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The value of tourist angling: a travel cost method estimation of demand for two destination salmon rivers in Ireland

Gianluca Grilli*[a,b] , Gavin Landgraf[a,c] , John Curtis[a,b] and Stephen Hynes[d]

Abstract: In this paper we use the travel cost method to estimate the demand function for two of western Ireland's destination salmon fisheries: the River Moy in County Mayo and the River Corrib in County Galway. Data were collected by an on-site survey questionnaire and demand was estimated using count data models. In the study sites commercial fishing was banned to avoid unsustainable harvesting of salmon, which removed an important source of income for the local communities. Therefore, the study is important to highlight whether recreational fishing presents an opportunity for further development of the local economy. Welfare estimates from our models indicate that anglers are willing to pay €867 for a day of angling on the Galway and Moy fisheries, approximately double the costs incurred. Differently from previous research, tourists anglers were found to be price sensitive, with a price elasticity close to unity. This means that escalating costs likely result in declining demand among tourist anglers. Corrib and Moy fisheries support local economic activity with visiting anglers' expenditure contributing €22-€31 per angler per day to local incomes, which is an indication of the potential of the fishery resource for economic development.

*Corresponding Author: gianluca.grilli@esri.ie

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a The Economic and Social Research Institute, Dublin
b Department of Economics, Trinity College, Dublin
c National University of Ireland Galway, University Road, Galway, Ireland
d Socio-Economic Marine Research Unit, J.E. Cairnes School of Business and Economics, National University of Ireland, Galway, Ireland

1. Introduction

The west of Ireland has historically possessed some of the most prolific salmon rivers in Europe, providing a livelihood for local fishermen, who exploited the salmon resource for many years. However, this level of fishing proved to be unsustainable, resulting in the Irish government curtailing commercial salmon fishing in the early 2000s. With the introduction of a river-by-river management scheme and with a mixed-stock drift net ban in 2007, large-scale commercial salmon fishing in Ireland effectively ended, marking a dramatic shift in Ireland's relationship with one of its most culturally significant natural resources. These measures resulted in a switch, from commercial fishing to recreational anglers as the primary users of the nation's wild salmon resources. Most recreational anglers are often more interested in landing a fish than actually taking it (Hynes et al., 2017), and consequently likely to engage in 'catch & release' fishing. Catch and release fishing involves releasing the fish into the water after landing it (Cooke and Schramm, 2007), leaving the fish unharmed. Under the current management regime salmon populations are constantly monitored and, in case of significant decrease in number, fisheries may be turned into catch and release only, with little loss of recreational opportunities. In the years since the ban on drift netting, salmon angling catches have increased substantially (IFI, 2014), boosting Ireland's reputation as a premier salmon angling destination. Indeed, Ireland's rivers are a major international attraction, drawing anglers from 52 nations in 2014 to try their hand at landing a wild Atlantic salmon (IFI, 2014). Recreational fishing — and particularly angling tourism — holds a huge economic potential for the development of the west coast of Ireland. An important question is what is the economic benefit of maintaining a fish population for recreational purposes only, compared to the benefits from commercial fishing.

In the literature, there are several studies highlighting the important contribution of natural resources to local economies. For example, the benefits provided by forests to local communities are well-documented (De Meo et al., 2015; Notaro and Paletto, 2011; Bernues et al., 2014), as well as those of coastal areas (Barry et al., 2011; Czajkowski et al., 2015) and agricultural lands for walkways and hiking paths (Buckley et al., 2009; Hynes et al., 2007; Doherty et al., 2013). In rural communities, natural resources represent a competitive advantage that can be used by local inhabitants to sustain their own development (Garrod et al., 2006). Although recreational benefits of angling have been widely studied (for example, amongst others Lawrence, 2005; Curtis, 2002; Lew and Larson, 2012; Raguragavan et al., 2013), few papers examined this activity in the broader perspective of rural development. An interesting exception is provided by Du Preez and Lee (2010), who explored the value of tourism in a community of 600 inhabitants in South Africa. They estimated that fishing tourism assures 39 job opportunities, in a village where less than one hundred people are formally employed.

River and lake resources are important components of a countryside's capital and, even if undervalued, contribute to the development of small rural areas (Garrod et al., 2004). Despite being considered a consumptive activity, recreational angling may be a form of ecotourism, if appropriately regulated. There are several examples of successful sustainable fishing that bring notable contribution to local incomes (Ditton and Grimes, 1995; USFWS, 1986). According to Zwirn et al. (2005), a smart angling regulation may accomplish the objectives of ecotourism activities: minimize environmental impacts and enhance local economies (Honey, 2008). While impact minimization could be pursued by legislation, angling contribution to Irish rural development, in terms of money spent locally, is quite clear. A study conducted in 2012 estimated that recreational angling in Ireland, which includes salmon angling, generated some €755 mln in economic activity from €555 mln of direct, angling-related expenditures (TDI, 2013). Angling tourism is particularly beneficial, accounting for just over half of the €555 million in direct expenditures. Though these estimates do not distinguish total expenditures by salmon anglers the same report found that salmon anglers tend to spend 40 percent more money per trip than the average recreational angler in Ireland, even when excluding travel costs. A follow-up report for the National Strategy for Angling Development estimated that salmon and sea trout anglers spend €154 million per year (O'Reilly, 2015). These expenditures bring substantial revenue to rural communities, which often have limited economic activity. Although these figures provide a picture of the general economic impact of angling for the population, a rigorous cost-benefit assessment of recreational angling versus commercial fishing is difficult to carry out, because welfare measures are not always easy to obtain for both activities.

Considering the importance of salmon angling and in an attempt to estimate the benefit anglers derive from salmon fishing, the purpose of this paper is to assess the economic contribution of salmon angling on the west coast of the Republic of Ireland. Using the travel cost method (TCM), the demand for recreational salmon fishing is estimated, highlighting the factors affecting this demand in order to provide policy relevant information for decision-makers. The TCM is a non-market technique, implemented to estimate the use value of tourist destinations, by investigating the actual behaviour of tourists. The method enables the estimation of consumer surplus of anglers, which is considered a good approximation of a welfare measure for rivers' use value (Hanley and Barbier, 2009). The monetization of the demand is conducted by including the cost sustained by visitors for travelling, round trip, from their home town to the fishery. In some cases, other costs, such as food and accommodation, costs for equipment and licences, are also included, to better refine the estimation. The main underlying hypothesis is that people with higher travel cost make fewer and/or shorter trips to the fishery, compared to those with lower expenses. In a review of the literature, Grantham and Rudd (2015) found that TCM was the most common approach for modelling the benefits derived from angling in inland fisheries. The present analysis is conducted for two premier salmon angling destinations: the River Corrib, which flows through Galway City, and the River Moy. Well-known internationally, these two rivers accounted for more than a quarter of all salmon caught recreationally in Ireland in 2014 (IFI, 2014). Estimating the value that different types of anglers place on these two destination salmon fisheries will inform policymakers' cost-benefit calculations while also providing a preview of what other, less-prolific rivers in Ireland could be worth if their salmon populations improved.

The rest of the paper is organized as follows. In section 2, it is provided an overview of the study area, of the economic theory behind TCM, of the data sampling and the econometric analysis of the data. In section 3, results of the questionnaire administration and data collected are presented. Section 4 discusses the welfare estimates, which is followed by a conclusion in section 5.

2. Methods

2.1. Study Areas

The study concentrates on the rivers Corrib and Moy, because they are two of the most important and famous angling destinations in the Republic of Ireland. Indeed, more than half of the 4,600 overseas anglers who purchased salmon licenses in Ireland in 2014 bought their licenses in the Moy or Corrib river basins. The river Corrib, although being short and running just six kilometers from Lough Corrib to Galway Bay, it is nevertheless the second largest Irish river by flow. The River Moy runs for 110 kilometres, from the heights of the Ox Mountains to the Atlantic Ocean at Killala Bay. The premier stretch of the river for angling is located in Ballina, in County Mayo, just before the river meets the sea. Because of the high recreational demand, angling on these rivers is well regulated and anglers must possess both a licence and a date-specific permit to fish. At the same time, salmon stock levels are carefully monitored so that catch rates do not exceed conservation limits.

2.2. The Travel Cost Model

The TCM is one of the most common techniques used in non-market valuation to estimate the recreational values of specific sites (Hanley and Barbier, 2009). It is based on revealed preferences, meaning that environmental values are retrieved by investigation of real choices made by visitors in order to derive a demand curve for recreation. The TCM method was first proposed by Hotelling (1947) and then refined by Clawson and Knetsch (1966). The main intuition is that costs sustained by visitors may approximate the value of their recreational experience. In this context, the quantity of recreation is valued as the number of trips tourists undertake in a given timespan, or days spent in the destination, while the associated unit cost is represented by the travel cost sustained for the round trip. People are assumed to be travel cost-sensitive, meaning that people living closer to the destination will undertake more visits compared to distant people, because the unit cost for a trip is lower than for the others (Ezebilo, 2016). This hypothesis reflects microeconomic theory, for which higher prices for goods lead to lower quantity consumed (Besanko and Braeutigam, 2011). People have a budget constraint and try to buy the bundle of goods that maximizes their utility (Bowles, 2009). Using this utility maximization approach, individual demand for recreation to a specific site may be described by the following indirect utility function:

$$Max\ u(T,\ q|s,\ a) \quad \text{subject to} \quad cR + qz = y \tag{1}$$

where u is the utility derived from two different goods, T is the number of days to a specific site, q is the quantity of all other goods consumed, s is a vector of site-specific characteristics, a individual characteristics, c the unit cost sustained for one day, R is the number of trips to a recreation site, z the composite price of all other goods and y the individual income. From equation 1 it is possible to establish a relationship between the number of days and the cost of each day, i.e. the demand curve:

$$T = f(c,\ z,\ y; s,\ a) \tag{2}$$

From equation 2, it can be seen that the demand for recreation not only depends on the cost of the trip and the budget but also on other factors, including site-specific and individual-specific characteristics. For this reason, recreational demand is often estimated including covariates of this kind in the model. Integrating the demand function below the curve and above the price it is possible to estimate the consumer surplus (CS), which is the typical welfare measure that is used to approximate the recreational value of the site (Bateman and Turner, 1993). Usually, what is presented in TCM analyses is the CS per trip or day, given by the negative inverse of the cost coefficient β_c of a regression (Hellerstein and Mendelsohn, 1993):

$$CS = -\frac{1}{\beta_c} \tag{3}$$

TCM studies may be found in many contexts of the environmental policy, ranging from forest and wetland recreation (see, among others, Ezebilo, 2016; Bertram and Larondelle, 2017; Kawsar et al., 2015) to angling (Curtis and Stanley, 2016; Curtis and Breen, 2017; Hynes et al., 2017) and birdwatching (Czajkowski et al., 2014). The rationale behind using TCM is that it provides reliable estimates based on real behaviours, it is therefore the preferred approach to model use-values of recreational resources. It is also considered, among the set of environmental goods evaluation techniques, the most robust for benefit transfer studies in the context of recreation (Zandersen and Tol, 2009).

Table 1: Surveyed Anglers by Fishery and Home Region

	Galway Survey	Moy Survey	Total	Percent
Ireland/NI	57	35	92	66.2%
UK	6	19	25	18.0%
Continental Europe	6	14	20	14.4%
Other	1	1	2	1.4%
Total	70	69	139	100.0%

2.3. Data collection

Data were collected by means of a self-administered, paper-based questionnaire, completed on-site during the fishing seasons of 2015 and 2016, which was delivered to a sample of tourists selected along the two rivers. Anglers were invited to take part in the survey when they registered at the fishery at the start of their fishing session. This method might be considered convenience sampling (Etikan et al., 2016), which has the advantage of being affordable and easy to collect. However, results can be considered representative only if there would be no differences with a random sample, i.e. the population of anglers is homogeneous. This is unlikely to be the case for our respondents, because completing the questionnaire is subject to selection bias. This potential bias is discussed later but is a limitation that must be considered when interpreting the results.

The questionnaire was organized in two main thematic sections. The first section, contained questions aiming to capture the necessary data for the TCM, i.e. total number of days spent fishing in the current trip in Ireland, the total amount of expenditures (for tackle, travel, subsistence and accommodation), type of accommodation, country and municipality of residence. The second section contained socio-demographic questions related to age, gender, personal income and occupation. The questionnaire was designed specifically with a TCM model in mind but confined to be as short as possible, as anglers would be unreceptive to a long questionnaire at the beginning of their fishing session. In addition to these data, travel distance variables were derived from the home town question and added to the dataset: round-trip distance between hometown and fishery .

The survey collected 141 questionnaires but some of them were incomplete, with only 134 usable for the TCM. Respondents were from 12 different countries, which demonstrates that Moy and Corrib rivers have an international fame for salmon angling (see Table 1). The median domestic angler lived 164 km from the place of the survey, while the median overseas angler lived 674 km from the fishery. It is noteworthy that the sample does not include local anglers. The angler living closest to either fishery lives 34km away. This practically means that the data sample is essentially visiting or tourists anglers. It is not clear why local anglers did not participate in the survey, which introduces a source of selection bias, which might be reflected in an upward bias of the welfare analysis. From separate data we know the order of that bias, as in 2016 approximately 15% of Corrib and 8% of Moy fisheries anglers lived within 50km of the fisheries. Nonetheless the survey could be considered a convenience sample of tourist or visiting anglers to these premier fishing sites.

2.4. Econometric Analysis

The usual approach to model the demand for recreation is using count data models, because the outcome variable (number of trips or number of days spent fishing) takes only integer and non-negative values

(Hellerstein, 1991). Even if the OLS estimator could be used for such an analysis, it is less efficient in the presence of a count outcome variable (Hellerstein and Mendelsohn, 1993). The basic count regression model is the Poisson model, for which the probability that an individual *i* undertakes a certain number of trips *t* is given by (Greene, 2003):

$$Pr[T = t] = \frac{\exp^{-\mu} \cdot \mu^{t_i}}{t_i!} \tag{4}$$

where μ is the rate parameter, which is usually parametrized in a regression framework as an exponential function $\mu = exp(X^T \beta)$, in which X is a matrix of covariates and β the vector of parameters to be estimated. A well-known limitation of the Poisson model is that it assumes equidispersion, i.e. the mean of the distribution equals its variance (Cameron and Trivedi, 2013). This is a strong assumption, which is unlikely to hold in many TCM applications that comprise over-dispersed data (Garrod and Willis, 1999). Over-dispersion occurs when a few visitors make a large number of trips, resulting in the variance of the distribution to be higher than the mean (McKean et al., 2003). For this reason, another econometric model frequently used is the negative binomial (NB), representing a generalized version of the Poisson (Cameron and Trivedi, 2013):

$$Pr[T = t] = \frac{\Gamma(\alpha^{-1} + t)}{\Gamma(\alpha^{-1})\Gamma(t + 1)} \times \left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu}\right)^{\alpha^{-1}} \times \left(\frac{\mu}{\alpha^{-1} + \mu}\right)^{t} \tag{5}$$

where Γ is the gamma function and α a parameter describing the over-dispersion of the data. In the special case where the α parameter is equal to zero the NB and Poisson models are the same (Cameron and Trivedi, 1986).

In addition to over-dispersion, there are two other issues that arise when data collection is made by means of on-site surveys, namely truncation and endogenous stratification (Englin and Shonkwiler, 1995). Truncation refers to the fact that interviewed people are contacted on-site and therefore their number of trips is at least one and never zero; in this way people with zero trips in the period are not represented and welfare estimates possess an upward bias (Fletcher et al., 1990). Endogenous stratification refers to the fact that frequent visitors are more likely to be sampled than anglers with only few trips (Parsons, 2003; Hindsley et al., 2011). These econometric issues were first identified by Shaw (1988) and subsequently included in most of the TCM studies based on on-site sampling (to name a few, Martínez-Espiñeira and Amoako-Tuffour, 2008; Ovaskainen et al., 2001; Chakraborty and Keith, 2000). Even if truncation has been assessed to have a larger influence on estimates, both features of on-site surveys were shown to have a significant effect in estimation biases (Martínez-Espiñeira and Hilbe, 2008). In order to account for these two aspects of on-site sampling, we estimated models corrected for truncation and endogenous stratification, using a user-written routine available for the statistical software STATA™ (Hilbe and Martínez-Espiñeira, 2005). Englin and Shonkwiler (1995) demonstrated that a Poisson model may be corrected for truncation and endogenous stratification by means of the same probability mass function shown in equation 4, using $y_i = t_i - 1$ as response variable. The NB model is corrected for truncation and endogenous stratification by modifying equation 5 as follows (Martínez-Espiñeira and Amoako-Tuffour, 2008):

$$Pr[T = t] = \frac{\Gamma(\alpha_i^{-1} + t_i)}{\Gamma(\alpha_i^{-1})\Gamma(t_i + 1)} \times \alpha_i^{t_i} \mu_i^{t_i} \times (1 + \alpha_i \mu_i)^{t_i} \tag{6}$$

The dependent variable in the TCM model is the number of days per trip. The variables included as independent variables, in order to explain the number of fishing days and angler undertakes, are summarized and described in Table 2. The *Tcost* variable includes the average daily cost sustained by anglers; it

Table 2: Covariates included in the TCM model

Variable	Description	Expected sign
Tcost	Cost for travelling to the destination (€ / day)	-
Moy	1 if angler fishing at Moy and 0 otherwise	+/-
*Age*66+	1 if angler is aged 66+ and 0 otherwise	+
Prof/Managerial	1 if angler occupies a managerial position and 0 otherwise	+
GroupSize	size of the group	-
GCDistance (00*s km*)	Distance of the hometown from fishery	+
Overseas	1 if angler comes from overseas and 0 otherwise	+

is inversely related to the number of days spent during the trip as one of the main assumptions of the TCM model. The variable labelled *Moy* is a dummy included to test whether there are significant differences between locations in terms of number of days spent fishing. We have no *a priori* knowledge about the sign of this coefficient, indicating if trip lengths differ between the two locations. On the other hand, we suspect a positive effect of *Age*66+ on the number of days spent fishing. This variable is a proxy for retired people, which have, on average, more free time to spend in leisure activities compared to younger people, *ceteris paribus*. *Prof/Managerial* is another dummy, used as proxy for high-income anglers. We presume that people with higher income have more money for recreational activities, therefore they can afford to spend a larger number of days fishing. *Groupsize*, indicating the number of people taking part to the trip, could also be inversely related to the number of days, because larger groups increase the organizational burden of long trips. *GCDistance* represents the distance between the home town and the fishery, while *Overseas* is a dummy for people coming from outside the island of Ireland; both these variables are suspected to be directly related to the number of days, because people travelling long distances are often forced to stay overnight, compared to people living closer to the fishery. A Wald test performed for the joint significance of the distance and its quadratic suggested the presence of an inflection point with respect to trip days and distance, which will be discussed in the results section.

3. Results and Discussions

Descriptive statistics of the 134 surveyed tourists are summarized in Table 3. Most of the people travelled alone (69% of the sample), while others in groups ranging from 2 to 6 people. Concerning the length of the trip, respondents declared a number of days for their holidays between 1 and 21, with a mean value of 5 days per trip, with the number of days spent fishing between 1 and 15, with a median value of 2 (mean = 2.84). In terms of age structure, only 3% of the sample was below 30 years old and 23% was over 66 years, with the median in the 51-65 age category. Most anglers had professional activities as their occupation (50% of the sample), a quarter of respondents held a managerial position (26%), a small proportion of people were involved in manual or non-manual occupations, and 17% of the sample was retired or unemployed.

Table 3 reports the average expenditure of respondents in the sample, by fishery and personal characteristics, which offer an indication of the overall economic contribution of one angler to the Irish economy. Anglers declared an average expenditure per trip of €947, corresponding to €440 per fishing day. Excluding travel costs allows an understanding of which part of these expenditures are sustained locally and contribute to the local economy. Excluding travel costs individual expenditures accounted for €313 per day, corresponding, on average, to €649 per trip. In particular, it can be seen that domestic anglers tend to

Table 3: Descriptive statistics of the sample

AGE	Frequency	min	max
18-30	2	0	1
31-50	46	0	1
51-65	55	0	1
66+	31	0	1
OCCUPATION			
Professional	50	0	1
Managerial/technical	26	0	1
Non-manual	2	0	1
Manual	4	0	1
Other	17	0	1

spend less than overseas anglers per trip, even excluding the cost of travel. Expenditures are much lower for people making day trips, mainly because they do not need accommodation facilities. In addition, there are differences in expenses for age and employment status categories, with older people and people holding managerial or professional positions showing higher average spendings.

Table 4: Angler Expenditure per trip and per day, ϵ

	Person / Trip	**Person / Day**	**Person / Day (Excl. Travel)**
Galway angler	908	492	346
Moy angler	987	387	280
Domestic Angler	692	418	321
Overseas angler	1452	482	297
Day trip	1023	461	331
Overnight trip	245	245	144
Under 66	830	415	295
66 or older	1338	521	371
Prof/Manager	783	417	327
Other professions	999	447	309
Total sample	947	440	313

Given the average expenditures in Table 4, it is possible to assess the marginal contribution of each angler to local incomes, allowing a margin for labour costs. Marginal cost of labour differ by sectors, therefore the estimation will not be precise but is useful to understand the extent to which recreational angling is beneficial to the local economy. In large grocery retailers, McKinsey and Company (2013) estimate a gross margin of 15-20% for labour costs. Taking a conservative approach we assume a labour cost margin of 7–10%, from which we estimate that each angler contributes roughly ϵ22–31 per day and ϵ45–65 per trip to local incomes. Even though these figures are a crude approximation, their magnitude is quite relevant and seems to confirm that the angling sector contributes to the enhancement of the economy of Corrib and Moy areas.

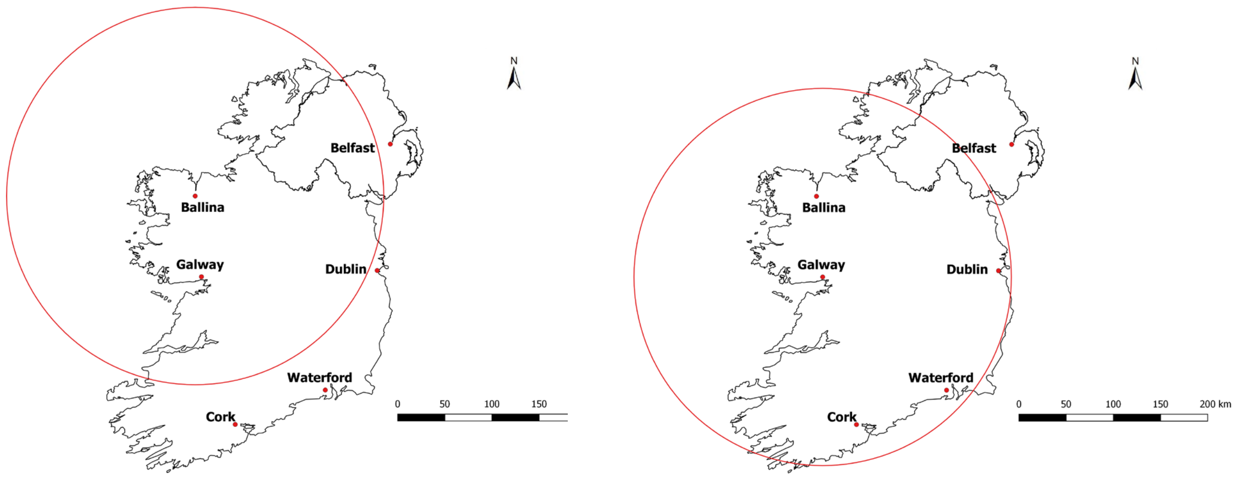
We now move to the results of the TCM models, which are shown in table 5, showing both the Poisson and the NB, both corrected for truncation and endogenous stratification. The two models are quite consistent with broadly similar parameter estimates. However, it can be seen that the log-likelihood of the NB model is higher than the Poisson model, which is an indication that the former performs better than the baseline model. The AIC and BIC statistics are lower for the NB model, also indicating that this model fits data better. In addition, the parameter $ln(\alpha)$, which is the one accounting for over-dispersion, is statistically significant, indicating that data are over-dispersed and should be therefore modelled with a NB distribution. The better performance of the NB model is common in the literature of TCM with on-site interviews (Curtis and Stanley, 2016; Hynes and Greene, 2013).

Table 5: Results of TCM models controlling for truncation and endogenous stratification

Variables	Poisson	Negative Binomial
Tcost	-2.792***	-2.360***
	(0.423)	(0.474)
Moy	-0.172	-0.111
	(0.161)	(0.208)
*Age*66+	0.535***	0.547***
	(0.148)	(0.195)
Prof/Managerial	0.704***	0.618***
	(0.184)	(0.229)
GroupSize	-0.0478	0.0236
	(0.0681)	(0.0896)
GCDistance	-2.304***	-2.042**
	(0.711)	(0.905)
$GCDistance^2$	0.608**	0.516*
	(0.253)	(0.313)
Foreign	-0.861*	-0.730
	(0.513)	(0.693)
$GCDistance * Foreign$	2.305***	2.048**
	(0.711)	(0.905)
$GCDistance^2 * Foreign$	-0.608**	-0.516*
	(0.253)	(0.313)
Constant	2.409***	1.702**
	(0.500)	(0.701)
$ln(\alpha)$		-0.957*
		(0.526)
Observations	134	134
AIC	451.9	438.4
BIC	483.8	473.1
Log-likelihood	-214.954	-207.186

Standard errors in parenthesis (*** $p < 0.01$, ** $p < 0.05$,* $p < 0.10$)

Looking at the explanatory variables, the coefficient for *Tcost* is negative and statistically significant. This was expected and consistent with the TCM theory, because it indicates that, as the cost of one day trip



(a) Moy fishery (b) Corrib fishery

Figure 1: Perimeter beyond which demand for angling days increases (Radius = 200 km)

to fish increases, the likelihood of spending more days fishing decreases. The price elasticity of angling days demanded is $\beta_c X_{Tcost}$ where β_c is the coefficient on the travel cost variable X_{Tcost}, the latter of which we evaluate at sample mean values.[1] The estimated price elasticity is -1.04 (s.e. 0.21), which is substantially more elastic than prior estimates of game angling in Ireland where estimates have been in the range of -.02 to -0.3 (Curtis and Breen, 2017; Curtis, 2002). At a practical level a 10% increase in costs, which on average equates to €44, would lead to a reduction of 0.28 in angling days demanded.

The coefficient for the variable labelled Moy is non-significant, which means that there are no differences between fisheries in terms of days spent fishing by anglers. Older people, aged 66 years or more, are more likely to undertake trips with a higher number days than younger anglers, as evidenced from the coefficient of *age*66+. This variable can be considered a proxy for retired people, therefore it is reasonable to presume that they have more time for recreational activities. Similarly, anglers whose main occupation involves a professional or managerial position (variable *Prof/Managerial*) are more likely to fish for a larger number of days. This variable can also be considered a proxy for people with higher income levels, it is therefore reasonable that, as the available budget increases, recreational demand increases as well. The size of the group does did not appear to affect the number of angling days. In general, these results are consistent with previous research on angling demand estimation (Hynes et al., 2015; Fisher, 2015).

The quadratic parameters *GCDistance* and $GCDistance^2$ were both statistically significant when explaining demand for angling days among domestic anglers. The negative coefficient for *GCDistance* indicates that as distance increases the number of days in a fishing trip to the Moy or Corrib declines. The positive coefficient on the squared term denotes a turnaround point of about 200 km, which is shown in Figure 1 for both locations. Within a 200 km radius of the fishery, increasing distance is associated with fewer angling days. Outside of the 200 km radius, increasing distance is associated with an increase in angling days. It is difficult to draw conclusions about what causes the initially negative relationship between

[1]The elasticity is calculated as $\frac{\partial E(\mu)}{\partial X}\frac{X}{\mu} = \beta X$, where $\mu = exp(X^{1}\beta)$ represents the mean parameter of the negative binomial density function.

GCDistance and *AnglingDays*. Considering that within 200 km anglers are all domestic, one explanation for making shorter trips as distance increases to 200 km could be that their demand declines with distance, an hypothesis that is backed up by the fact that per-angling-day expenditures are also falling with distance. In this respect, the negative relationship between distance and days demanded could be seen as identifying a preference for anglers' local angling spots. Perhaps medium-distance anglers make short trips to the Galway or Moy fisheries but prefer their local spots for longer duration angling trips. On the other hand, the survey only provides the number of days per trip and not the number of trips that each angler is making per year, so the hypothesis of number of trips falling with distance cannot be empirically explored. Instead, more distant anglers could be exhibiting a preference for shorter but more frequent trips. Our model identifies the fact that their trips are shorter without identifying the frequency of the trips, so we do not actually know the total number of angling days demanded in a year.

Explaining the 200 kilometre turnaround point is more straightforward. In the survey, the maximum distance travelled by a domestic day-trip angler was 187 kilometres. Beyond this distance, day-tripping is practically infeasible and anglers stay overnight. Because the pool of domestic anglers who visited from more than 200 kilometres away contains no day-tripping anglers, being in this pool is associated with an increasing demand for angling days. Without knowing the frequency of trips within a year, it is not possible to state whether these beyond-200 km anglers are actually demanding more angling days over the course of a year or are simply economizing on fixed costs by making fewer but longer trips. We do know that average spending (excluding travel costs) per angling day by domestic anglers from within 200 km was €363 while it was only €302 for domestic anglers from beyond 200km. However, these are not *ceteris paribus* comparisons.

Interestingly, the coefficients for $GCDistance^2$ and $GCDistance^2{*}Overseas$ cancel out in the NB model, indicating that the relationship between distance and demand for angling among overseas anglers is linear. The coefficient for *Overseas* is not statistically significant in itself, indicating that anglers from outside the island of Ireland do not show statistically relevant differences compared to domestic anglers. During the initial analysis, the variable *overseas* was interacted with the travel cost variable, in order to test whether significant differences might be considered between domestic and foreign visitors in terms of cost of travel and related CS. The coefficient was not significant and, therefore, we might presume that there are no relevant differences across domestic and international anglers visiting the Moy and Corrib fisheries. As an additional proof, the sample was split between domestic and overseas anglers, then regressions and welfare measures were calculated for both samples. It was noticed that the confidence interval for the CS of overseas anglers fully falls into the one of domestic anglers. This strengthen the hypothesis that domestic and foreign anglers do not show differences in welfare from visits to the two fisheries.

4. Discussion and Welfare analysis

This study revealed interesting information about recreational fishing activity in western Ireland. In particular, it shows that visitors from overseas are not statistically different from domestic anglers, which means that the two rivers are equally attractive for these two groups of tourist anglers. Similarly, there is no evidence that the two fisheries are different in terms of number of days spent fishing by visitors.

We now move to the analysis of the consumer surplus (CS), which is the measure of the benefit people derive from angling at the two sites. Estimated CS with a 95 % confidence interval (calculated by the delta method, Cox, 1998), for the NB model is shown in Table 3, together with the willingness to pay (WTP). WTP is calculated as the sum of CS and travel cost and represents the maximum amount of money an angler was willing to pay for one day's angling. The CS estimate for the NB model is per day and considering that the median angler spent 2 days fishing per trip, the CS per trip rises to €848. Estimated WTP is €864, corresponding on average to €1728 per trip. Such figures are roughly double the cost sustained for travelling and demonstrate the value for money of recreational angling at the two fisheries.

Table 6: Consumer surplus and Willingness to Pay, €

	Negative binomial (NB)
Consumer surplus	424
95% CI	(257–590)
Willingness to pay	864
95% CI	(700–1033)

In general, results are similar to previous research, in particular Curtis and Breen (2017) found a CS of about €670 for game anglers in the whole Ireland. CS for angling day is higher than those that can be found in other recreational activities. For example, recreation in forest sites provides much lower estimates (see, among others, Zandersen and Tol, 2009). Interestingly, estimated CS for angling in Irish inland waters is higher than that found in the sea (Hynes et al., 2017).

The turnaround point of 200 kilometres for domestic anglers suggests that fishermen who live more than 200 kilometres away from the fishery are more likely to stay overnight at the fishery, bringing more revenue to the local economy in the process. This observation is especially applicable to the Moy fishery, which is harder to access from the major population centres. In the case of domestic tourist anglers the greatest economic impact in the locality of the Moy fishery is likely to derive from anglers resident on the east and south coasts, for example, in cities such as Belfast, Dublin, Waterford and Cork. A limitation of this study is the lack of local respondents, given that the closest angler to either fishery is 34 km away. This bias in the sample will overestimate the expenses sustained by domestic anglers, because local anglers generally have lower travel costs. However, allowing for the bias, the data is a convenience sample of visiting tourist anglers, which itself is of direct relevance to policy makers wishing to utilise angling resources to improve local economic development. While this convenience sample provides useful insight more research with a more extensive dataset is necessary to generalise the results and make conclusive policy recommendations.

5. Conclusions

This paper analysed the demand for salmon angling recreation at two locations in Ireland, based on data from an on-site, self-administered survey questionnaire. Fishing is an important activity and decision makers should be aware of its value to fully inform management decisions. This is fundamental in rural areas, where natural resources are one of the few drivers to generate income for the local communities. Visiting recreational anglers spend (excluding the cost of travel) on average €313/day, which constitutes a valuable source of income for the local communities. Assuming a margin for labour cost of 7–10%, each angler contributes between €22–31 per angling day to local incomes. Although a larger amount of data would be necessary to effectively extrapolate results, this study highlights that angling tourism is an important activity for the local economy.

In addition, the demand for salmon recreation was estimated by means of the travel cost method. Estimated consumer surplus is high, suggesting that tourist anglers visiting the Moy and Corrib fisheries derive appreciable utility from the angling experience. The econometric analysis estimated a mean consumer surplus of ϵ424 per angling day, representing approximately half of the total willingness to pay per day. This finding has an obvious policy implication. Specifically, in the case of the Moy and Corrib fisheries, there would appear to be scope to increase revenues, given that the CS is roughly half of the total willingness to pay. However, visiting anglers' price elasticity of demand is approximately unity, meaning that tourist anglers are quite responsive to costs. For a 10% change in cost (e.g. in permit fees, or travel costs), which across the sample is equivalent to ϵ44/day, there is a one-quarter day reduction in mean angling days demanded. So while the cost of angling on the Moy and Corrib fisheries represents good value to tourist anglers, they are price sensitive and escalating costs are likely result in declining demand among tourist anglers.

The greatest impact to the local economy arises from anglers that stay overnight at the fisheries with associated expenditures on food and accommodation; and such anglers are more likely to live on the east or south coast of the country, which suggests a regional marketing campaign to promote the fisheries. It is worth reaffirming the importance of the sustainability of recreational angling, which is only possible by a regulation of the activities and a constant monitoring of the fish population. As demonstrated by Zwirn et al. (2005), recreational fishing can be seen as an ecotourism activity, in particular in the form of catch and release, which contributes to the well-being of the rural communities.

6. Bibliography

Barry, L., van Rensburg, T. M., and Hynes, S. (2011). Improving the recreational value of ireland's coastal resources: A contingent behavioural application. *Marine Policy*,35(6):764–771.

Bateman, I. J. and Turner, R. K. (1993). Valuation of the environment, methods and techniques: the contingent valuation method. *Sustainable Environmental Economics and Management: Principles and Practice, Belhaven Press, London*, pages 120–191.

Bernues, A., Rodr´ıguez-Ortega, T., Ripoll-Bosch, R., and Alfnes, F. (2014). Socio-cultural and economic valuation of ecosystem services provided by mediterranean mountain agroecosystems. *PloS one*, 9(7):e102479.

Bertram, C. and Larondelle, N. (2017). Going to the woods is going home: Recreational benefits of a larger urban forest site –a travel cost analysis for Berlin, Germany. *Ecological Economics*, 132:255–263.

Besanko, D. and Braeutigam, R. R. (2011). *Microeconomics*. John Wiley & Sons, New Jersey.

Bowles, S. (2009). *Microeconomics: behavior, institutions, and evolution*. Princeton University Press.

Buckley, C., van Rensburg, T. M., and Hynes, S. (2009). Recreational demand for farm commonage in Ireland: A contingent valuation assessment. *Land use policy*, 26(3):846–854.

Cameron, A. C. and Trivedi, P. K. (1986). Econometric models based on count data. comparisons and applications of some estimators and tests. *Journal of applied econometrics*, 1(1):29–53.

Cameron, A. C. and Trivedi, P. K. (2013). *Regression analysis of count data*, volume 53. Cambridge university press.

Chakraborty, K. and Keith, J. E. (2000). Estimating the recreation demand and economic value of mountain biking in Moab, Utah: An application of count data models. *Journal of Environmental Planning and Management*, 43(4):461–469.

Clawson, M. and Knetsch, J. L. (1966). *Economics of Outdoor Recreation*. John Hopkins Press for Resources for the Future, Baltimore.

Cooke, S. and Schramm, H. (2007). Catch-and-release science and its application to conservation and management of recreational fisheries. *Fisheries Management and Ecology*, 14(2):73–79.

Cox, C. (1998). Delta method. *Encyclopedia of biostatistics*.

Curtis, J. and Breen, B. (2017). Irish coarse and game anglers preferences for fishing site attributes. *Fisheries Research*, 190:103–112.

Curtis, J. and Stanley, B. (2016). Water quality and recreational angling demand in Ireland. *Journal of Outdoor Recreation and Tourism*, 14:27–34.

Curtis, J. A. (2002). Estimating the demand for salmon angling in Ireland. *Economic and Social Review*, 33(3):319–332.

Czajkowski, M., Ahtiainen, H., Artell, J., Budziński, W., Hasler, B., Hasselström, L., Meyerhoff, J., Nõmmann, T., Semeniene, D., Söderqvist, T., et al. (2015). Valuing the commons: An international study on the recreational benefits of the baltic sea. *Journal of environmental management*, 156:209–217.

Czajkowski, M., Giergiczny, M., Kronenberg, J., and Tryjanowski, P. (2014). The economic recreational value of a white stork nesting colony: A case of 'stork village' in Poland. *Tourism Management*, 40:352–360.

De Meo, I., Paletto, A., and Cantiani, M. G. (2015). The attractiveness of forests: preferences and perceptions in a mountain community in italy. *Annals of Forest Research*, 58(1):145.

Ditton, R. and Grimes, S. (1995). A social and economic study of the costa rica recreational billfish fishery. *Report prepared for The Billfish Foundation.(The Billfish Foundation: Fort Lauderdale, FL.)*.

Doherty, E., Campbell, D., and Hynes, S. (2013). Models of site-choice for walks in rural ireland: Exploring cost heterogeneity. *Journal of Agricultural Economics*, 64(2):446–466.

Du Preez, M. and Lee, D. E. (2010). The contribution of trout fly fishing to the economy of Rhodes, North Eastern Cape, South Africa. *Development Southern Africa*, 27(2):241–253.

Englin, J. and Shonkwiler, J. S. (1995). Estimating social welfare using count data models: an application to long-run recreation demand under conditions of endogenous stratification and truncation. *The Review of Economics and statistics*, pages 104–112.

Etikan, I., Musa, S. A., and Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1):1–4.

Ezebilo, E. E. (2016). Economic value of a non-market ecosystem service: an application of the travel cost method to nature recreation in sweden. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 12(4):314–327.

Fisher, W. L. (2015). Recreational fishing and socioeconomic characteristics of eastern oklahoma stream anglers. In *Proceedings of the Oklahoma Academy of Science*, volume 82, pages 79–87.

Fletcher, J. J., Adamowicz, W. L., and Graham-Tomasi, T. (1990). The travel cost model of recreation demand: theoretical and empirical issues. *Leisure Sciences*, 12(1):119–147.

Garrod, B., Wornell, R., and Youell, R. (2006). Re-conceptualising rural resources as countryside capital: The case of rural tourism. *Journal of rural studies*, 22(1):117–128.

Garrod, B., Youell, R., and Wornell, R. (2004). Links between rural tourism and countryside capital. *Countryside Agency, Cheltenham*.

Garrod, G. and Willis, K. (1999). *Economic valuation of the environment. Methods and case studies*. Edward Elgar, Cheltenham, UK.

Grantham, R. and Rudd, M. (2015). Current status and future needs of economics research of inland fisheries. *Fisheries management and ecology*, 22(6):458–471.

Greene, W. H. (2003). *Econometric analysis*. Pearson Education India.

Hanley, N. and Barbier, E. B. (2009). *Pricing nature: cost-benefit analysis and environmental policy*. Edward Elgar Publishing.

Hellerstein, D. and Mendelsohn, R. (1993). A theoretical foundation for count data models. *American journal of agricultural economics*, 75(3):604–611.

Hellerstein, D. M. (1991). Using count data models in travel cost analysis with aggregate data. *American journal of agricultural economics*, 73(3):860–866.

Hilbe, J. and Martínez-Espiñeira, R. (2005). *NBSTRAT: Stata module to estimate negative binomial with endogenous stratification*. Boston College Department of Economics. Available online: http://econpapers.repec.org/software/bocbocode/s456414.htmi.

Hindsley, P., Landry, C. E., and Gentner, B. (2011). Addressing onsite sampling in recreation site choice models. *Journal of Environmental Economics and Management*, 62(1):95–110.

Honey, M. (2008). *Ecotourism and sustainable development: Who owns paradise?* Island Press.

Hotelling, H. (1947). Letter to the national park service. *An Economic Study of the Monetary Evaluation of Recreation in the National Parks (US Department of the Interior, National Park Service and Recreational Planning Division, 1949)*.

Hynes, S., Buckley, C., and Van Rensburg, T. (2007). Recreational pursuits on marginal farm land: a discrete-choice model of Irish farm commonage recreation. *Economic and Social Review*, 38(1):63–84.

Hynes, S., Gaeven, R., and O'Reilly, P. (2017). Estimating a total demand function for sea angling pursuits. *Ecological Economics*, 134:73–81.

Hynes, S. and Greene, W. (2013). A panel travel cost model accounting for endogenous stratification and truncation: A latent class approach. *Land Economics*, 89(1):177–192.

Hynes, S., OReilly, P., and Corless, R. (2015). An on-site versus a household survey approach to modelling the demand for recreational angling: Do welfare estimates differ? *Ecosystem Services*, 16:136–145.

IFI (2014). *Wild Salmon and Sea Trout Fisheries Statistics Report 2014*. Inland Fisheries Ireland. Available online: http://www.fisheriesireland.ie/fisheries-management-1/ 608-wild-salmon-and-sea-trout-statistics-report-2014/file.

Kawsar, M. H., Abdullah-Al-Pavel, M., Uddin, M. B., Rahman, S. A., Abdullah-Al-Mamun, M., Hassan, S. B., Alam, M. S., Tamrakar, R., and Abdul-Wadud, M. (2015). Quantifying recreational value and the functional relationship between travel cost and visiting national park. *International Journal of Environmental Planning and Management*, 1(3):84–89.

Lawrence, K. (2005). Assessing the value of recreational sea angling in South West England. *Fisheries Management and Ecology*, 12(6):369–375.

Lew, D. K. and Larson, D. M. (2012). Economic values for saltwater sport fishing in Alaska: A stated preference analysis. *North American journal of fisheries management*, 32(4):745–759.

Martínez-Espiñeira, R. and Amoako-Tuffour, J. (2008). Recreation demand analysis under truncation, overdispersion, and endogenous stratification: An application to Gros Morne National Park. *Journal of Environmental Management*,88(4):1320–1332.

Martínez-Espiñeira, R. and Hilbe, J. M. (2008). Effect on recreation benefit estimates from correcting for on-site sampling biases and heterogeneous trip overdispersion in count data recreation demand models (STATA). *Journal of Modern Applied Statistical Methods*, 7(1):29.

McKean, J. R., Johnson, D., and Taylor, R. G. (2003). Measuring demand for flat water recreation using a two-stage/disequilibrium travel cost model with adjustment for overdispersion and self-selection. *Water Resources Research*, 39(4).

McKinsey, M. and Company, G. (2013). The future of online grocery in europe. *Perspectives on retail and consumer goods*, 1:22–31.

Notaro, S. and Paletto, A. (2011). Links between mountain communities and environmental services in the Italian alps. *Sociologia Ruralis*, 51(2):137–157.

O'Reilly, P. (2015). The economic contribution of salmon and sea trout angling in Ireland. *Report to the National Strategy for Angling Development*. Available online: http://www.fisheriesireland.ie/socio-economics/ 527-the-economic-contribution-of-salmon-and-sea-trout-angling-in-ireland/file.

Ovaskainen, V., Mikkola, J., Pouta, E., et al. (2001). Estimating recreation demand with on-site data: an application of truncated and endogenously stratified count data models. *Journal of Forest Economics*, 7(2):125–144.

Parsons, G. R. (2003). The travel cost model. In Champ, P. A., Boyle, K. J., and Brown, T. C., editors, *A primer on nonmarket valuation*, pages 269–329. Springer, Netherlands.

Raguragavan, J., Hailu, A., and Burton, M. (2013). Economic valuation of recreational fishing in western australia: statewide random utility modelling of fishing site choice behaviour. *Australian Journal of Agricultural and Resource Economics*, 57(4):539–558.

Shaw, D. (1988). On-site samples' regression: Problems of non-negative integers, truncation, and endogenous stratification. *Journal of Econometrics*, 37(2):211–223.

TDI (2013). *Socio-Economic Study of Recreational Angling in Ireland*. Inland Fisheries Ireland. Available online: http://www.fisheriesireland.ie/media/tdistudyonrecreationalangling.pdf.

USFWS (1986). *Togiak National Wildlife Refuge: Final Comprehensive Conservation Plan, Wilderness Review, and Environmental Impact Statement*. US Fish and Wildlife Service, Region 7.

Zandersen, M. and Tol, R. S. (2009). A meta-analysis of forest recreation values in Europe. *Journal of Forest Economics*, 15(1):109–130.

Zwirn, M., Pinsky, M., and Rahr, G. (2005). Angling ecotourism: Issues, guidelines and experience from Kamchatka. *Journal of Ecotourism*, 4(1):16–31.

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