among a number of alternative sites, is mutually exclusive on every choice occasion. Therefore choices can be regarded as discrete, i.e. the dependent variable takes the value 1 (if a site is chosen) or 0 (otherwise). The model is estimated by the method of maximum likelihood. Given the characteristics of the whitewater sites available as options to the kayaker, the model estimates coefficients that maximise the likelihood that we would observe the actual site choices of our sample of kayakers. Once we have these coefficients, we can estimate the probability of a kayaker choosing any given whitewater kayaking site.

The conditional logit model is restricted by the independence of irrelevant alternatives (IIA) assumption (Luce, 1959). IIA assumes that the ratio of probabilities of choosing any set of alternatives remains constant no matter what happens in the remainder of the choice set. The IIA assumption implies that the errors in estimating utility across alternatives are un-correlated. When groups of sites (alternatives) share similar characteristics the IIA assumption is not realistic. The nested multinomial logit model could be used in this case as it allows sites that are similar to form into separate groups (Morey, Rowe and Watson, 1993). Within each group, or nest level, the IIA assumption applies. It does not however apply across nest levels. The error terms in the nested logit model come from a generalised extreme value distribution. The standard conditional logit model is used in this study to estimate recreational benefits, mainly because no obvious division of groups could be found for our 11 chosen whitewater sites (see section 5 for IIA test results).

The underlying utility theory allows computation of per trip welfare estimates. Small and Rosen (1981) as well as Hanemann (1982) have described how welfare measures can be obtained from discrete choice models, when the marginal utility of income is assumed constant. Hausmann (1982) used expected utility (V) to estimate the compensating variation associated with a change in prices or quality attributes associated with choices. Thus, measuring a change in welfare associated with a change in some quality attribute in the indirect utility function involves estimating the amount individuals must be compensated to remain at the same utility level as before the change. When there are multiple alternative sites to choose from, the welfare measure involves the expected value (the utility for each alternative times the probability of choosing each alternative) of utility arising from the multiple alternatives. The expected value of the base case is then compared to the expected value of the changed case and the difference is multiplied by 1 over the marginal utility of income to convert the utility difference into a monetary value. Consider a change in the characteristic *b* of whitewater site *i*. The associated change in the consumer surplus per kayaker per trip as measured by compensating variation (CV) can be expressed as:

$$V_i(p_i, b_i^1, y - CV) = V_i(p_i, b_i^0) \tag{17}$$

where the superscript 0 (1) denotes the initial (final) level of characteristic *b*. In the case of a quality improvement, CV is the maximum willingness to pay for the change occurring. The expression for CV is based on the actual utility from visiting site i. The inclusive value index captures the expected utility from visiting the site.

$$IV = \ln\left\lfloor \sum \exp(V_i) \right\rfloor \tag{18}$$

The change in trip utility is converted to money terms by dividing *IV* by the negative of the coefficient on trip cost, $\beta_m$. $\beta_m$ tells us how much a kayaker's site utility would increase if trip cost were to decline for that trip. When the marginal utility of income is constant, the following expression gives a valid measure of the compensating variation

(CV) for a change in the characteristics or attributes of one or several of the whitewater sites:

$$CV = -1/\beta_m \left\lfloor \ln\left\lfloor \sum \exp(V_i^1(b_i^1)) \right\rfloor - \ln\left\lfloor \sum \exp(V_i^0(b_i^0)) \right\rfloor \right\rfloor \quad (19)$$

The above expression can be interpreted as the expected CV for a choice occasion, i.e. the CV for taking a whitewater kayaking trip after a change has occurred in the underlying attributes. In application, we use an expected value for the change in trip utility because its actual value is random and unknown to the researcher. Hanemann (1984) has shown that the marginal utility of income, $\beta_m$ is equal to the negative of the coefficient of travel cost for a linear in income travel cost model. Thus, the estimated coefficient for travel cost can be used in the calculation of CV. The relative value of each of the expected utilities (V), when different levels of the attributes are included, gives an estimate of the support that each attribute would generate. In a political context, policy makers could use the calculated change in consumer surplus as measured in equation 19 to predict the kayaking community's support generated by different policy options. Some of the potential policy options in regards to Irish whitewater kayaking are discussed in section 7. In section 6 we present results of our wage estimation procedure and compare two RUM models, one where the opportunity cost of time is not included in the travel cost calculation and one where the opportunity cost of time is included and calculated as outlined above using our secondary dataset and the potential hourly wage.

## 6. Model estimation and results

Table 7 contains the results of our estimated Random Effects wage equations (which uses a generalized least squares estimator) from the ECHP dataset. For comparison purposes we also estimate a fixed effect (using the within regression estimator), a pooled cross-sectional and a first differenced wage equation (see appendix A). On the whole the Random Effects and the pooled cross-sectional models provide results that are much more significant that either the fixed effect or first differenced models. Indeed, the later two models have goodness of fit statistics ranging only between 4 and 11%. Also, the coefficients in these later two models are mostly insignificant, the worst example being in the female student first-differenced wage equation where only 4 variables have coeficients that are significant at the 5% level.

These low $R^2$ values and insignificant variables in the first differenced model occur due to the fact that the time-invariant variables (such as education level and occupation) have been almost completely differenced out along with the fixed effects. These variables do not fall out of the equations completely due to a small amount of transitions between education levels, occupations, etc. over the lifespan of the ECHP panel. In any case a fixed effect modelling approach is not deemed suitable for our ECHP dataset. When your data contains all existing cross-sectional units (for example a specific set of $N$ firms or a set of $N$ Irish counties), one finds that the fixed effect model works best but where one has a limited sample of the existing cross-sectional units (as is the case with the ECHP dataset for Ireland, where we have data on the behaviour of a few thousand individuals over time – where these are only a few of the thousands of individuals in the Irish population), the random effects model works best.

The pooled cross-sectional model provides results that are broadly similar to our chosen Random Effects model and even provide a marginally higher $R^2$. Having said that, the OLS regression estimates, when they are applied to pooled data, are likely to be biased, inefficient and/or inconsistent. A discussion of the complications that arise with the use of pooled cross-sectional models is beyond the scope of this paper but the interested reader will find a full discussion of the problems involved in Hicks (1994). Therefore, even though the random effects model estimated here fails the Hausman test, the bias involved is found to be small and we take it as our chosen model. The $\chi^2$ test of significance for the dominant equation of males in employment yields a value of 2445, which indicates that, taken jointly, the coefficients in our chosen model are significant. Almost all variables are significant at the 5% level for the male employed wage equation. Also the Breusch-Pagan Lagrange Multiplier Test indicates that all our Random effects models have significant unobserved effects. The $\chi^2$ test of significance for the equation of males in employment for example, yields a value of 2987, which indicates that the probability of the variance of $v_{it}$ being equal to zero is virtually zero.

In regards to the male hourly earnings equation the coefficients of what one would expect, a piori, to be the most relevant variables in explaining hourly wages (experience, education levels and experience squared) are significant at the 1% level and of the expected sign. Indeed, these variables are significant at the 1% level for all four equations whether it be for men, women or students in part-time work. The dummy variables for occupation are of the correct sign in relation to the base category of "legislators, senior officers and managers" for the male employed wage equation. The dummy for armed forces however is found to be insignificant in all models. In terms of interpretation[14] we estimate that having completed secondary level education has a rate of return of 15% and having completed third level education gives a rate of return of 43%. Total experience increases wages at a decreasing rate as expected. The increase in wages with experience turns around after 25.5 years. Working in agriculture/fishing or in some elementary occupation has the greatest negative impact on ones wages compared to the base occupational category, 19% and 17% respectively. Finally being from the East or South East of the country increases wages by 4.5%.

Because the explanatory variables in our Random effects wage model are also variables collected in our kayaking questionnaire we are able to use this earnings equation to predict a potential hourly wage rate for each kayaker in our dataset[15]. On average, our proposed wage model predicts potential wages that are 49% lower than the wage rate derived by dividing each respondent's gross earnings by 2000, €7.03 compared to €13.81. Although this may appear slightly on the low side we would expect our method of calculating the wage rate to give lower values since our estimation procedure predicts the mean rather than the marginal wage rate. The dispersion of wages predicted for our respondents using our proposed wage equation is also 28% lower, as measured by the standard deviation statistic, than from the alternative method of dividing each

[14] The interpretation is for the wage equation of male workers not in fulltime education as this is the dominant group in the ECHP dataset and also, this group caters for 68% of the individuals in our kayaking dataset.

[15] For current third level students in our kayaking dataset, the potential hourly wage rate was not calculated with our full wage equations but instead with a part-time wage equation (columns 3 and 4 in Table 7 and again in Tables A and B in Appendix A), again estimated using data on full-time students with part-time employment in our ECHP dataset. This was done under the assumption that students could be working part-time rather than out kayaking in the time they have available to them outside of their study commitments. It was further assumed that the opportunity cost of leisure time for unemployed persons in our dataset was zero. Therefore, even though their potential wage should be positive to reflect the fact that these individuals have attributes that should allow them to earn a certain wage in the labour market, we set it to zero as it is to be used as their opportunity cost of time figure in the calculation of their travel costs.

respondent's gross earnings by 2000. Given these alternative measures of the opportunity cost of time, table 8 presents summary statistics of three alternative travel cost specifications for our sample of 2805 kayaker-whitewater site observations. Travel cost including opportunity cost of leisure time, as measured using the potential wage figure, has the average value of €37.60. This is 1.72 times greater than the travel cost specification that excludes the opportunity cost of time altogether and 30% lower than the travel cost specification that includes the opportunity cost of leisure time derived by dividing each respondent's gross earnings by 2000.

Having calculated the potential wage (or the opportunity cost of leisure time) and the travel cost for all individuals in our kayaking dataset our next goal was to estimate a random utility site choice model to examine the demand for whitewater kayaking in Ireland. Two RUSC or conditional logit (CL) models have been estimated in this paper. In both models the choice probabilities of going to whitewater kayaking sites are regressed on travel cost, the six attributes; parking, crowding, star rating, water quality, scenery and prior information on water levels. The other regressors are dummy variables for all whitewater kayaking sites except the Liffey. This allows us to pick up all unobserved attributes, which explain variations in site choice. The only way in which the two models differ is in the treatment of travel cost. The models were estimated in Stata using Maximum Likelihood estimation procedures. Alternatively we could also have used a Random Parameters Logit model if the assumption of IIA was rejected. This method allows parameters on observed variables to vary across kayakers, rather than being fixed.

The first model (CL1) ignores the opportunity cost of leisure time completely, i.e. travel cost is simply travel distance times the average kilometer cost of travel divided by the average number of passengers in the vehicle travelling to the whitewater site. The second model (CL2) includes the opportunity cost of leisure time. The opportunity cost of leisure time is derived from a secondary data source and uses the potential hourly wage. As outlined in the previous section we derived an hourly earnings equation for the Irish labour force using the ECHP dataset. This equation was then used in connection with the corresponding socio-economic information gathered in our kayaking survey to estimate a potential hourly wage figure for each respondent in our sample. It is this estimated potential hourly wage that is then used in CL2 to calculate the opportunity cost of time.

Results from the RUSC models, as estimated across all choice options using McFadden's (1974) Conditional Logit model, are presented in Table 9. The log likelihood value for Model CL2 is the lower of two models at -913.95. Under the IIA assumption, we would expect no systematic change in the coefficients of our CL models if we excluded one of the whitewater sites from our model. To test this hypothesis we re-estimated the parameters of model CL2, excluding Cliften Play Hole as a whitewater site option, and performed a Hausman-McFadden[16] test against our fully efficient, complete model. On examination of the test results we found no evidence that the IIA assumption had been violated ($\chi^2(16) = 10.51$, prob = .8389) and thus accepted our null hypothesis that the differences in the coefficients between our complete and restricted model were not systematic. A similar result is obtained when alternative whitewater sites are excluded.

The estimated coefficients (other than the travel cost coefficient) vary slightly in magnitude in both models. Travel cost, star rating, scenic quality and the whitewater site dummies are statistically significant at the 1-per cent level for both models, whereas crowding and parking are significant at the 5-per cent level for Models CL2 but marginally insignificant for model CL1. The site dummies represent the somewhat unique physical characteristics of each kayaking site. The fact that they are all found to be highly significant could help explain the wide range of values associated with the loss in consumer surplus when the access to alternative sites is hypothetically denied (see section 7).

The variables water quality and prior information are statistically insignificant in both models. Water quality has the expected sign and its insignificance is not that surprising. It may be explained by the fact that Irish kayakers will kayak at almost any whitewater site regardless of pollution levels so long as the quality of the kayaking feature or its "star rating" is high. Indeed in 2002, 8 kayakers contracted wheals disease through kayaking in "the sluice" on the river Liffey. Even though nothing has been done to improve the water quality at this whitewater site since this incident, it still remains one of the most frequented whitewater sites in the country due mainly to its proximity to the large urban

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[16] For an extensive discussion, see Hausman and McFadden (1984).

center of Dublin city. This site was also the most visited site for our sample of kayakers. The Curragower wave on the Shannon is also a feature noted for its poor water quality but because it is one of the best standing wave features from a kayaking perspective in Europe, Irish kayakers still frequent it regularly.

All the statistically significant variables (at both levels), except for parking, also have the expected signs. Travel cost is expected to have a negative impact on the choice probability that a site is visited, whereas star quality, scenic quality and how uncrowded a whitewater site is, are all expected to have positive impacts on the choice probability. The fact that parking has a negative sign would seem to indicate that the poorer the quality of parking at a whitewater site the higher the probability of visiting that site. Even though at first this fact may seem counterintuitive, it may in fact be correct. Many respondents in the survey highlighted remoteness of the whitewater site as a characteristic that added significantly to their whitewater kayaking experience. Indeed, even though this characteristic was not raised by our focus groups, The Irish Whitewater Guidebook (MacGearailt, 1996) highlights solitude as one of the characteristics that allows kayakers to get “a great return for their effort” on Irish rivers. If this is indeed the case, then it is not an unreasonable assumption that the more secluded whitewater sites are, the poorer the associated parking facilities will be. This would suggest that the negative sign on the parking coefficient is correct and could be interpreted as showing that the remoter or more secluded the whitewater site is, the higher the probability the site will be visited.

The one major difference between CL1 and CL2 is the values attached to the coefficients of travel cost in both models. As already stated, the opportunity cost of travel (or leisure) time is included in model CL2 but excluded in CL1. This results in higher travel cost, and thus in lower coefficient values. The travel cost coefficient for model CL2 is just over one half of the travel cost coefficient associated with model CL1, in absolute terms, -0.07 compared to –0.121, respectively. This lower absolute value should result in higher estimates of welfare changes when different whitewater site management options are considered. Model CL2’s estimate of the travel cost coefficient may be a better indication of a kayakers true marginal cost of travel as it takes into account each individuals unique characteristics and what they could potentially earn in the labour market, through the use of the ECHP hourly earnings equation in calculating the opportunity cost of travel time.

The estimated results for both models will be used in the next section where the welfare impact of site changes is looked at.

## 7. Welfare Impacts of Site Changes

Most travel cost random utility models are estimated for the purpose of valuing site access or changes in site characteristics. With this in mind, we consider a number of welfare scenarios for our two models.

- Closure of individual whitewater sites.
- 50% reduction in star rating of the Roughty river due to the building of a hydro scheme.
- 25% improvement in water quality at Curragower Wave on the Shannon.
- 20% reduction in scenic value at the Annamoe whitewater site
- €3 parking fee at the Sluice site on the river Liffey

The first scenario values site access and the last four values changes in a site characteristic. The results based on both models are shown in Tables 10 but in the proceeding discussion we concentrate on the welfare estimates for our preferred model, CL2. It is possible to compute by how much consumer surplus per trip would fall on average if any of the whitewater kayaking sites were closed. All results are per kayaker per trip. The expected CV loss per trip per site is calculated using equation 19. The results reveal consumer surplus per trip varying between €0.406 for the Liffey and €1.97 for the Roughty (based on results from our preferred model, CL2). These values are the loss in consumer's surplus if a kayaker is prevented from kayaking at his or her most preferred site only. At the same time as the sport of kayaking grows in popularity, Irish whitewater sites are coming under increasing threat from many different sources: water pollution, forestry, housing developments and hydro-electric schemes are but some examples. As can be seen from Table 10, a 50% reduction in the star rating of the Roughty river due to the building of a hydro scheme would result in a reduction in kayak surplus per visit of

€0.06[17]. Water pollution is another threat to whitewater recreation in Ireland. Curragower wave on the Shannon is one of the most polluted stretches of river that Irish kayakers frequent (Environment Protection Agency, 2000). The estimated recreational benefit from a 25% improvement in water quality at the Curragower Wave on the Shannon would result in an increase in consumer's surplus per visit for each kayaker of €0.008.

Forestry and housing developments are other increasing threats for Irish whitewater sites. A loss of compensating variation (CV) per trip of approximately €0.03 would be the welfare implication for whitewater kayakers if there was a 20% reduction in scenic value at the Annamoe whitewater site due to, perhaps, the removal of 20% of the substantial deciduous woodlands along its northern bank and the development of a large housing estate at the put in to the river. Even though this result and the water improvement result are quite low it must be remembered that these welfare impacts apply only to one group of recreationalists. For example, a water clean up program in Limerick city would have additional and perhaps greater benefits for other recreationalists and sightseers along this stretch of the river.

The final scenario we are interested in what impact a €3 parking fee at the Sluice would have on kayakers' welfare. It would be interesting to know the drop in number of trips due to this policy option but since we have not modelled participation, we cannot estimate the change in the number of trips taken. Nevertheless, it should be reasonable to assume that an entrance fee would reduce, to some degree, the number of trips taken by kayakers to the Sluice and thereby alleviate the overcrowding situation that occurs at this "park and play" feature. It was found that the €3 parking fee reduced consumer surplus per kayaker per visit to the Sluice by €0.31. Of any of the policy options considered here this option has the greatest impact on the welfare of the kayaking population using a particular whitewater site, resulting in a decrease in total consumer surplus for the kayaking population per year of €10,358[18].

[17] For an extensive discussion on the conflict between kayaking recreation and hydroelectric development see Hynes and Hanley (2004).

[18] Calculated from mean number of trips to Liffey (16.5) x proportion of kayaking population likely to use the Liffey (2500) x percententage of the sample that had visited the Liffey in the last year (81%) x 0.31

Not surprisingly, the two models yield a wide range of welfare estimates. In the case of the €3 parking fee at the Sluice on the river Liffey for example, Model CL2 yields an expected welfare loss that is 55% larger than the loss associated with model CL1 (where the opportunity cost of time is ignored in the travel cost specification completely). This is consistent with the parameter estimates for travel cost provided in Table 9. Both models suggest that the loss of any whitewater kayaking site will reduce consumer welfare, though the estimated compensating variations range from a low of €0.04 for the Liffey in Model CL1 to a high of €1.98 in the case of the Roughty in Model CL2. Obviously the main explanation for the larger welfare estimates from model CL2 is that they contain an estimate of travel cost that is on average higher than the simpler model CL1.

## 8. Conclusions

This paper has shown how the potential wage rate can be used to calculate the opportunity cost of travel (leisure) time in order to calculate the travel costs associated with a recreational activity. These travel cost estimates are then used in a multi-nomial logit random utility site choice model to model the demand for whitewater kayaking in Ireland. We were then able to use the whitewater site choice models to estimate the welfare impacts of a number of different management scenarios. To be able to use models of recreational behavior to evaluate a policy measure, an attempt must be made to include not only the sites that are directly affected by the policy, but also to all sites that are likely to be close substitutes. The present study covers 11 Irish whitewater kayaking sites, and should thus meet this criterion. To the knowledge of the authors, this study is also the first RUM travel cost model applied to European whitewater kayaking data.

One weakness of the approach adopted in this paper is that it does not take into account the effect of changes in whitewater site attributes on total kayaking trips taken. Three ways of solving this problem are discussed by Hanley et al. (2001). Firstly the site choice model could be combined with a count model, thus connecting decisions over trip frequency with decisions over trip duration (Parsons et al., 1998). Secondly, a repeated nested logit could be estimated that handles participation as well as site choice (Hanley et al. 2000). Finally, a system of count models could be estimated, although Hanley et al. (2001) point out that computational difficulties are often involved when trying to combine many Poisson equations. Also appealing, and worthy of additional research beyond this paper, would be the use of random parameter logit as an analog to the conditional logit model presented above.

Our approach to measuring the opportunity cost of travel time has a distinct advantage over most other travel cost studies. Whereas these other studies simply use a fraction of the wage rate extracted from the gross income variable for the sample population in calculating the opportunity cost of travel time (see for example Cesario and Knetsch, 1976 and Loomis et al., 1995) we use each individuals potential hourly wage as predicted by our earnings model from the ECHP dataset and based upon that persons actual socio-economic characteristics. This should give a much better indication of the true opportunity cost facing each and every kayaker in our sample when they are deciding on which whitewater site to visit.

In much of the travel cost literature the average wage is taken as the upper bound estimate of the opportunity cost of time. In the modern era of incentive based pay structures such as overtime, piece-work and performance related pay regimes an individuals opportunity cost of time may actually be higher than his or her basic net hourly wage. Due to this fact, we have argued in this paper that the full wage rate should in fact be taken as the lower bound estimate and that the use of the "fractional" wage may be grossly underestimating the true opportunity cost of leisure time. Also, since large micro-datasets of labour markets are now becoming more and more available, they could be utilised, as was done in this paper, to get a better estimate of the wage rate of recreationalists, especially when the sample size collected in the recreation demand study is limited, as was the case here. In this regard our methodology for calculating the opportunity cost of time is not just a once-of method due to some uniquely available dataset, rather, it is a process that could be implemented in the field with relative ease when carrying out travel cost studies due to the current widespread availability of labour market datasets in most developed countries.

The results presented here have potentially important implications for recreational demand policy and data collection. Our preferred model gives higher welfare estimates of consumer surplus than the simpler model where the opportunity cost of time is excluded in the travel cost calculation. This means that this method may be underestimating the true welfare impacts arising out of different recreation management scenarios. Hopefully, the approach adopted in this paper leads us some way towards meeting the criticism expressed by Randall (1994). He claimed that a fundamental problem with the travel cost method is that travel cost is unobservable. By using individuals potential wage in calculating the opportunity cost of time, estimated from a secondary dataset on a sample of the labour market participants in the same population from which our kayaking survey was drawn (in our case, the ECHP dataset), we believe has helped us to come closer to a "truer" measure of travel cost.

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**Tables**

Table 1. Mean Visits to Each Whitewater Site Last Year and Total Sites Visited Last Year as a Whole

| Kayaking Site | Mean visits per annum | Std. Deviation |
|---|---|---|
| The Liffey | 16.59 | 42.32 |
| Clifden Play Hole | 2.63 | 5.54 |
| Curragower Wave | 3.34 | 6.46 |
| The Boyne | 5.65 | 14.73 |
| The Roughty | 0.82 | 2.00 |
| The Clare Glens | 1.00 | 2.14 |
| The Annamoe | 3.42 | 5.30 |
| The Barrow | 1.01 | 6.12 |
| The Dargle | 1.28 | 3.78 |
| The Inny | 1.07 | 1.82 |
| The Boluisce | 1.01 | 2.52 |
| All Sites | 37.83 | 47.16 |

Table 2. Visits to Kayaking Sites in Ireland Anytime in the Past

| Kayaking Site | No.of Respondents | % of repondents |
|---|---|---|
| The Liffey | 225 | 80.65 |
| Clifden Play Hole | 146 | 52.33 |
| Curragower Wave | 158 | 56.63 |
| The Boyne | 196 | 70.25 |
| The Roughty | 116 | 41.58 |
| The Clare Glens | 128 | 45.88 |
| The Annamoe | 175 | 62.72 |
| The Barrow | 102 | 36.56 |
| The Dargle | 102 | 36.56 |
| The Inny | 160 | 57.35 |
| The Boluisce | 137 | 49.10 |

Table 3. Factors Ranked 1st in Importance and Last in Importance with Regard to Choosing a River to Kayak

| Factors | % of kayakers ranking attribute 1st in Importance | % of kayakers ranking attribute Least in Importance |
|---|---|---|
| Quality of parking | 2.87 | 18.28 |
| Crowding at the paddling site | 1.43 | 4.66 |
| Quality of the kayaking site (stars) | 60.22 | 3.58 |
| Water Quality | 5.73 | 2.51 |
| Scenic quality of the kayaking site | 3.58 | 31.54 |
| Reliability of Water | 15.05 | 2.51 |
| Number of other sites within 10 miles | 2.87 | 22.94 |
| Travel Time (one way from home to site) | 7.53 | 10.75 |

Table 4. Mean Ranking of Attribute by Whitewater Site

| Factor | Liffey | Clifden | Curragower | Boyne | Roughty |
|---|---|---|---|---|---|
| Average quality and safety of parking at the site (on a scale from 1 to 5 where 1 indicates poor safety and quality of parking to 5 indicating excellent safety and quality of parking) | 3.35 | 2.99 | 3.08 | 2.36 | 3.06 |
| Average crowding at the paddling site (measured from 1 to 5 where 1 means very crowded to 5 meaning uncrowded) | 2.76 | 2.74 | 2.92 | 3.22 | 3.94 |
| Average quality of the kayaking site (no. of stars) | 1.66 | 2.37 | 2.64 | 1.64 | 2.72 |
| Average quality of the water (measured from 1 to 5 where 1 means extremely polluted to 5 meaning unpolluted) | 1.93 | 4.15 | 2.61 | 3.27 | 4.57 |
| Scenic quality of the kayaking site (measured from 1 to 5 where 1 means not at all scenic to 5 meaning very scenic) | 2.63 | 4 | 2.37 | 3.97 | 4.41 |
| Reliability of Water (measured from 1 to 5 where 1 indicates that before visiting the site, a kayaker is completely unsure of the water level at the site and 5 indicates that the kayaker is positive about water level | 3.33 | 4.52 | 3.34 | 3.2 | 2.62 |
| Number of other kayaking sites within 10 miles proximity of this site (measured on a Likert scale, from 1 to 5, where 1 is none and 5 is many) | 2.37 | 2.05 | 2.66 | 1.64 | 3.8 |
| Travel Time (minutes taken to get from home to whitewater site) | 85 | 195 | 123 | 91 | 225 |

Table 5. Mean Ranking of Attribute by Whitewater Site

| Factor | Clare Glens | Annamoe | Barrow | Dargle | Inny | Boluisce |
|---|---|---|---|---|---|---|
| Average quality and safety of parking at the site (on a scale from 1 to 5 where 1 indicates poor safety and quality of parking to 5 indicating excellent safety and quality of parking) | 3.55 | 3.16 | 2.58 | 3.88 | 3.65 | 2.85 |
| Average crowding at the paddling site (measured from 1 to 5 where 1 means very crowded to 5 meaning uncrowded) | 4.03 | 2.98 | 3.65 | 4.13 | 3.51 | 3.6 |
| Average quality of the kayaking site (no. of stars) | 2.89 | 2.11 | 2.88 | 1.32 | 1.57 | 2.04 |
| Average quality of the water (measured from 1 to 5 where 1 means extremely polluted to 5 meaning unpolluted) | 4.43 | 4.13 | 4.13 | 3.43 | 3.67 | 4.26 |
| Scenic quality of the kayaking site (measured from 1 to 5 where 1 means not at all scenic to 5 meaning very scenic) | 4.73 | 4.02 | 4.38 | 3.68 | 2.84 | 3.43 |
| Reliability of Water (measured from 1 to 5 where 1 indicates that before visiting the site, a kayaker is completely unsure of the water level at the site and 5 indicates that the kayaker is positive about water level | 2.48 | 3.02 | 2.56 | 3.13 | 2.71 | 2.98 |
| Number of other kayaking sites within 10 miles proximity of this site (measured on a Likert scale, from 1 to 5, where 1 is none and 5 is many) | 2.57 | 4.07 | 3.2 | 2.15 | 1.5 | 1.85 |
| Travel Time (minutes taken to get from home to whitewater site) | 143 | 111 | 102 | 145 | 127 | 134 |

Table 6. Personal Expenditure on Kayaking over Previous 12 Months.

| Category of Expenditure | Total Spend (€) in Previous 12 months | Average Spend per Kayaker (€) | % Spend in the Kayaking Area |
|---|---|---|---|
| Travel Cost | 112465 | 403.10 | 63 |
| Food | 62480 | 223.94 | 72 |
| Magazines/Guides/Books | 6594.5 | 23.64 | 16 |
| Kayaking Equipment | 268260 | 961.51 | 20 |
| Kayaking Courses/Tuition | 24723 | 88.61 | 21 |
| Socialising | 109995 | 394.25 | 71 |
| Accommodation | 44685 | 160.16 | 73 |
| Miscellaneous | 8026 | 28.77 | 6 |

Table 7. Random Effects Hourly Earnings Regression from European Community Household Panel (ECHP) Irish Dataset, Estimated for Men and Women Separately

| ln W | Men (Employed) | Women (Employed) | Men (Students) | Women (Students) |
|---|---|---|---|---|
| University level education achieved | 0.436 | 0.399 | 0.65 | 0.757 |
| | (20.77)** | (15.89)** | (8.83)** | (9.87)** |
| Upper Secondary level education achieved | 0.151 | 0.177 | 0.331 | 0.464 |
| | (10.98)** | (9.51)** | (5.97)** | (7.03)** |
| Experience | 0.051 | 0.03 | 0.088 | 0.079 |
| (Age minus years of education minus 5) | (25.08)** | (12.41)** | (6.83)** | (6.81)** |
| Experience Squared | -0.001 | -0.001 | -0.002 | -0.002 |
| | (16.97)** | (9.45)** | (3.40)** | (3.29)** |
| Working Part-time | 0.441 | 0.31 | | |
| (0 - full time worker, 1 - part time worker) | (10.38)** | (13.50)** | | |
| Public Sector Worker | 0.171 | 0.204 | | |
| (0- private sector, 1 - public sector) | (10.44)** | (11.70)** | | |
| Professionals | 0.1 | 0.157 | 0.072 | 0.266 |
| | (4.06)** | (4.81)** | -0.73 | (2.91)** |
| Technicians and associate professionals | 0.037 | 0.045 | 0.062 | 0.229 |
| | -1.61 | -1.38 | -0.63 | (2.37)* |
| Clerks | -0.052 | -0.004 | -0.087 | 0.073 |
| | (2.02)* | -0.12 | -0.84 | -0.79 |
| Service workers and shop and market sales workers | -0.085 | -0.186 | -0.01 | 0.087 |
| | (3.35)** | (5.99)** | -0.1 | -0.93 |
| Skilled agricultural and fishery workers | -0.194 | -0.449 | -0.386 | -0.612 |
| | (4.69)** | (2.88)** | (2.03)* | -1.39 |
| Craft and related trade workers | -0.046 | -0.046 | 0.026 | -0.057 |
| | (2.01)* | -0.85 | -0.27 | -0.28 |
| Plant and machine operators and assemblers | -0.103 | -0.054 | -0.067 | 0.015 |
| | (4.45)** | -1.51 | -0.66 | -0.14 |
| Elementary occupations | -0.158 | -0.15 | -0.208 | -0.03 |
| | (6.65)** | (4.09)** | (2.10)* | -0.25 |
| Armed forces | -0.068 | -0.044 | -0.086 | 0.373 |
| (0 is legislators, senior officers and senior managers) | -1.38 | -0.16 | -0.5 | -1.13 |
| 1995 | 0.037 | 0.06 | 0.058 | 0.042 |
| | (3.48)** | (4.26)** | -0.98 | -0.83 |
| 1996 | 0.014 | 0.062 | 0.009 | 0.086 |
| | -1.26 | (4.24)** | -0.15 | -1.66 |
| 1997 | 0.028 | 0.087 | 0.175 | 0.052 |
| | (2.42)* | (5.73)** | (2.86)** | -0.92 |
| 1998 | 0.045 | 0.104 | 0.125 | 0.052 |
| | (3.75)** | (6.73)** | (2.12)* | -0.95 |
| 1999 | 0.078 | 0.11 | 0.249 | 0.046 |
| | (6.21)** | (6.81)** | (4.13)** | -0.79 |
| Regional Dummy | 0.045 | 0.02 | 0.121 | -0.043 |
| (0-Border, Midlands and West, 1- East and South East) | (3.11)** | -1.11 | (2.26)* | -0.91 |
| Constant | 1.249 | 1.258 | 0.876 | 0.725 |
| | (40.55)** | (31.54)** | (7.53)** | (5.98)** |
| Observations | 7980 | 5454 | 858 | 799 |
| Number of PID | 2507 | 1867 | 556 | 514 |
| Overall R-squared | 0.44 | 0.43 | 0.25 | 0.3 |

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Table 8. Summary Statistics of Alternative Travel Cost Specifications

| | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Travel Cost including opportunity cost of leisuire as measured using ECHP data[1] | 37.60 | 20.76 | 1.22 | 151.07 |
| Travel Cost excluding opportunity cost of leisure time[2] | 21.8 | 12.12 | 0.32 | 66.30 |
| Travel Cost including opportunity cost of leisure as measured using derived hourly earnings from kayaker survey [3]. | 53.01 | 39.57 | 1.077 | 363.8 |

1. Travel Cost = ((2* (distance * €0.25))/2.3) + ((travel time/60) * Estimated Hourly Wage)
2. Travel Cost = ((2* (distance * €0.25))/2.3)
3. Travel Cost = ((2* (distance * €0.25))/2.3) + ((travel time/60) * ((Gross Earnings/2000)))

Table 9. Random Utility Site Choice, all trips, CL Models 1 and 2.

| Variable | Model CL1 | Model CL2 |
|---|---|---|
| Travel Cost | -0.121 | -0.07 |
| | (19.33)** | (17.98)** |
| Quality of Parking | -0.096 | -0.145 |
| | -1.24 | (2.04)* |
| Crowding | 0.101 | 0.153 |
| | -1.45 | (2.19)* |
| Star quality of the whitewater site | 0.409 | 0.351 |
| | (3.25)** | (2.82)** |
| Water Quality | 0.186 | 0.142 |
| | -1.79 | -1.39 |
| Scenic quality | 0.289 | 0.285 |
| | (2.99)** | (2.99)** |
| Availability of Information on water levels | -0.077 | -0.08 |
| levels prior to visiting the site | -0.88 | -0.92 |
| Clifden Play Hole | -1.38 | -0.905 |
| | (3.78)** | (2.47)* |
| Curragower Wave on the Shannon | -1.838 | -1.413 |
| | (6.80)** | (5.34)** |
| The Boyne | -2.003 | -1.772 |
| | (6.51)** | (5.93)** |
| The Roughty | -2.134 | -1.641 |
| | (5.34)** | (4.10)** |
| The Clare Glens | -4.016 | -3.387 |
| | (10.11)** | (8.63)** |
| The Annamoe | -2.597 | -2.076 |
| | (7.55)** | (6.25)** |
| The Barrow | -3.491 | -2.914 |
| | (10.93)** | (9.27)** |
| The Dargle | -5.787 | -5.011 |
| | (13.80)** | (12.33)** |
| The Inny | -2.35 | -1.769 |
| | (7.86)** | (6.04)** |
| The Boluisce (Spiddle) | -2.643 | -2.344 |
| | (7.73)** | (6.96)** |

Absolute value of z statistics in parentheses; * significant at 5%; ** significant at 1%
Models CL1and CL2 have log likelihood values of –865.11 and –913.95 respectively.

Table 10. Welfare Impact of Different Policy Scenarios

| Scenario | Change in Consumer's Surplus per Visit for Model CL1 (€) | Change in Consumer's Surplus per Visit for Model CL2 (€) |
|---|---|---|
| *Closure of individual whitewater sites:* | | |
| The Liffey | 0.035 | 0.406 |
| Clifden Play Hole | 0.890 | 1.650 |
| Curragower Wave | 0.868 | 1.428 |
| The Boyne | 0.721 | 1.166 |
| The Roughty | 1.089 | 1.976 |
| The Clare Glens | 0.861 | 1.433 |
| The Annamoe | 0.914 | 1.352 |
| The Barrow | 0.269 | 0.520 |
| The Dargle | 0.647 | 1.112 |
| The Inny | 1.171 | 1.959 |
| The Boluisce | 0.811 | 1.456 |
| 50% reduction in star rating of the Roughty river due to the building of a hydro scheme | 0.039 | 0.062 |
| 25% improvement in water quality at Curragower Wave on the Shannon | 0.005 | 0.008 |
| 20% reduction in the scenic quality at the Annamoe river | 0.014 | 0.029 |
| €3 parking fee at the "Sluice" on the river Liffey | 0.144 | 0.309 |

Source: Calculated from models reported in Table 9.

# Appendix A

Table A. Alternative Hourly Earnings Regressions from European Community Household Panel (ECHP) Irish Dataset, Estimated for Employed Men and Women

| | **Fixed Effects** | | **Pooled Cross-Sectional** | | **First Differenced** | |
|---|---|---|---|---|---|---|
| ln *W* | Men (Employed) | Women (Employed) | Men (Employed) | Women (Employed) | Men (Employed) | Women (Employed) |
| University level education achieved | -0.031 | -0.121 | 0.402 | 0.418 | 0.054 | -0.1 |
| | -0.66 | -1.95 | (23.65)** | (20.89)** | -1.04 | -1.38 |
| Upper Secondary level education achieved | -0.028 | -0.045 | 0.145 | 0.173 | 0.013 | -0.043 |
| | -1.22 | -1.18 | (12.76)** | (11.40)** | -0.5 | -1.01 |
| Experience | 0.017 | -0.003 | 0.049 | 0.031 | 0.025 | 0.002 |
| (Age minus years of education minus 5) | (4.00)** | -0.5 | (32.80)** | (16.79)** | (4.62)** | -0.28 |
| Experience Squared | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 |
| | (10.32)** | (4.15)** | (22.77)** | (12.97)** | (5.45)** | (2.63)** |
| Working Part-time | 0.482 | 0.359 | 0.419 | 0.21 | 0.006 | 0.084 |
| (0 - full time worker, 1 - part time worker) | (10.17)** | (13.20)** | (8.55)** | (9.29)** | -0.19 | (2.83)** |
| Public Sector Worker | 0.038 | 0.085 | 0.226 | 0.231 | 0.577 | 0.433 |
| (0- private sector, 1 - public sector) | -1.46 | (3.25)** | (19.58)** | (17.11)** | (11.82)** | (15.68)** |
| Professionals | 0.045 | -0.012 | 0.087 | 0.163 | 0.021 | 0.011 |
| | -1.48 | -0.29 | (3.99)** | (5.31)** | -0.65 | -0.22 |
| Technicians and associate professionals | 0.053 | 0.041 | -0.011 | 0.022 | 0.043 | 0.099 |
| | (2.01)* | -1.07 | -0.52 | -0.69 | -1.51 | (2.27)* |
| Clerks | 0.014 | 0.056 | -0.154 | -0.092 | 0.018 | 0.079 |
| | -0.45 | -1.52 | (6.37)** | (3.13)** | -0.52 | -1.85 |
| Service workers and shop and market sales workers | 0.015 | -0.024 | -0.193 | -0.287 | 0.023 | 0.09 |
| | -0.47 | -0.61 | (8.43)** | (9.62)** | -0.67 | (2.07)* |
| Skilled agricultural and fishery workers | -0.027 | -0.421 | -0.384 | -0.545 | -0.007 | -0.39 |
| | -0.55 | (2.14)* | (9.45)** | (3.77)** | -0.13 | -1.85 |
| Craft and related trade workers | 0.02 | 0.05 | -0.109 | -0.101 | -0.006 | 0.16 |
| | -0.7 | -0.74 | (5.38)** | (1.96)* | -0.19 | (2.13)* |
| Plant and machine operators and assemblers | -0.03 | 0.007 | -0.158 | -0.057 | -0.027 | 0.021 |
| | -1.03 | -0.15 | (7.56)** | -1.72 | -0.86 | -0.41 |
| Elementary occupations | 0.01 | 0.022 | -0.37 | -0.276 | 0.003 | 0.109 |
| | -0.34 | -0.48 | (16.76)** | (7.96)** | -0.08 | (2.09)* |
| Armed forces | -0.01 | 0.593 | -0.165 | -0.243 | 0.13 | 0.693 |
| (0 is legislators, senior officers and senior managers) | -0.13 | -1.5 | (4.58)** | -0.85 | -1.27 | -1.92 |
| 1995 | 0.082 | 0.119 | 0.038 | 0.042 | | |
| | (6.95)** | (7.41)** | (2.58)** | (2.34)* | | |
| 1996 | 0.103 | 0.16 | 0.011 | 0.036 | -0.059 | -0.078 |
| | (7.22)** | (8.33)** | -0.73 | (1.99)* | (4.12)** | (3.93)** |
| 1997 | 0.161 | 0.229 | 0.014 | 0.048 | -0.082 | -0.124 |
| | (9.37)** | (9.98)** | -0.9 | (2.59)** | (3.23)** | (3.55)** |
| 1998 | 0.207 | 0.28 | 0.036 | 0.059 | -0.112 | -0.195 |
| | (10.74)** | (10.95)** | (2.25)* | (3.17)** | (3.10)** | (3.90)** |
| 1999 | 0.277 | 0.32 | 0.073 | 0.067 | -0.121 | -0.268 |
| | (12.17)** | (10.72)** | (4.40)** | (3.50)** | (2.57)* | (4.14)** |
| Regional Dummy | 0.017 | -0.021 | 0.06 | 0.042 | 0.028 | -0.042 |
| (0-Border, Midlands and West, 1- East and South East) | -0.94 | -0.86 | (4.98)** | (2.94)** | -1.43 | -1.53 |
| Constant | 2.045 | 1.962 | 1.356 | 1.345 | 0.07 | 0.116 |
| | (25.06)** | (19.37)** | (50.57)** | (37.85)** | (6.03)** | (7.16)** |
| Year -Individual Observations | 7980 | 5454 | 7980 | 5454 | 5309 | 3473 |
| Number of Individuals | 2507 | 1867 | 7980 | 5454 | | |
| R-squared | 0.08 | 0.11 | 0.46 | 0.44 | 0.04 | 0.08 |

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Table B. Alternative Hourly Earnings Regressions from European Community Household Panel (ECHP) Irish Dataset, Estimated for Male and Female Students

| | **Fixed Effects** | | **Pooled Cross-Sectional** | | **First Differenced** | |
|---|---|---|---|---|---|---|
| ln *W* | Men (Students) | Women (Students) | Men (Students) | Women (Students) | Men (Students) | Women (Students) |
| University level education achieved | 0.947 | -0.483 | 0.616 | 0.776 | 0.82 | -0.326 |
| | (3.34)** | -1.3 | (8.67)** | (10.79)** | (2.79)** | -0.87 |
| Upper Secondary level education achieved | 0.454 | -0.261 | 0.327 | 0.466 | 0.304 | -0.104 |
| | (2.57)* | -0.97 | (6.01)** | (7.44)** | -1.82 | -0.4 |
| Experience | 0.092 | -0.107 | 0.087 | 0.087 | 0.087 | -0.104 |
| (Age minus years of education minus 5) | (2.38)* | (2.46)* | (7.02)** | (8.03)** | -1.66 | (2.05)* |
| Experience Squared | -0.002 | 0.005 | -0.002 | -0.003 | -0.002 | 0.004 |
| | -1.24 | (2.62)** | (3.57)** | (4.34)** | -0.89 | (2.13)* |
| Professionals | -0.042 | 0.114 | 0.073 | 0.21 | -0.069 | 0.081 |
| | -0.23 | -0.78 | -0.76 | (2.46)* | -0.43 | -0.58 |
| Technicians and associate professionals | 0.121 | 0.248 | 0.038 | 0.176 | 0.091 | 0.221 |
| | -0.7 | -1.6 | -0.38 | -1.93 | -0.63 | -1.57 |
| Clerks | 0.119 | 0.195 | -0.114 | 0.035 | -0.019 | 0.077 |
| | -0.68 | -1.29 | -1.08 | -0.41 | -0.12 | -0.56 |
| Service workers and shop and market sales workers | 0.231 | 0.393 | -0.046 | 0.039 | -0.086 | 0.328 |
| | -1.24 | (2.63)** | -0.47 | -0.43 | -0.52 | (2.40)* |
| Skilled agricultural and fishery workers | 0.223 | 0.547 | -0.386 | -1.149 | -0.267 | 0.526 |
| | -0.65 | -0.95 | (2.03)* | (2.47)* | -0.94 | -1.06 |
| Craft and related trade workers | 0.155 | -0.04 | 0.006 | -0.083 | -0.157 | 0.163 |
| | -0.8 | -0.12 | -0.06 | -0.41 | -0.88 | -0.6 |
| Plant and machine operators and assemblers | 0.079 | 0.085 | -0.061 | -0.017 | -0.086 | 0.009 |
| | -0.41 | -0.44 | -0.61 | -0.16 | -0.49 | -0.05 |
| Elementary occupations | 0.17 | 0.197 | -0.296 | -0.086 | -0.162 | 0.201 |
| | -0.92 | -0.74 | (2.99)** | -0.73 | -1.01 | -1.03 |
| Armed forces | -0.415 | 0.923 | -0.066 | 0.262 | 0.051 | 0.809 |
| (0 is legislators, senior officers and senior managers) | -1.17 | -1.71 | -0.39 | -0.78 | -0.09 | -1.68 |
| 1995 | 0.106 | 0.256 | 0.057 | 0.009 | | |
| | -1.19 | (3.21)** | -0.9 | -0.16 | | |
| 1996 | 0.073 | 0.377 | 0.015 | 0.061 | -0.161 | -0.103 |
| | -0.74 | (4.06)** | -0.24 | -1.1 | -1.66 | -1.47 |
| 1997 | 0.295 | 0.441 | 0.165 | 0.032 | -0.118 | -0.227 |
| | (2.68)** | (4.00)** | (2.56)* | -0.53 | -0.7 | -1.81 |
| 1998 | 0.249 | 0.637 | 0.109 | 0.022 | -0.217 | -0.308 |
| | -1.91 | (4.54)** | -1.75 | -0.38 | -0.89 | -1.67 |
| 1999 | 0.458 | 0.722 | 0.226 | 0.037 | -0.198 | -0.424 |
| | (2.99)** | (4.22)** | (3.59)** | -0.62 | -0.62 | -1.78 |
| Regional Dummy | 0.295 | -0.152 | 0.1 | -0.03 | 0.083 | -0.198 |
| (0-Border, Midlands and West, 1- East and South East) | (2.32)* | -1.38 | (1.98)* | -0.72 | -0.71 | (2.08)* |
| Constant | 0.445 | 1.801 | 0.928 | 0.754 | 0.137 | 0.254 |
| | -1.66 | (4.68)** | (7.93)** | (6.51)** | -1.8 | (4.06)** |
| Year -Individual Observations | 858 | 799 | 858 | 799 | 344 | 374 |
| Number of Individuals | 556 | 514 | 858 | 799 | | |
| R-squared | 0.27 | 0.15 | 0.25 | 0.3 | 0.12 | 0.11 |

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%