An empirical estimation of the opportunity cost of time for visitors to Gros Morne National Park.

Joe Amoako-Tuffour and Roberto Martínez-Espiñeira*
St. Francis Xavier University

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Abstract

In this paper we apply the individual travel cost method to estimate the value of trips to Gros Morne National Park. We use count data models that account not only for the truncated and overdispersed nature of the distribution of the dependent variable but also for endogenous stratification due to the oversampling of avid users resulting form the on-site sampling. The focus is on the proper estimation of the opportunity cost of travel time as part of the overall cost of the trip. The fraction of hourly earnings that corresponds to the opportunity cost of travel time is endogenously estimated for each visitor as a function of visitor characteristics, rather than fixed exogenously. The analysis reveals that in this application the relevant opportunity cost of time for most visitors represents a smaller fraction of their wage rate than what is commonly assumed in the literature.

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1 Introduction

Often biodiversity sanctuaries are also destinations for recreational purposes. A social value is derived then from user values related to, for example, the viewing of animal species in their natural habitat or from extractive uses such

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as fishing or hunting. In order for this type of natural protected areas to be valued properly and to promote biodiversity conservation, the benefits and impacts of these recreational uses must be clearly documented and demonstrated. This way policies related to the management of protected areas can be based on the knowledge of both the costs and benefits associated with maintaining them. However, since access to natural recreational areas is often only subject to nominal entry fees that clearly underestimate the maximum willingness to pay by most visitors, the value of having them available to the public is unknown and must be estimated through non-market valuation methods. The most commonly used valuation method applied to the case of natural recreation areas is the Travel Cost Method.

Recent applications of the travel cost method are usually based on count data models, since the dependent variable is the number trips taken by the visitor over a certain period of time, which can only take on values that are nonnegative integers.[1] A demand function is generated that explains the number of trips according to the cost faced by the visitor to reach the site and other characteristics of the visitor. The cost of accessing the site is made up by explicit costs such as driving costs, which are approximated on the basis of distance between the visitor's residence and the site and implicit costs such as the opportunity cost of the time used in travelling to the site.

A convenient and cost-effective way to collect data is to conduct an on-site sample of recreationists. However, this implies that the data analysis must account for a series of features associated with on-site sampling. First, since all observed visitors have taken at least the current trip, non-visitors are not observed, so the sample is truncated at zero. Second, sampling on site leads to what is known as choice-based sampling or size-bias, because avid visitors are more likely to end up being sampled than occasional visitors. This means that the data will be endogenously stratified. Finally, the data frequently exhibit overdispersion, since the variance is greater than the mean, because a few visitors make many trips and most make only a few.

Truncated count data models are now routinely applied in single-site recreation demand studies after their evolution since the late eighties (Shaw, 1988; Creel and Loomis 1990, 1991; Grogger and Carson, 1991; Hellerstein and Mendelsohn, 1993). In order to address endogenous stratification too, Englin and Shonkwiler (1995a) developed and empirically applied a truncated, endogenously stratified negative binomial model. However, empirical applications that rigorously correct for all the problems associated with on-site sampling are still relative few (Ovaskainen et al., 2001; Curtis, 2002; McKean et al., 2003; Englin et al., 2003).

In this paper truncated count data models that account not only for the truncated and overdispersed nature of the data but also for endogenous stratification due to on-site sampling are used to estimate the demand curve for trips to Gros Morne National Park in Newfoundland. We follow Englin and Shonkwiler

[1] Note that in this case the dependent variable is the product of trips made times the group size in the current trip, but still a count.

(1995) by modelling the overdispersion parameter of the negative binomial specification as a function visitor characteristics. In addition, we parameterise the fraction of the wage rate that is used to calculate the opportunity cost of travel time.

The econometric analysis is based on count data models that account not only for the truncated and overdispersed nature of the data but also for endogenous stratification due to the oversampling of avid users resulting form the on-site sampling. The main objective of the paper is the estimation of the opportunity cost of travel time as part of the overall cost of the trip. We assume that visitors respond to travel time costs exactly in the same way that they respond to non-time travel costs and we assume that the opportunity cost of time can be proxied as a proportion of the wage rate. Under these assumptions, we endogenously estimate the fraction of hourly earnings that corresponds to the opportunity cost of travel time for each visitor as a function of visitor characteristics. We show that this approach proves to dominate the more restrictive ones often used in previous studies. Traditionally, the opportunity cost of time was based on an arbitrary fraction of the wage rate fixed exogenously and common for all visitors. To our knowledge, there is no published study that uses such a flexible approach to the valuation of travel time while simultaneously addressing the problems of truncation, overdispersion, and endogenous stratification.

The next section of the paper briefly outlines the Travel Cost Method. This is followed in Section 3 by the methodology of the survey and the data collection procedures. The econometric and estimation issues are dealt with in Section 4 followed the description of the data and the definition of variables for the estimation, which follows in Section 5. The estimation results are shown in Section 6, followed by the conclusions.

2 The valuation of time costs in the travel cost method

The Travel Cost Method (TCM) is one of several revealed preference methods used in non-market valuation. It relies on the assumption that, although access to recreational sites often has a minimal or no explicit price, individuals' travel costs proxy the surrogate prices of their recreational experience. If visitors perceive and respond to changes in travel costs to the site as they would respond to changes in an entry fee, the number of trips to a recreation site should decrease with increases in distance travelled and other factors increasing the total travel cost. Socioeconomic characteristics of the individuals and information concerning substitute sites and environmental quality indicators can also be included in the demand function.[2] This function can be used to estimate the total ben-

[2] The weak separability of recreation demand from non-recreation consumption and weak complementarity (Mäler, 1974) of the marketed goods and services needed to get to and enjoy the site makes it possible to estimate a demand curve for individual sites. Therefore, the TCM measures only user values of the site and not non-use values (Krutilla, 1967), such as intrinsic value, existence value, option value, or bequest value.

efits derived by visitors (usually expressed in terms of consumer surplus) and under certain assumptions extrapolated to the general population. Examples of the application of the method to value national parks include Beal (1995) and Liston-Heyes and Heyes (1999).

Many aspects of the Travel Cost Method have been the object of critique and subject to extensive research during the last few decades. However, probably one the most intractable difficulties that remain associated with the method have to do with the calculation of the value of travel time and on-site time.[3]

The calculation of the opportunity cost of time represents one of the most thorny issues affecting the TCM, and one that has received much attention in the literature (Shaw, 1992; Englin and Shonkwiler, 1995b; Feather and Shaw, 1999; Shaw and Feather, 1999; Zawacki et al., 2000; Hesseln et al., 2003; McKean et al., 2003). The value of time, which is a key ingredient of the TCM, must be based on the notion of opportunity cost: the visitor to a site sacrifices not only cash costs but also the opportunity of using the time in an alternative manner. The time used traveling to and from the site and the time spent on the site is could have been devoted to other endeavors (Parsons 2003), so the cost of time is the benefit of the next best alternative forgone. However, something that is sometimes overlooked is that there are many possibilities to conceive the opportunity cost of time used in recreation at a given site, apart from being working time foregone. Beal (1995) suggest as alternatives to recreation at a particular site voluntary work, other leisure activities such as sport, pottering around at home, doing manual crafts, reading, studying or indeed going to another site for recreation. Another reason why the use of wages as the opportunity cost of time might be misleading is because as Shaw (1992) maintained the value and the cost of time are different concepts. Someone with a low wage could value time very highly. In this sense, an individual's value of time is virtually impossible for the researcher to observe (Beal, 1995).

In practice, most empirical applications estimate time cost as a proportion of the visitor's wage in some way. Cesario and Knetsch (1976) first suggested approximating the opportunity cost (value) of time as some proportion of the wage rate. In relation with this approach, a key question is which proportion of the wage rate should be used as a proxy for the opportunity cost of time. Thirty-three percent has probably been the most often chosen fraction (e. g. Hellerstein, 1993; Englin and Cameron (1996); Coupal et al., 2001; Bin et al., 2005; Hagerty and Moeltner (2005)). However, lower fractions of the wage rate have also been proposed. For example, Ward and Beal (2000) suggest 0% as appropriate, since individuals travel for leisure and recreation mostly during holidays when they face no loss of income. Parsons et al. (2003)observe that

[3] Time traveling to the site as well as time spent on-site should be included in the calculation of time cost. However the time at the site is chosen by each individual, making it endogenous. Often on-site time is assumed to be constant across individuals and valued the same as travel time. Sometimes analysts use the sample average length of stay on the last trip as an estimate of the fixed on-site time. In this study, we focus on the estimationof the opportunity cost of travel time.

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 (Hynes et al., 2004).

This assumes that individuals have a flexible working schedule so they can substitute work time for leisure time at the margin. That is, the labour market is assumed to be in equilibrium. Under such conditions, 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. In this case, the product of the hourly wage (adjusted for any other benefits of work) times travel time would represent a fair estimate of time cost.

However, most people are constrained by fixed work-holiday schedules and have no opportunity to substitute paid work for leisure. The leisure/work trade-off does not apply to those working a fixed number of hours a week, since they cannot exchange work time for leisure. The trade-off is also implausible for retirees, homemakers, students, and the unemployed. The trade-off may still apply to the self-employed and others who have discretion over their work schedules.

As pointed out by Smith et al. (1983) the marginal value of on-site and travel time relates to the wage rate only indirectly through the income effect if, as it is often the case, recreation time cannot be traded for work time. Smith et al. (1983) estimated the proportion K to vary considerably among respondents and ended up making on-site time endogenous in their model (Beal , 1995).[4]

McKean et al. (2003) considered a two-stage/disequilibrium approach to value flat water recreation. They assumed that recreationists either preallocate their time between work and leisure before deciding among consumer goods (Larson, 1993; Shaw and Feather, 1999), or employers set work hours (Bockstael et al, 1987), or the recreationists are not in the labour force. Any of these conditions results in a corner solution whereby the wage rates do not equate the opportunity cost of time. This approach does not require the estimation of a money value for the recreationist's time and it explicitly accounts for the fact that in reality wage rates are in general not an accurate proxy for the opportunity cost of time. McConnell (1999) provide an additional rationale for the disequilibrium labour market. Similarly, Bockstael et al. (1987) use a theoretically consistent approach to including time costs in recreational demand models. The demand model is conditional on the recreationist's labor-market situation. For those at corner solutions in the labor market, utility maximization is subject to two constraints, leading to a demand function with both travel costs and travel time as independent variables. With interior solutions in the labor market, time is valued at the wage rate and combined with travel costs to produce one 'full cost' variable.

[4] A respondent's hourly wage could be also calculated using a simple wage regression over the subset of individuals in the sample earning an hourly wage, using self-reported values for this wage rate (Smith, et. al. 1983). The fitted regression is then simulated over non-wage earners to impute a wage. This approach however suffers from the tendency of respondents to be reluctant to disclose their income. Additionally the self-employed and those who earn monthly salaries will be unlikely to know what their implied hourly wage is anyway.

A less common alternative approach is to try and infer values of recreation time from market data in the recreation context (Bockstael et al., 1987) or to estimate the wage fraction that results in the best fitting for a particular data set (Bateman et al, 1996). Englin and Shonkwiler (1995) treated the various determinants of site visitation costs as components of a latent variable, which they estimated using distance converted to money travel costs, travel time, and the wages lost in travel as indicator variables. Using this approach, they provided empirical evidence that using a fraction of the hourly wage (in their case 33%) may be appropriate in measuring the opportunity cost of time.

More recently, Hynes et al. (2004) showed how a potential wage rate can be estimated from a secondary data source to use in the measurement of the opportunity cost of travel time. They evaluated the effect of different treatments of the cost of time on the welfare impacts of a number of different management scenarios.

Another approach is to ask the individuals directly about their opportunity cost of time. Casey et al. (1995) found that estimating recreation demand models using stated values of the opportunity cost of time (rather than the traditional measures based on a fraction of the wage rate) improves the goodness of fit of the regressions. Feather and Shaw (1999) estimated the shadow wage by using contingent behavior questions about respondents' willingness to work further hours along with actual working decisions.

Despite the difficulties and the alternatives described above, the most commonly used approach to value time in travel cost models of recreation demand is still wage-based (Parsons 2003). Most studies impute an hourly wage by dividing the reported annual income by the number of hours worked in a year – usually a number in the range 1800 to 2080 (Sohngen et al., 2000; Bin et al., 2004). Travel time is usually calculated from the estimated travel distance to the site by assuming a certain driving average speed.[5]

Perhaps even more common is to use some fraction of the imputed wage to value time. The fractions range from 0 to 1 in the literature, although a common convention is to use 1/3 of the wage as the value of time (Hellerstein, 1993; Englin and Cameron, 1996; Bin et al., 2005). The recreation literature has more or less accepted 1/3 as the lower bound and the full wage as the upper bound, although neither values enjoy full support. For example, Feather and Shaw (1999) show that for those on a fixed work week, the value of time could actually exceed the wage. Cesario (1976(Cesario 1976)) used 0.43 as the fraction of the wage rate corresponding to the cost of time, Zawacki et al. (2000) and Bowker et al. (1996) used 0, 0.25, and 0.5 as wage multipliers. Liston-Heyes and Heyes (1999) and Hagerty and Moeltner (2005) used 1/3 of the wage. Sohngen et al. (2000) and Sarker and Surry (1998) used 0.3. Hanley (1989) and Bateman et al. (1996) found that using 0% (i.e. excluding time costs) and 0.025% provided them with the 'best' fit for their data.

Finally, there are approaches for inferring values of time from market data

[5] For example, Layman et al. (1996) use 60 miles/hourr, Englin et al. (1996) use 50 km (31 mi) per hour; Casey et al. (1995) and Zawacki et al. (2000) use 50 miles/hour.

in the recreation context (McConnell and Strand, 1981; Bockstael et. al. 1987; Feather and Shaw, 1999). McConnell and Strand, 1981 assumed that the cost of time would be some proportion k of the visitor's wage rate and that k could be estimated from the data using regression analysis. They estimated k to be 0.6 of the wage rate.

Another issue that complicates matters when trying to establish the relevant opportunity cost of travel time is that in principle one should be looking for the perceived cost of travel time as a determinant of the number of trips taken to a recreational site. Moons et al. (2001) consider this problem, finding that the difference between the perceived and calculated time and cost measures is negatively related to distance and frequency of trips. This means that those who do not visit the site often or visit it for the first time may misperceived the time and costs involved in reaching it. It is likely that in practice, there is a difference between the real cost of travel time for the visitor and the cost of travel time as perceived by that visitor. In theory, the relevant cost of travel time that enters the demand or trip generating function is the perceived cost.

Finally, the assumption that travel time has a positive opportunity cost originates in transportation studies dealing with commuting behavior. Walsh et al. (1990) remind us that travel to and form a recreational site may well have consumptive value, implying that a correct measure of net travel cost would be net of these consumptive benefits. This is likely to apply in the case of travelling to a national park such as Gros Morne, since most visitors are likely to derive some benefit from following their routes from their homes to the site.

In any event measuring trip cost calls for considerable researcher judgement. As explained above, when the cost of travel time is estimated using the most common accounting-like procedure, based on a common fraction of the hourly wage estimated as a fraction of annual income, the following assumptions are made:

- There is trade-off at the margin between leisure time and income (although in reality some visitors are not even employed, work fixed hours, etc.)
- All visitors work the same number of hours a year and are paid in the same manner for that job (even if different amounts)
- All individuals value travel cost at the same fraction of their hourly wage rate
- All individuals equally enjoy or dislike travel time and they equally like or dislike their time at work.
- All individuals travel to the site at the same speed
- All individuals perceive the cost of time as calculated by the researcher and are able to correctly calculate the relevant opportunity cost of time themselves

Given all these assumptions, it is not surprising that as expressed by (McKean et al. , 2003):

The consensus is that the opportunity cost component of travel cost has been its weakest part, both empirically and theoretically (McKean et al. , 2003).

In this paper we use a flexible specification of the cost of travel time that, although still based on the notion that the opportunity cost of travel time is given by a fraction of the wage rate, does not impose strong restrictions on what that fraction should be. For example, we allow for the possibility that the opportunity cost of travel time be zero or even negative. Furthermore, we do not restrict the relevant fraction of the wage rate to be common across visitors, but rather we make it a function of visitors' characteristics. Although this approach has been used before, we know of no previous works that apply it together with the correction for the effects of on-site sampling in the distribution of the dependent variable.

3 Data collection

The data used in this study come from an on-site survey of visitors conducted between June and September 2004 at Gros Morne National Park, which covers 1,805 Km^2 on the Southwestern side of the Great Northern Peninsula in the Canadian province of Newfoundland and Labrador. This national park was identified in 1987 as a UNESCO World Heritage Site, due to its rather unique geological features, and it is considered one of Canada's most spectacular and unspoiled locations. The park is most often used during the peak season of July and August for a variety of activities such as hiking, angling, swimming, and whale watching. About 120,000 visitors come to the park annually.

A team of interviewers approached visitors daily (except Sundays) at park entrances and at a series of hotspots within the park. Interviewers were distributed across the park according to a sampling plan ensuring that visitors from all origins and using different facilities had some likelihood of being interviewed. The data were not collected randomly but rather follow a sampling plan developed by Parks Canada that oversampled visitors from rare origins, so the analysis uses sampling weights to correct for this.[6]

Visitors were briefly interviewed (mainly about party size and place of residence) and were then asked to take with them a questionnaire and mail it back after their visit to the Park. A total of 3140 questionnaires were administered and 1213 returned, giving a response rate of 0.386. Note that the format of the survey prevented the use of reminders, since interviewers only asked about zipcodes and postcodes, rather than actual names and addresses. The questionnaire included questions on the main reasons for the trip, the number of times the respondent had visited the park in the previous five years, home location,

[6] However, no correction was possible for oversampling of visitors who stayed longer at the park or who visited more locations within the park (so they would have a higher likelihood of being interviewed).

duration of visit, attractions visited, income, travel cost, size and age composition of travel party, distance to substitute sites, and other sites visited during the same holiday.[7]

Travel cost models assume that trips are for a single purpose only. In our sample the majority of visitors (64%) intended this to be a single purpose – vacation or pleasure- trip and about 65% of respondents indicated that the Gros Morne National Park either was or played a major influence in their decision to visit the island.[8]

4 Econometric Methods

The dependent variable in this analysis is the product of the number if people in the travelling party during the current trip and the number of visits made to the site during the previous five years. This variable takes only nonnegative integer values so it is best modelled as a count variable. Count data models are now commonly used in the estimation of single-site recreation demand models (Creel and Loomis, 1990; Englin and Shonkwiler, 1995; Gurmu and Trivedi, 1996; Shrestha et al., 2002). Hellerstein and Mendelsohn (1993) provide a theoretical basis for the use of count data to model recreational demand: on any choice occasion, the decision whether to take a trip or not can be modelled with a binomial distribution. As the number of choices increases this asymptotically converges to a Poisson distribution. Englin et al. (2003) summarize the history of the application of count data models to recreation demand analysis. For details on the different types of count data models and their properties see Cameron and Trivedi (1998).

A basic approach to modelling count data is to extend the Poisson distribution to a regression framework by parameterizing the relation between the mean parameter and a set of regressors. An exponential mean parametrization is commonly used. The first two moments of the Poisson distribution, the mean and the variance, equal each other, a property known as equidispersion. However, data on the number of trips to a recreation site are often overdispersed, since a few visitors make many trips and many make few trips. This overdispersion of the dependent variable makes the Poisson model overly restrictive. The Poisson maximum-likelihood estimator with overdispersion is still consistent, but it underestimates the standard errors and inflates the t-statistics in the usual maximum-likelihood output. If the overdispersion problem is severe, the negative binomial model should be applied instead. The negative binomial is commonly obtained by introducing an additional parameter (usually denoted α) that reflects the unobserved heterogeneity that the Poisson fails to capture.

When the data are collected on-site, the distribution of the dependent variable is also truncated at zero, since non-visitors are not observed. This feature

[7] For further details about the survey effort, the questionnaire, and the data see Parks Canada (2004a, and 2004b) and D. W. Knight Associates (2005).

[8] Further details on the data collection process can be found in Martínez-Espiñeira and Amoako-Tuffour (2005), which is part of the same overarching research project as this paper.

of the dependent variable leads to biased and inconsistent estimates, because the conditional mean is misspecified (Shaw, 1988; Creel and Loomis, 1990; Grogger and Carson, 1991; Yen and Adamowicz, 1993; Englin and Shonkwiler, 1995) unless it is accounted for by using a truncated negative binomial model. Examples of applications of this model include Bowker, English and Donovan (1996); Liston-Heyes and Heyes (1999); and Shrestha et al. (2002), while Yen and Adamowicz (1993) compare welfare measures obtained from truncated and untruncated regressions.

Finally, since a visitor's likelihood of being sampled is positively related to the number of trips made to the site data collected on-site are affected by endogenous stratification. Fortunately, under the assumption of equidispersion, standard regression packages can be used to run a plain Poisson regression on the dependent variable modified by subtracting 1 from each of its values (Haab and McConnell, 2002, p. 174-181), which corrects for both truncation and endogenous stratification, as shown by Shaw (1988). This model has been used in several applied studies under the assumption of no significant overdispersion (Fix and Loomis, 1997; Hesseln et al., 2003; Loomis, 2003; Hagerty and Moeltner, 2005; Martínez Espiñeira, Amoako-Tuffour and Hilbe, 2006).

However, if the overdispersion of the dependent variable is significant, the Poisson model is not valid and the negative binomial must be used instead. The density of the negative binomial distribution truncated at zero and adjusted for endogenous stratification, derived by Englin and Shonkwiler (1995), cannot be rearranged into an easily estimable form, so it used to require custom programming as a maximum likelihood routine, with the associated increase in computational burden.[9] Further details on the evolution of these count data models, their theoretical properties and their empirical application can be found in Martínez Espiñeira and Amoako-Tuffour (2005).

In this case, we use a negative binomial model that corrects simultaneously for overdispersion, truncation at zero, and endogenous stratification. The density of the negative binomial distribution truncated at zero for the count (y) was derived by (Englin and Shonkwiler 1995a) as:

$$\Pr[Y = y|Y > 0] = y_i \frac{\Gamma(y_i + \alpha_i^{-1})}{\Gamma(y_i + 1)\Gamma(\alpha_i^{-1})} \alpha_i^{y_i} \mu_i^{y_i - 1} (1 + \alpha_i \mu_i)^{-(y_i + \alpha_i^{-1})} \qquad (1)$$

Examples of the use of variants of this model, often with α constrained to be equal across visitors, include Ovaskainen et al. (2001); Curtis (2002); Englin et al. (2003)(Englin, Holmes, and Sills 2003) McKean et al. (2003), and Martínez Espiñeira and Amoako-Tuffour (2005). The empirical application that follows was done using the maximum likelihood programming feature in STATA 9.1. In this paper we allow the overdispersion parameter to vary according to characteristics of the visitors.[10] Furthermore, as described in Section 5, our

[9] These modelling has been made less demanding now for STATA 9.1 users by (Hilbe, 2005) and Hilbe and Martínez-Espiñeira (2005).

[10] We are indebted to Jeff Englin for very useful suggestions on which covariates to use to estimate α in our sample.

analysis extends the previous applications by allowing the data to suggest a value for the fraction of the wage rate that represents the opportunity cost of travel time and by making this parameter a function itself of visitors' characteristics.

5 Model specification and variable definitions

Within the framework of the individual Travel Cost Method, the single-site demand function is

$$Y_i = f(TC_i, TTC_i, S_i, D_i, I_i, V_i) \tag{2}$$

where TC_i is the 'out-of-pocket' travel cost and TTC_i is the cost of travel time; S_i is information on substitutes sites. D_i represents demographic characteristics of the respondent and the visitor party. I_i is a measure of income. V_i captures features of the current visit to the park.

The dependent variable (Y_i) was defined as the number of *person-trips*. It was calculated as the product of the size of the travelling party during the current trip (s) times the number of times the respondent visited Gros Morne during the previous five years (including the current trip). Bowker at al. (1996) proposed the use of this type of variable to circumvent the problem of lack-of-dispersion endemic to individual Travel Cost Method models (Ward and Loomis, 1986). Bhat (2003) also used this format for the Florida Keys because, as it is the case of Gros Morne, group travel by car is very common in the Florida Keys (Leeworthy and Bowker, 1997). Given the geographical size of the relevant market for the park, many long-distance visitors would not travel to the park several times during the same season, so a multi-year time frame was deemed appropriate to balance the need to get variability in the dependent variable while retaining the ability of the respondents to recall how many times they had visited the park.

The independent variables in Expression 2 were constructed on the basis of information obtained through to the questionnaire.[11] The travel cost (TC), measured in CAN$ 1000, was calculated following the approach commonly taken in the literature (Hesseln et al., 2003; Englin et al., 2003), as the number of round-trip kilometers from the visitor's residence to the park times 0.35 $CAN/Km if the visitor entered Newfoundland by ferry. For visitors who entered Newfoundland by air, we assumed that the flight originated in the visitor's hometown and we valued the cost of flying at $CAN/Km 0.20 for one-way distances less than 4000 Km and 0.10 $CAN/Km for one-way distances over 4000 Km (a similar calculation was done by Bhat, 2003).

Unfortunately, we only knew about the point of entry in Newfoundland, not about modes of transportation for the whole trip. Probably some of the visitors we classified as having driven all the way to the park actually flew from their destination to the main hub in Eastern Canada (Halifax) or one of the main hubs in central Canada (Montreal, Toronto, or Ottawa) rented a car

[11] The full text of the four-page 27-question survey is vailable upon request.

and drove through the Maritime Provinces. Distances travelled were calculated based on postal codes for Canadian residents, zipcode for US residents, and country for residents of other countries. We trimmed off from the sample 12 respondents living further than 7500 Km away from the Gros Morne, because long haul travellers are often not well described by the recreational demand model applicable to visitors from closer areas (Beal (1995); Bowker at al., 1996; Bin et al., 2005). In particular, long haul travellers are much more likely to visit the park as part of a multipurpose trip. The estimated travel cost (TC) is then divided by s to normalise it according to the size of the travelling party.

Central to the aim of this study is the treatment of the cost of travel time, the valuation of travel time. Three different specifications were used and compared to value the opportunity cost of travel time. Following the most common approach in the literature, we used the product of round trip time times a fraction of the wage rate. The wage rate was roughly approximated as the ratio of the annual income divided by 1080 hours of work per annum (Sohngen et al., 2000, Bin et al., 2004). Travel time was calculated from the estimated travel distance to the Park by assuming a driving average speed of 80 Km/hour and a flying[12] average speed of 600 Km/hour.

When it came to choosing the relevant fraction of the hourly wage rate to apply as the opportunity cost of time, we followed three different strategies that yielded three different measures of the cost of travel time. $TTC1$ is based on a fraction of the wage constant across visitors and arbitrarily made equal to 0.3. $TTC2$ is based on a fraction K of the wage constant across visitors and estimated from the data. $TTC3$ is based on a fraction of the wage that was allowed to vary across visitors and estimated from the data as a function of characteristics of the visitor group ($K_i = f(\cdot)$). The two last specifications were obtained by introducing a variable composed of travel time times the wage rate as a separate argument in the maximum likelihood program and assuming that individuals respond in the same way to changes in travel cost (TC) and to changes in the cost of travel time. In the case of $TTC3$ that fraction was made a function of a series of characteristics of the visitor. In all three cases, we build our model under the assumption that the the visitor responds to changes in TC as it would to changes in $TTCi$. That is, the money value of time and the out of pocket expenses related to travelling to the site affect the number of trips in the same manner. Therefore, the whole rationale of estimating K for the sample or for each individual hinges on the assumption that the out-of-pocket component of travel costs can be proxied using the traditional accounting-like method. Additionally, since out-of-pocket driving costs are calculated based on the same $/Km for every visitor the differences in efficiency among visitors' cars will be also accounted for as a side product of the flexibilization of K.[13]

[12] For those whose point of entry was one of Newfoundland's airports.

[13] Hagerty and Moeltner (2005) propose two alternative approaches to introduce user-specific driving costs into recreation demand models: one based on a refined measurement of driving costs based on engineering considerations and the second on estimated perceived per mile cost as a function of vehicle attributes in an empirical framework. They find that driving costs are a visitor-specific concept, and that prescribed and perceived costs differ substantially, but

The questionnaire elicited the level of *income* (in $CAN 1000) of the respondents. Although recreation may be considered a normal good, often the influence of income is found to be weak in travel cost studies (Creel and Loomis, 1990; Sohngen et al., 2000; Loomis, 2003). Liston-Heyes and Heyes (1999) even find visits to a national park an inferior good, although Bin et al. (2005) find a significant positive effect of income on the number of trips to North Carolina Beaches. Given the remoteness of Gros Morne, we expected income to exert a positive effect on the number of visits, even though residents of Newfoundland, whose average income is relatively low, would have of course visited very often.

Someone who lives near a substitute recreational site will likely make fewer trips to the site analyzed. Our questionnaire failed to obtain a measure of the distance to the next best alternative recreational site for most respondents, so we followed Bowker et al. (1996) in using a dummy (*substitute*) that takes the value of one if the respondent suggested an alternative site or the distance to it.

Other variables included time spent on the site ($daysatGM$) and the *education* level. The sign of the expected effect of the former was uncertain *a priori*. Shrestha et al. (2002) and Creel and Loomis (1990) find that the longer the duration of the trip the fewer the trips taken and Bell and Leeworthy (1990) also find that people living far away make fewer trips but stay longer at the site. The sign of the effect of the level of educational attainment (*education*) was expected to be positive, although Shrestha et al. (2002) found a negative effect. Visitors were also asked whether they had visited other national parks in the Atlantic region during the current trip, (as in Liston-Heyes and Heyes, 1999). The final model also includes a dummy variable describing whether the respondent declared to be satisfied with the current visit to the park.

We also used information on the number of people in the visitor group sharing travel expenses during the current trip (s) as in Liston-Heyes and Heyes (1999) and Hesseln et al. (2003) and age composition of the visitor group in the current trip (Siderelis and Moore, 1995).

Other questions asked about the visitors' reasons for visiting Newfoundland and Labrador and the relative influence of Gros Morne in their decision to visit this province. This helped us identify and remove visitors from outside the province whose decision to visit Newfoundland and Labrador had little to do with their visit to Gros Morne. Similar variables were also used by Beal (1995); Sohngen (1998); and Liston-Heyes and Heyes (1999).

Finally, different aspects of their experience during the current trip were considered, including an estimate of total out-of-pocket spending in the Gros Morne area per member of the visiting party (*expenses*, in thousands of $CAN). Visitors were asked about the time of decision to visit the park and the degree of influence of different activities (hiking, backpacking) within and different features (the fact that it is a World Heritage site, etc.) of the park in the decision to make the visit. When estimating $TTC3$, we made use of a series of some of these variables related to the type of visitor. These are introduced in

welfare measures generated by these alternative specifications are not statistically different from those produced by the standard model in their empirical application.

Section 6.

6 Results

A great proportion of questionnaires were discarded due to item nonresponse, out of the 1213 completed. Only those visitors who planned the visit to Gros Morne 'before leaving home' were included in the analysis. This is because the 123 visitors[14] who planned the visit to the park after leaving home would clearly be multisite travellers. We also screened off those visitors from outside Newfoundland for whom Gros Morne did not strongly influence their coming to Newfoundland.[15]

Some visitors did not report their *income* and/or their estimated on-site *expenses*. For this visitors, missing values were substituted by the mean sample values calculated from the available observations. For these observations affected by item nonresponse, we assigned a value of one to the variables *missincome* and/or *missexp* respectively, so we could then test the impact of imputing the missing values in the final estimations.

The final sample contained 854 observations. Summary descriptives of the variables used by the demand models are shown in Table 1.

Table 2 shows the results of five specifications, all of which correct for both truncation at zero and endogenous stratification due to the oversampling of frequent visitors.[16] $TSPOI$ assumes equidispersion, since it is based on a zero-truncated Poisson model. We suspected the presence of significant overdispersion at the outset, since most visitors made few trips to the site while a few made many trips. The effect of overdispersion is confirmed by the improvement in goodness of fit achieved by the $TSNB$ specification, as shown in Table 3.[17] The value of the log-likelihood improves further as we allow, in the generalized negative binomial model ($GTSNB$), for the overdispersion parameter (α) to vary across visitors and be a function of the proportion of members under sixteen in the travelling party and visitors' income.[18] These three specifications use as a price variable the combined travel cost and travel time cost (denoted CTC). In order to calculate CTC, we added together TC plus $TTC1$. As explained in Section 5, $TTC1$ is based on the assumption that the opportunity cost of time is 1/3 of the wage rate for all visitors ($K = 0.33$).

[14]To err in the conservative side, we also dropped 16 observations with a miising value for this variable, assuming that those respondents had decided to visit Gros Morne after leaving their home.

[15]On a scale of 0 (no influence) to 10 (primary reason) we only kept those visitors who indicated a value of at least 3, excluding about 19% of the 1213 original observations.

[16]Frequency weights were used to adjust the sampling proportions for the fact that Parks Canada's sampling plan was not random, but rather attempted to oversample visitors from the rarest origins.

[17]This regression was obtained with the routine NBSTRAT (Hilbe and Martínez-Espiñeira 2005) for STATA 9.1.

[18]This regression was obtained with the routine GNBSTRAT (Hilbe, 2005) for STATA 9.1.

Variable	Obs	Mean	Std. Dev.	Min	Max
budgaccom	854	3.344	1.557	1	5
campgrounds	854	0.375	0.484	0	1
CTC	854	1.370	1.231	0.006	8.851
daysatGM	854	3.949	2.710	0.5	40
distance	854	2776.335	1839.730	21.01	18199
educat	854	4.133	1.097	1	6
expenses	854	0.275	0.470	0	12
fjord	854	6.150	3.492	0	10
flew	854	0.381	0.486	0	1
hikback	854	5.576	3.813	0	10
income	854	88.548	42.304	20	160
income	854	88.548	42.304	20	160
incsq	854	9628.356	8081.442	400	25600
missincome	854	0.090	0.287	0	1
missq20	854	0.093	0.290	0	1
museums	854	0.362	0.481	0	1
persontrip	854	3.782	6.228	1	91
propu17	854	0.066	0.170	0	1
propu17	854	0.066	0.170	0	1
satisfied	854	2.499	0.539	1	3
SUB	854	0.636	0.481	0	1

Table 1: Summary descriptives of sample analysed.

The last two specifications $OPTK$ and $GOPTK$ correspond to generalised truncated and endogenously stratified negative binomial models too. However, $OPTK$ is based on a regression in which the travel cost variable was calculated, rather than assuming the cost of travel time at 1/3 of the wage rate ($K = 0.33$), allowing the data to find the optimal value of K. That is, under $OPTK$ the combined travel cost variable is constructed as $CTC = TC + TTC2$. As shown at the bottom of the table, the estimated K is much lower than 33%. This suggests that in this case most visitors would have attached very little opportunity cost to their travel time. This is probably because of a combination of the facts that some of them traveled to the park during vacation time or during weekends, when they could not be earning income, that they were retired, students, or unemployed, and that they enjoyed the time used to travel to the park.

Finally, the specification was generalized further by allowing K to vary across respondents. The results ($GOPTK$) reveal that the proportion of the wage rate that each visitor finds relevant when deciding how many trips to make to the site depends on characteristics of the trip and on characteristics of the visitor party. As expected those travelling from farther distances attached a lower value to their time, probably because they traveled during vacation time. Although the relationship is non-linear, for low levels of income the fraction K rises with income, while it decreases with income for income levels beyond CAN $140,000. Somewhat surprisingly, visitors who travel with children and teenagers find the opportunity cost of their travel time relatively higher in terms of their wage rate. This may be explained, however, by the fact that we are measuring the cost of travel time considering any utility or disutility from travel time itself. It is understandable that those travelling with children will find driving time to the site more expensive both because of the out-of-pocket expenses associated with travelling with children, but also because of the decreased utility of travelling with children (most of all in the case of those who drive to the site). Those whose decision to visit Gros Morne was influenced by availability of accommodation rated 3.5 star or less (*budgaccom*) and by the prospect of enjoying the Western Brook Pond fjord boat tour ($fjord$) faced a higher K. Similarly, those who used campgrounds faced a higher K. We expected that those who flew (rather than driving) to Newfoundland, would face a higher K. We found this positive effect of variable $flew$ on K, but it is not significant.

The main trip generation equation in the upper part of Table 2 shows that, as expected, the coefficient on the combined travel cost CTC (calculated as $TC + TTC_i$, where i=1,2,3) variable takes a negative sign, which results in a negatively sloped demand curve for *persontrip*. This means that the further away a visitor lives, the fewer the visits to the park in the past five years and/or the smaller the visitor party in the current trip. We report the values of consumer surplus per $persontrip$ in Table 2, calculated as \$1000(-1/β_{CTC}).[19] For example The value of -2.4807 yields an estimate of consumer surplus for users

[19] Multiplying by $1000 translates the value of the consumer surplus into dollars, since the variable CTC is measured in thousands of dollars.

of the park of \$403.11 per *persontrip*. As expected, since the travel time cost appears overestimated under specification $TTC1$ (corresponding to $TSPOI$, $TSNB$, and $GTSNB$) of the wage rate (based on a common $K = 0.33$), the estimates of consumer surplus per *persontrip* are corrected downwards under $BESTK$ (based on $TTC2$) and BEST ($TTC3$).

When the value of K is allowed to vary across visitors as a function of different variables (including *income*) *income* appears significant at the 5% level and has a positive sign in the trip generation function. Often income is found to be non-significant in travel cost studies. It is likely that the remote location of Gros Morne makes the visit expensive enough that for many visitors visits is a normal good. Bin et al. (2005) find a significant positive effect of income on the number of trips to North Carolina Beaches. However, the variable on educational attainment *educat* presents alternate and non-significant sign. It is likely that income and education are too collinear to allow for independent estimation of the effect of education.

The variable *expenses* presents the expected negative sign, which suggests that those who tend to spend more on a visit to the park, tend to make fewer trips. The length of the stay at the park ($daysatGM$) exerts a significant and positive effect on persontrips (Bowker et al. 1996) also find a positive sign for time spent at the site. However, this result is at odds with previous findings. Shrestha (2002) and (Creel and Loomis 1990) find that the longer the duration of the trip the less the trips taken and Bell and Leeworthy (1990) also find that people living far away make fewer trips but longer stays. The fact that the length of stay appears positively correlated with the frequency of visits may be associated with the remote geographical location of Gros Morne and the type of recreational activities that it offers.

The dummy variable *substitute* has a non-significant positive sign. In theory, we would have expected that those visitors who came up with a next best alternative to Gros Morne would visit this park less frequently. However, it is also possible that avid recreationists have a more readily available mental list of recreational destinations than those who travel less frequently. It is also likely that respondents failed to successfully come up with a valid substitute for Gros Morne (and that explains why there was a great problem of item nonresponse with this variable)[20], since this park offers a rather unique combination of features. The fact that nearly 92% of the respondents made it a point to visit Gros Morne before leaving home suggests for many the single minded purpose of the trip and the irrelevance of alternative sites closes to home in the decision making. also find the effect of this variable nonsignificant. $satisfied$ presents a negative sign suggesting that those who were not satisfied with their current trip took more frequent trips during the last five years.

Finally the non-siginifcant effect of both missincome and missexp confirms that substituting the missing values of *income* and *expenses* by their sample averages obtained from those visitors who did provide that information did not

[20] This problem of item nonresponse forced us to use a dummy variable for substitutes rather than the distance to the substitute, as originally intended.

Variable	TSPOI	TSNB	GTSNB	OPTK	GOPTK
persontrip	($\alpha = 0$; $K = 0.33$)	(α ; K =0.33)	(α_i ; K =0.33)	(α_i ; K)	(α_i ; K_i)
CTC ($TC + TTC_i$)	-1.3077***	-0.6346***	-0.5680***	-1.7192***	-2.4807***
income	0.0027	0.0018	0.0063*	0.0005	0.0054**
SUB	0.2830	0.2078	0.0869	0.0587	0.1279
education	-0.0034	-0.0250	-0.0019	0.0189	0.0312
expenses	-1.4072**	-0.6633	-0.5141*	-0.3506*	-0.3086**
daysatGM	0.1224***	0.1046***	0.0955***	0.0847***	0.0803***
satisfied	-0.4118***	-0.5465***	-0.4607***	-0.4334***	-0.3422***
missincome	0.243	0.3001	0.3972	0.3196	0.1407
missexp	0.2924	0.3548	0.3490	0.3577	0.3622
cons	2.8082***	1.1372***	0.7066***	1.6095***	1.5042***
ln(α)					
propu17			2.3764***	4.8244**	3.8471**
income			-0.0093	-0.0077*	-0.0052***
cons		1.2897**	1.443**	1.6191***	1.0855***
K					
distance					$-0.047 \cdot 10^{-3}$***
income					0.0053***
income^2					$-0.019 \cdot 10^{-3}$***
budgaccom					0.0078*
propu17					0.1949***
hikback					-0.0048***
fjord					0.0052***
campgrounds					0.0359**
museums					-0.0306**
flew					0.1298
cons				0.1147***	0.5990***
Statistics					
ll	-3516	-2089	-2042	-1976	-1894
N	854	854	854	854	854
χ^2	57.67	106	84.79	99.83	205
CS/trip	$764.70	$1575.80	$1760.56	$581.67	$403.11
$\overline{K}$				-6.7%	0.8%
* p<.1; ** p<.05; *** p<.01					

Table 2: RESULTS RESULTS RESULTS l

Comparison	Test statistic	Significance
TSNBIN vs TSPOI	$\overline{\chi}^2(1) = 2855.16$	$Prob > \chi^2 = 0.0000$
GTSNB vs TSNB	$\overline{\chi}^2(2) = 94.46$	$Prob > \chi^2 = 0.0000$
BESTK vs GTSNB	$\overline{\chi}^2(1) = 130.47$	$Prob > \chi^2 = 0.0000$
BEST vs BESTK	$\overline{\chi}^2(10) = 164.66$	$Prob > \chi^2 = 0.0000$

Table 3: Likelihood ratio tests.

lead to significant biases. This is because the distribution *income* and *expenses* values for those who did not answer those two questions were not systematically different from the rest of respondents'.

The generalized versions of the truncated and endogenously stratified negative binomial ($GTSNB$, $OPTK$ and $GOPTK$) model the overdiseпersion parameter α as a function of income and the proportion of members under seventeen years of age in the travelling party. In this equation, the coefficient on *income* becomes significant only when K is not forced to take the arbitrary value of 0.33.

Table 3 shows the likelihood ratio test results that confirm that the improvements in goodness of fit obtained as the model is made more flexible are significant.

7 Conclusions

In this paper we applied the individual travel cost method to model the number of recreational trips to Gros Morne National Park. We used data collected on-site, so we used count data models that account not only for zero-truncation and overdispersion in the distribution of the dependent variable but also for endogenous stratification due to oversampling of frequent visitors.

We based our analysis on the assumption that the relevant price of a trip can be approximated by the expenses in terms of monetary outlays and time needed to reach the recreational site. Following the previous literature, we assumed that the relevant opportunity cost of time for this purpose is a fraction of the hourly wage rate. However, rather than choosing an arbitrary fraction for all visitors, we allowed the data to determine the fraction that would results in the best fit for our sample. This revealed that the most commonly fractions used in the literature would overestimate the opportunity cost of time and therefore overestimate the consumer surplus derived by the average visitor from access to the park.

Furthermore, we estimated the relevant fraction of the hourly wage rate as a function of individual visitor characteristics. Allowing for a heterogeneous opportunity cost of time proved useful to improve the goodness of fit and confirmed that the proportion of the wage rate that accounts for the value of travel time is an empirical question and that different individuals will respond to travel time costs differently.

Many efforts directed at the conservation of biodiversity have to do with the notion of of valuing and preserving nataural habitats that also provide recreational uses. We expect to have contributed to these efforts by casting light on the technical aspects of the evaluation of the welfare benefits derived from access to these areas.

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