Multi-destination and multi-purpose trip effects in the analysis of the demand for trips to a remote recreational site.

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Abstract

The travel cost method assumes that travel is incurred for a single purpose. However, in remote recreational areas, multi-destination or multi-purpose trips are not uncommon. This paper examines the consequences of allocating travel costs to recreational site when trip was taken for purposes other than recreation and, or included visits to other recreational sites. Using multi-purpose weighting approach on data from Gros Morne National Park, Canada, we conclude that a proper correction for multi-destination or multi-purpose trips is a preferred to eliminating these observations to avoid potential biases in the estimates of the coefficients in the trip generation equation.

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1 Introduction

The valuation of the benefits and costs of recreational sites visits is in its infancy as far as the valuation application methods and their refinements are concerned. The most commonly used method applied to the valuation of the natural resources is the Travel Cost Method (TCM). The TCM relies on the assumption that although access to recreational site has a minimal or no explicit price, individuals travel costs can be used to approximate the surrogate prices for their recreational experience. A basic assumption is that the travel cost is always incurred for a single purpose recreational trip (Haspel and Johnson, 1982; Freeman 1993, p. 447; Loomis et. al, 2000). That is why the TCM is best suited to sites which attract only day-trip visitors. In practice, this is not always the case. How to allocate travel costs for trips involving multiple destinations and/or taken for multiple purposes in recreational demand analysis remains an intractable problem. Several studies have skirted around the issue with simplifying assumptions that the cost were incurred exclusively to visit a single site, or by excluding those visitors considered as holiday-makers and other non-traditional visitors from the sample (e.g Smith and Kopp, 1980; Loomis and
Walsh 1997). Given the remoteness of recreational sites to the majority of visitors, it is likely that many visitors, especially those traveling from outside local communities, will take trips for multiple purposes, including, but not limited to visiting other recreational sites.

The consequences for not recognizing the multi-destination or multi-purpose nature of recreational travel on the valuation of recreational benefits remain conjectural. Excluding multi-purpose or multi-destination visitors may bias the sample considerably, especially in terms of the demographic and socio-economic characteristics of visitors. A priori, the exclusion is likely to underestimate the average consumer surplus and therefore the benefits associated with a site. At the policy level, one consequence is the downgrading of service facilities at the site. On the other hand, simply treating multipurpose and multisite trips as if they were single purpose visits to the site concerned will bias the consumer surplus estimate upwards and possibly lead to an overprovision of services at the site.

This paper examines the consequences of allocating travel costs to recreational site when trip was taken for purposes other than recreation and, or included visits to other recreational sites. With the benefit of survey data which elicited visitors’ decision-making before making the trip, we examine how travel costs may be allocated according to the influence a site may have had in the decision-making process. In particular, we weighted travel costs or each visitor according to the stated influence Gros Morne National Park had on their decision to vacation in Newfoundland and Labrador, Canada.1

In the next section of the paper, we outline the Travel Cost Method and its application to a single site. This is followed in Section 3 by a review of the issue of multipurpose and multisite trips. The methodology of the survey, the data collection procedures, and data description are included in Section 4, while the description of the variables used for the estimation follows in Section 5. The econometric and estimation issues are dealt with in Section 6 followed by the estimation results (Section 7), and then by the conclusions.

2 The travel cost method

The Travel Cost Method (TCM) is one of several revealed preference methods applied to the valuation of non-marketed goods and services. It is often used to assess the value of protected forests, national parks, lakes, and other public areas used for recreational purposes that require most users to travel to the site. The TCM method relies on the assumption that, although access to recreational site has a minimal or no explicit price, individuals’ travel costs, including transportation, accommodation, and lost wages, can be used to approximate the surrogate prices for their recreational experience. The method’s

1It may be useful to clarify that the Canadian Province of Newfoundland and Labrador is made up of Newfoundland, an island, and Labrador, which is in the mainland. When relevant, we will refer below as “Newfoundland” when we mean the insular part of the province, where the studied site is located.
basic premise\(^2\) is that visitors perceive and respond to changes in travel costs to the site just as they would respond to changes in an entry fee, so 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. This function can be used to estimate the total benefits derived by visitors (usually expressed in terms of consumer surplus\(^3\)) 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).

The first step in a Travel Cost study (estimating a trip generating function) can involve one of two types of functions: one based on an individual model, the other based on a zonal model. The type of function determines the dependent variable, which is either the number of trips made by individuals or the number of trips made by those living in a geographical zone. In either case, the independent variables describe the costs of travel. Socioeconomic characteristics of the individuals (or the zone of origin) can also be included, such as zonal populations, socioeconomic characteristics of study participants, information concerning substitute sites, environmental quality indicators, etc. The zonal model used to be more common, but it recently has been mostly replaced by the individual approach. The latter necessitates a more labour-intensive data collection process, as information on all the relevant variables must be collected from each visitor, which increases the length of the questionnaire and the cost of the survey. The individual version of the travel cost method is also more involved analytically, but it is favoured in the technical literature, because it yields more precise results than the simple zonal model.

### 3 Multipurpose/Multisite trips

Many aspects of the Travel Cost Method have been the object of critique and subject to extensive research during the last few decades. A rather difficult issue when designing a Travel Cost study is the treatment of the opportunity cost of time.\(^4\) Apart from the issues related to the calculation of the value of travel time and on-site time, one of the most intractable difficulties that remain associated with the method have to do with the allocation of travel costs for trips involving multiple destinations and/or taken for multiple purposes. This is because a standard assumption of this technique that allows using the travel cost faced by a visitor to a site as a valid proxy for the price of accessing a

\(^2\)Kolstad (2000, Ch. 16) provides a summary of the theoretical basis of the method.

\(^3\)It is the weak complementarity (Mäler, 1974) of the marketed goods and services required to get to and to enjoy the site that makes it possible to estimate a demand curve for the site and, from it, a measure of the benefit society derives from the site. In this sense, it is clear that the measure of value calculated with the TCM is a measure of only the user value of the site.

\(^4\)Amoako-Tuffour and Martínez-Espiñeira (2008) address these issues specifically for the case of visits to Gros Morne.
site is that the travel cost be incurred exclusively to visit that site (Freeman, 1993, p.447). That is, the single-site TCM is based on assuming that travel is for a single purpose (recreation) and to a single site, with the visitor deciding to take her trip to the site before leaving home, travelling directly from home to the site and returning directly home (Loomis, Yorizane, and Larson 2000). This assumption makes it reasonable to allocate all the travel expenses to the valuation of the site concerned. This is why the TCM is best-suited to sites which attract only day-trip visitors. However, many sites, especially those that, like Gros Morne, are located far from big population centres, will probably be visited by people who are on holiday for an extended time period, or who stop at the site without making the trip exclusively for the purpose of visiting it. Including all the travel costs of the latter visitor seems inappropriate, while including only the local travel costs of the former would also be incorrect.

The travel cost method has been, since its first applications, affected by the practical problem of how to handle multi-destination and multi-purpose trips, since many trips to a site of interest fall within at least one of those categories (Clough and Meister 1991; Hwang and Fesenmaier 2003). Although the issue has received considerable attention in the literature, there is so far no consensus on a satisfactory solution. In fact, empirical applications of the TCM rarely consider any correction for potential biases due to multi-destination trips (MDT henceforth) or multi-purpose trips (MPT henceforth).

The problem is often solved by discarding holiday-makers and other non-traditional visitors from the sample (e. g. Smith and Kopp 1980; Common, Bull and Stoeckl 1999), which may well bias many estimates downwards. Omitting MDT visitors from the sample does not necessarily involve any systematic error, as long as the sample is large enough that data availability does not introduce problems. On the other hand, omitting the MDT visitors may substantially decrease the sample size in some cases. However, by only including single destination visitors, the analysis becomes affected by the problem that single destination visitors might differ considerably from MDT visitors in terms of their demographic and socio-economic characteristics. Single-purpose visitors usually live closer to the site considered than MDT and MPT visitors, the omission of long-distance multi-destination travelers might leave some important influences of demographic variables undetected because of little variation in the sample. This can also influence the shape of the estimated demand curve, and hence consumer surplus estimate (Kuosmanen, Nillesen, and Wesseler 2004).

Otherwise, visitors on a MPT may be simply treated as if they were single purpose respondents, which can lead to an overestimation of consumer surplus. Alternatively, one can include a trip-type variable among the explanatory variables. This would be a dummy variable indicating if someone was taking part in an extended trip, a day trip, or just stopping in as part of a multi-purpose trip. This would be equivalent to the separate estimation of demand curves for each group, yet another approach to this issue. Another solution, proposed by Bell and Leeworthy (1990), is to use the number of days of recreation as the dependent variable, and to handle fixed trip costs in addition to daily on-site costs.
For the trips involving multiple destinations (MDT), which pose a similar problem, there is no theoretically-acceptable method of allocating travel costs and the researcher must resort to arbitrary methods, so making no correction at all would be preferable according to some authors (Beal 1995; Beal 1998).\textsuperscript{5} However, the bulk of the available empirical suggests that ignoring the MDT visitors can lead to a substantial overestimation (Haspel and Johnson 1982) or underestimation of the value of recreational sites (Mendelsohn, Hof, Peterson and Johnson 1992; Loomis et al. 2000).

An alternative way to handle MDT visitors is to follow Mendelsohn et al. (1992), who proposed including all alternative sites, and combinations thereof, in the estimation of the demand function, which accounts for all the substitution and complementarity possibilities. One obvious problem with this approach is that the number of demand equations rises exponentially with the number of sites to be considered, and the information to be collected increases tremendously (Kuosmanen, Nillesen, and Wesseler 2004). In fact, if the number of observations corresponding to each combination of sites is small, the system cannot be estimated (Loomis 2006), which rules out this solution in most empirical analyses. One rare example of an empirical application of this solution is Ortiz, Motta and Ferraz (2001).

Smith (1971) and Bowker and Leeworthy (1998) suggest using only the travel cost from a temporary residence to the site valued when this site is not the main destination for the trip. This solution was also suggested casually by Brown and Plummer (1990). However, as pointed out by Mendelsohn et al. (1992), this approach based on ‘marginal prices’ implicitly assumes that having the option of making a trip to the secondary destination does not alter the likelihood or the utility of making the trip to the first destination. Additionally, the researcher has no way of knowing which site was chosen first and which second by the visitor. Ulph and Reynolds (1981, p. 203) also remind us that the approach would lead to biases in those cases where a highly regarded site were just a short distance from a secondary stopover.

Finally, the researcher can try to allocate total costs among multiple destinations. One way to do this is to use a quantifiable variable, such as ‘nights spent’ at each site, as a proxy for their relative importance (Knapman and Stanley 1991; Stoeckl 1993; Yeh, Haab and Sohngen 2006). Another approach would be to directly elicit each visitor’s preferences about the importance of each site within the trip to allocate the cost. As Bennett (1995) points out, the second approach is much more subjective, but it takes into account that the importance of visits is unlikely to be simply a function of the time spent by the MDT visitor on each destination. For example, it has been found that MDT visitors sometimes state that they valued a given site more single destination trips (Sorg, Loomis, Donnelly, and Nelson. 1985). More objective approaches such as using the number of nights spent to weight the importance of a site also usually results in low travel cost values associated with long distance trav-

\textsuperscript{5}On the other hand treating multiple-destination visitors as single destination ones can be seen as equally arbitrary, as pointed out by Kennedy (1998) in his comment to Beal (1995).
ellers, which undermines the logic of the TCM (Beal, 1995; Nillesen, Wesseler and Cook 2005). This makes the strategies based on eliciting visitors’ preferences the theoretically preferred approaches (Walsh, Johnson, and McKean 1988) (Ward and Beal 2000).

Loomis et al. (2000) find, using a methodology proposed by Parsons and Wilson (1997) that is, in essence, a simplified version of the approach suggested by Mendelsohn et al. (1992), that mixing SDT and MDT visitors increases the estimated consumer surplus per trip by at least 20% (and to as much as 70%). However, they also found that MDT value differences were not statistically significant, although they could be still policy relevant. The authors also remind us that even if omitting MDT users may yield an unbiased estimate of per trip consumer surplus, omission of these MDT will result in an underestimate of total site benefits. Loomis (2006) also uses Parsons and Wilson (1997)’s approach to investigate the effect of lumping together multiple destination and single destination trips. Loomis (2006) finds that ignoring the distinction between multiple destination trips and single destination trips results in a substantial underestimation of welfare measures, but that the simplified correction, suggested by Parsons and Wilson (1997), performs well as compared with a stated preference approach, while being much less data and computationally intensive than the one proposed by Mendelsohn et al. (1992).

Kuosmanen et al. (2004) analyze the theoretical effect of MDT on the calculation of consumer surplus estimated by the TCM. They decomposed the MDT effect into two measurable components: the direct effect of the price change, and the indirect effect of the shift of the empirical demand function. They show that treating MDT as single-destination trips does not involve any systematic upward or downward bias in consumer surplus estimates, because the direct negative effect of a price increase (treating MDT as a single-destination trip) is offset by a shift in the estimated demand curve. However, they warned that ignoring MDT altogether can greatly underestimate or overestimate consumer surplus. In their empirical application to Bellenden Kerr National Park in Australia (see also Nillesen et al. 2005) they used ordinal rankings of the alternative MDT sites as a basis for extracting cardinal cost-shares with which to conduct their TCM. Their proposed survey method is described as convenient for respondents, who are only asked to provide ordinal rankings of a small number of alternatives. The complexity of this approach arises, however, when translating the ordinal rankings into cardinal weights.

In this paper we adopt a somewhat similar approach, also based on weighting the price variable in order to adjust for the relative importance of the studied

\footnote{These effects can be visualised by considering that in a linear demand model a downscaling of the price (which is in essence what correcting for the MDT and MPT nature of the trips does) will increase the absolute value of the price coefficient in the direct version of the demand curve, while decreasing it in the inverse version. That is, decreasing the price flattens the inverse demand curve, which would increase the consumer surplus if all the observations were rescaled equally. However, since this is not the case (travel cost for single purpose/destination trips is not adjusted) there will also be a correction in the intercept of the demand curve.}
site within the multidestination/multipurpose trip. The weights are obtained also as ordinal responses to a question posed directly to the respondents. Our study differs from Kuosmanen et al. (2004)’s in that we deal with the individual (rather than the zonal) version of the travel cost method and that we do not use a ranking of several sites but rather a statement of the influence of our single studied site on the decision to take the trip. In this sense, our approach also offers the advantage of simultaneously accounting for both the possible multidestination problem and the multipurpose problem.

4 Data collection

Gros Morne National Park covers 1,805 km² on the Southwestern side of the Great Northern Peninsula in the Canadian province of Newfoundland and Labrador. The park was established in 1973 and identified in 1987 as a UNESCO World Heritage Site, due to its unique geological features (in particular the Tablelands, the Long Range Mountains and Western Brook Pond). It is regarded as one of Canada’s most spectacular and unspoiled national parks. Gros Morne is a key contributor to the Newfoundland’s appeal as an exotic, high quality wilderness area (Locke and Lintner 1997). Most visitors come to hike in the park, mainly during the peak season of July and August. The hiking experience provided by the varied and attractive scenery is enhanced by the opportunities to encounter wildlife (for example arctic hare, caribou, and, above all, moose). The approximately 120,000 visitors7 who annually come to the park also have the opportunity to enjoy other recreational activities such as angling, swimming, and whale watching.

An on-site survey of visitors was conducted between June and September 2004. Visitors were intercepted at park entrances and at a series of hotspots within the park. The team of interviewers randomly sampled visitors daily (except Sundays). Interviewers were distributed across the park according to a careful sampling plan developed by Parks Canada, which ensured that visitors from all origins and using different facilities had a known 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.8 A representative number of sample days were selected throughout the season to cover both the peak and shoulder season and weekend and weekdays within these seasons. 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

7Locke and Lintner (1997) identified the societal, personal and business benefits associated with the park, but provided no monetary estimates of the benefits. While their findings established the broad societal benefits of the park and justified its continuing maintenance and preservation, sustainability requires knowledge of the demand for and use values of the park.

8However, 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).
the Park. A total of 3140 questionnaires were administered with 1213 returned, yielding a response rate of 0.386. The format of the survey prevented the use of reminders, since on-site interviewers only asked about zipcodes and postcodes, rather than actual names and addresses. Although we may not claim about the representativeness of the sample, we were satisfied with the relative success of the interviewing effort, since according to Parks Canada representatives, the usual response rate obtained from similar survey efforts is usually smaller.

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, duration of visit, attractions visited, income bracket, travel cost, size and age composition of travel party, and other sites visited during the same holiday.

Within the full sample obtained ($N = 1213$) 18% of the visitors were over 65, 58% were between 35 and 64 years, 14% in the range of 17 to 34 years and 10.25% were under 16 years. By origin, 41% came from Newfoundland and the other Atlantic provinces, 42% from outside the Atlantic provinces of Canada, 13% from the USA, and 4% from other countries. Most visitors (83%) were from within Canada. The mean income of respondents was $90,000 (in 2004 Canadian dollars).

Travel cost models assume that trips are for a single purpose only. The majority of visitors (64%) intended this to be a single purpose-vacation or pleasure-trip and about 65% of respondents indicated that Gros Morne National Park either was or played a major influence in their decision to visit the island.\(^9\)

We dropped all those trips for which respondents stated a null influence of Gros Morne in the decision to make a trip to Newfoundland or for which information on that variable was missing. This variable is described in more detail in Section 5. It is noteworthy to note one important expected difference between those for whom Gros Morne was not an attractor into the province and the rest of sample: for those visitors for which influence was null only 64.58% stated that they had planned to visit Gros Morne before leaving home, while in the rest of the sample 93.18% of visitors decided to visit Gros Morne before leaving home. Of course this leaves almost 7% of them stating that the park had some weight in their decision to visit the province, but who had not definitely decided to visit the park before leaving home. This could be explained by a combination of several reasons: they decided to visit Newfoundland after leaving home, the left home planning to visit Newfoundland and being influenced by the uncertain prospect of visiting Gros Morne, they had another strong reason to visit the province and considered that the park visit, although a planned activity, would not be at all affecting their decision, or, hopefully in a minority of cases, they provided inconsistent answers to both questions (about when they had planned to visit the park and how heavily it influenced their decision).

The analyses below were based on the resulting subsample containing 986

\(^9\) For further details about the survey effort, the questionnaire, and the data see Parks Canada (2004a, and 2004b) and D. W Knight Associates (2005).
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Table 1: Summary descriptives of employed sample (N=986).

observations, summarised in Table 1. A few (slightly over 10%) of these observations presented missing values for income and expenses which were substituted by the mean values obtained from the complete observations from the rest of the sample. For these observations affected by item nonresponse, we assigned a value of one to the variables missincome and/or missexpenses respectively, so we could then test the effect of imputing the missing values in the final estimations.

Within this 986 sample 83.47% of visitors declared to have taken the trip into Newfoundland for the main reason of "vacation or pleasure"; and additional 7.10% where residents of Newfoundland while for the rest (slightly less that 10%), the main reason included attending a convention or conference, visiting friends/relatives or "other reason".  

5 Model specification and variable definitions

Within the framework of the individual Travel Cost Method, the single-site demand function for the $i_{th}$ visitor is

$$Y_i = f(TC_i, S_i, D_i, I_i, V_i)$$ (1)

where $TC_i$ is travel cost, $S_i$ 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.

\[1\] However, closer inspection of these reasons show that they can mostly be classified within some of the main headings.
As the dependent variable ($Y_i$) we construct a person-trip as the product of current size of the travelling party ($\text{partysize}$)\textsuperscript{11} and the number of times the respondent visited Gros Morne during the past five years (including the current trip).\textsuperscript{12} This type of variable was suggested by Bowker et al. (1996) to ameliorate the lack-of-dispersion affecting to individual Travel Cost Method models (Ward and Loomis 1986). Bhat (2003) also used this variable in the study of the Florida Keys, where group travel by car is very common (Lee worthy and Bowker 1997), as it is in visits to Gros Morne.

The explanatory variables in Expression 1 were constructed on the basis of answers to the questionnaire. A full description of most of these variables can be found in Martínez-Espiñeira and Amoako-Tuffour (2008). Additionally, the full text of the four-page 27-question survey is available upon request. Travel cost ($tc$) is measured in CAN$ 1000 per year and was calculated on the basis of the distance travelled from the visitor’s residence (as determined by the postal code or zipcode in case of North American residents and by country of origin in the case of residents of other countries) and an assumed cost per Km dependent on the mode of transportation used (see Martínez-Espiñeira and Amoako-Tuffour (2008) for details on these calculations).

The valuation of travel time remains a rather complex issue in travel cost method studies (Feather and Shaw 1999; Zawacki and Bowker 2000; Hesseln, Loomis, González-Cabán, and Alexander 2003; McKe an, Johnson, and Taylor 2003). Since the main aim of this study was the analysis of the effects of handling multipurpose trips in different ways, we used a simple proxy of the cost of time: the round trip time times 0.30 times the wage rate to proxy the opportunity cost of travel ($ttc$). The wage rate was approximated by the annual income divided by 1880 hours of work per annum. Travel time was calculated from the estimated travel distance by assuming a driving average speed of 80 Km/hour and a flying\textsuperscript{13} average speed of 600 Km/hour. Again, a more rigorous treatment of travel time could have been possible (e. g. Bockstael, Strand, and Hanemann 1987; Shaw 1992; Larson 1993; McConnell 1999; Shaw and Feather 1999 Larson and Shaikh 2001 2004; McKe an et al. 2003). However, we followed many previous recreation demand analyses by applying a simple ad-hoc specification. For further insights on the issue of estimating the cost of travel time for the same study site see Amoako-Tuffour and Martínez-Espiñeira (2008).

The estimated travel cost ($tc$) is divided by $\text{partysize}$ before adding it to the estimated cost of travel time ($ttc$) to compute the total travel cost to the park, $\text{CTC}$, that acted as a price in Expression 1 (Cesario 1976). Due to the high collinearity between the two measurers, it was not possible to enter them

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\textsuperscript{11}We had to make the implicit simplifying assumption that $\text{partysize}$ as well as other features of the current trip were the same for all the trips made to the park during the period.

\textsuperscript{12}Because of 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.

\textsuperscript{13}For those whose point of entry was one of Newfoundland’s airports.
separately in the model.\textsuperscript{14} Note that this variable did not include any on-site expenses (see variable \textit{expenses} below).

The main contribution of this paper has to do with the treatment of multisite and multipurpose trips. In this paper we decided to take advantage of one of the questions included in the questionnaire. It reads as follows:

\textit{On a scale of 0 (zero) to 10, where 0 indicates no influence and 10 indicates the main single reason, how much influence would you say that the Gros Morne National Park area had in your decision to vacation in Newfoundland and Labrador? (For NL residents, this refers to your decision to vacation within the province versus opting for a trip outside of the province.)}\textsuperscript{15}

Using the values obtained for the resulting variable (\textit{influ}) we weighted the travel cost as previously calculated (\textit{CTC}) for each visitor into the new variable \textit{WCTC}, a weighted combined travel cost. In this way, for those visitors for which Gros Morne was a key determinant of their trip the value of travel cost was not reduced, while for those for whom Gros Morne was not a key influence (because they traveled to Newfoundland for other purposes and/or to visit other recreational sites), the travel cost was adjusted downwards. We expect that this weighting procedure will improve the goodness of fit of the regression relative to the traditional approach that treats MDT/MST observations as if they were single purpose/trip observations. This is because the travel cost method assumes that the number of trips taken to visit a site are the result of a decision made taking into account the cost of reaching the site. When visiting the site is not a strong influence in the decision to travel, it is likely that the cost of travelling to it is less of a determinant factor in the decision to travel. In essence, we expect that the travel cost method is best suited to model the decisions on single purpose and single site trips, so we expect that a correction that downplays the effect of the travel cost variable for MDT/MPT will improve the performance of the model.

We discarded all those observations for which influence took the value of zero or had a missing value. If Gros Morne had no influence in the decision to make the trip for some visitors, it would not be appropriate to include their information in the construction of the trip demand function. The values taken by this variable in the sample analysed are summarised in Table 1.

We ran the regressions with both \textit{CTC} and \textit{WCTC} so we could analyse the effect of weighting the travel cost variable.

The influence of \textit{income}\textsuperscript{16} is often (but not always, Bin et al. 2005) found

\textsuperscript{14}Englin and Shonkwiler (1995a) faced the same problem of multicollinearity and could not independently estimate the effect of the cost of travel time. Other studies (e. g. Fix and Loomis, 1998) use reported travel costs. To avoid survey overburden and avoid response and recall bias, we did not ask respondents to calculate their travel costs themselves. Bowker et al. (1996) used both approaches to variable travel cost calculation and found no appreciable differences.

\textsuperscript{15}This note applied to 87 observations in our sample (N=986).

\textsuperscript{16}We measured \textit{income} as the mid-points of seven income brackets suggested in the questionnaire.
negative and/or non-significant (Creel and Loomis 1990; Liston-Heyes and Heyes (1999); Sohngen, Lichtkoppler, and Bielen 2000; Loomis 2003). In principle, because of the remoteness of Gros Morne, we would expect income to exert a positive effect on the number of visits.\footnote{Even though residents of Newfoundland, whose average income is relatively low, would have of course visited very often.}

Apart from the variables related to price and income, the demand model considered additional variables. The expected effect of the time spent on the site (\textit{dayspent} was uncertain \textit{a priori}).\footnote{Although Bell and Leeworthy (1990); Creel and Loomis (1990); and Shrestha, Seidl, and Moraes (2002) find that the longer the time spent on site the fewer the trips taken.} We asked visitors if they had visited other sites during the current trip (national parks in the Atlantic region, as in Liston-Heyes and Heyes 1999) and kept in the final model a dummy for Terra Nova National Park (\textit{TerraNova}).

We also collected information on the number of people in the visitor group sharing travel expenses during the current trip (\textit{partysize}) as in Liston-Heyes and Heyes (1999) and Hesseln et al. (2003) and the age composition of the visitor group in the current trip (Siderelis and Moore 1995). In addition to \textit{income}, the proportion of party members under sixteen (\textit{propou}17) and of adults between the ages of 34 and 65 (\textit{prop}34 – 65), the \textit{partysize}, whether the visitor entered Newfoundland by plane (\textit{flew}), were used in the final parametrization of the overdispersion parameter \(\alpha\).

Finally, different aspects of visitors’ experience during the current trip were considered, including an estimate of out-of-pocket spending in the Gros Morne area per member of the visiting party (\textit{expenses}, in thousands of \$CAN). Visitors were asked about the time they made the decision to visit the park and whether and to which degree it was influenced by a variety of activities (hiking, backpacking) within the park and by different features (the fact that it is a World Heritage site, etc.) of the park. The variable \textit{camping} (about the influence of camping) and \textit{geology} (about the influence of the Tablelands geology) were used as additional information to parameterize the overdispersion parameter \(\alpha\) in the final model.

\section{Econometric Analysis}

Given the nature of \textit{persontrips}, the dependent variable in the demand equation used for the analysis, count data regression methods were used in its estimation. Count data models are routinely applied in single-site recreation demand models (Creel and Loomis 1990; Englin and Shonkwiler 1995; Gurmu and Trivedi 1996; Shaw and Jakus 1996; Chakraborty and Keith 2000; Curtis 2002; Shrestha et al. 2002; Bin et al. 2005; Hynes and Hanley 2006; Shrestha, Stein and Clark 2007). Regression models for counts differ from the classical regression model in that the response variable is discrete with a distribution that places probability mass at nonnegative integer values only. Count data distributions are also characterized by a concentration of values on a few small discrete values (such as 0,
1 and 2), skewness to the left, and intrinsic heteroskedasticity with variance increasing with the mean (Cameron and Trivedi 1998 and 2001). Englin, Holmes, and Sills (2003) summarize the history of the application of count data models to recreation demand analysis, while further details and comparative analyses on the econometric issues involved in the use of single site visitation data collected on-site are available in Haab and McConnell (2002, p. 174-181); Loomis (2003); Martínez-Espiñeira and Amoako-Tuffour (2008); Martínez-Espiñeira and Hilbe (2008).

Hellerstein and Mendelsohn (1993) justify the application of count data models in recreational demand analysis by considering that 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 the binomial asymptotically converges to a Poisson distribution. This Poisson-based model can be extended to a regression framework by parameterizing the relation between the mean parameter and a set of independent variables.

The first two moments (mean and variance) of the Poisson distribution are equal, a property known as equidispersion. However, data on the number of trips are often substantially overdispersed in practice: the variance is larger than the mean for the data, because a few visitors make a large number of trips while most visitors make only a few. This overdispersion therefore makes the Poisson model overly restrictive. Overdispersion has qualitatively similar consequences as heteroskedasticity in the linear regression model. However, as long as the conditional mean is correctly specified, 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. As a consequence, it can be shown that welfare measures obtained from an analysis based on the Poisson distribution exaggerate the value of recreational destinations.

For cases where the overdispersion problem is serious, a widely-used alternative is the negative binomial model. This is commonly obtained by adding an additional parameter (usually denoted $\alpha$) that reflects the unobserved heterogeneity that the Poisson fails to capture. A likelihood-ratio test based on the parameter $\alpha$ can be employed to test the hypothesis of no overdispersion.\footnote{See Cameron and Trivedi (1990) or Cameron and Trivedi (2001, p. 336) for details.}

An additional feature of the distribution of the dependent variable is that it is truncated at zero, since the data collection was done on-site. Failing to account for truncation leads to estimates that are biased and inconsistent because the conditional mean is misspecified (Shaw 1988; Creel and Loomis 1990; Grogger and Carson 1991; Yen and Adamowicz 1993; Englin and Shonkwiler 1995). The standard Poisson model is unbiased even with overdispersion but this is not the case with the truncated version of Poisson. If there is overdispersion, the truncated Poisson model yields inconsistent and biased estimates (Grogger and Carson 1991). In that case, the truncated negative binomial is in order. This model has been applied in several contributions to the literature during the last decade (Bowker et al. 1996; Liston-Heyes and Heyes 1999; Zawacki and Bowker...
Finally, and also because the data have been obtained on-site, the sample is also endogenously stratified, because each visitor’s likelihood of being sampled is positively related to the number of trips they made to the site (e.g. Shaw 1988; Englin and Shonkwiler 1995). If the assumption of equidispersion holds, standard regression packages can be used to estimated a Poisson model adjusted for both truncation and endogenous stratification. This is because, as shown by Shaw (1988) it suffices 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). This strategy has been followed in several earlier works (Fix and Loomis 1997; Hesseln et al. 2003; Loomis 2003, Bin et al 2005; Hagerty and Moeltner 2005; Martínez-Espiñeira et al. 2006), under the assumption that overdispersion is not significant.

However, for cases in which the overdispersion is significant, the density of the negative binomial distribution truncated at zero and adjusted for endogenous stratification for the count variable \( y \), derived (Englin and Shonkwiler 1995) as:

\[
\Pr[Y = y | Y > 0] = y! \frac{\Gamma(y_i + \alpha_i^{-1})}{\Gamma(y_i + 1) \Gamma(\alpha_i^{-1})} \alpha_i^{y_i} \mu_i^{y_i-1} (1 + \alpha_i \mu_i)^{-(y_i + \alpha_i^{-1})} \tag{2}
\]

cannot be manipulated into an easily estimable form, so it needs to be programmed as a maximum likelihood routine. The associated increase in computational burden probably explains why applications of this model are more rare (Englin and Shonkwiler 1995; Ovaskainen, Mikkola, and Pouta 2001; Curtis 2002; Englin et al. 2003; McKeen et al. 2003; Martínez-Espiñeira, Loomis, Amoako-Tuffour and Hilbe 2008). Most of these applications are based on a version of (2) that restricts the overdispersion parameter \( \alpha \) to a common value for all observations (so \( \alpha_i = \alpha \)). In this contribution we use a negative binomial model that corrects simultaneously for overdispersion, truncation at zero, and endogenous stratification. We also report regressions based on allowing the overdispersion parameter to vary according to the characteristics of the visitor (\( WGTSNB \) and \( GTSNB \)) and compare them with the more restrictive approach (\( WTSNB \) and \( TSNB \)). The software code is available for STATA 9.1 as downloadable commands \( NBSTRAT \) (Hilbe and Martínez-Espiñeira 2005) and \( GNBSTRAT \). The former restricts the overdispersion parameter to a constant, while the latter generalises the approach to allow that parameter to vary across respondents.\(^{20}\)

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 (2008) and Martínez-Espiñeira and Hilbe (2008).

\(^{20}\)We are indebted to Jeff Englin for very useful suggestions on which covariates to use to estimate \( \alpha \) in our sample.
7 Results

The results of applying several econometric specifications to the data are reported in Table 2. Three types of specifications are used, and for each we report both the results obtained with a plain travel cost variable and the results obtained with a travel cost variable weighted according to the influence of Gros Morne in the decision to take the trip. The latter are signified by the letter W at the start of the relevant acronym. All the reported results correspond to models in which endogenous stratification is accounted for, while they differ in terms of the way in which the problem of overdispersion is handled. The third and second specifications are nested in the first one and the last specification is also nested in the second. The first specification (WTSP and TSP) corresponds to a truncated Poisson regression that accounts for endogenous stratification but assumes equidispersion. The second specification accounts for truncation but also for overdispersion, since it is based on the Negative Binomial Regression rather than the Poisson (WTSNB and TSNB). Finally, WGTSNB and GTSNB further generalize the truncated negative binomial corrected for endogenous stratification by allowing the overdispersion parameter to vary across observations.

The results show that the model specified appears highly robust in the sense that there are no sign changes across specifications and only the statistical significance and the goodness of fit differ. These differences confirm that accounting for the effects of using on-site sampling largely improves the efficiency and consistency of the estimates. In fact, Table 2 also shows that the econometric specification that best fits the data is the one that accounts not only for the truncation, but also for endogenous stratification affecting the dependent variable, while allowing the overdispersion parameter to vary across visitors according to characteristics of the visitor group.

The overdispersion parameter (α) is significant in the truncated negative binomial models, which confirms that overdispersion is a problem. A likelihood-ratio test of WTSNB versus WTSP yields a test statistic $\chi^2(1) = 1461.72$ and while $\chi^2(1) = 1418.78$ for the comparison between the unweighted TSNB and TSP. In both cases $\text{Prob} > \chi^2 = 0.0000$, further confirming the superiority of the negative binomial specification. Therefore, the models based on the Poisson distribution are overly restrictive, since they fail to account for the fact that many visitors take a few trips, while only a few take many trips. The coefficients of all the covariates in the equation are highly significant, confirming that using

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21 A likelihood-ratio test of $\alpha=0$ yields $\chi^2(01) = 1210.70$ for the unweighted case and $\chi^2(01)=1244.99$ for the weighted case ($\text{Prob} > \chi^2 = 0.0000$ in both cases) from a simpler zero truncated negative binomial regression (not reported but available upon request). See Footnote 22 about the validity of likelihood-ratio tests with sample-weighted regressions.

22 The "likelihood" for regressions that use probability weights (which is our case, due to the sampling strategy followed for the survey) is not a true likelihood, that is, it is not the distribution of the sample. When proportionality weights are used, the "likelihood" does not fully account for the randomness of the weighted sampling. Therefore the standard likelihood-ratio test should be relied on. For this reason, we report diagnostic statistics based on the unweighted versions of each specification.
<table>
<thead>
<tr>
<th>Variable</th>
<th>WTSP</th>
<th>TSP</th>
<th>WTSNB</th>
<th>TSNB</th>
<th>WGTSNB</th>
<th>GTSNB</th>
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<td>expenses</td>
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<td>0.1106***</td>
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<td>0.0842***</td>
<td>0.8125***</td>
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<td>-0.0135***</td>
<td>-0.0137***</td>
<td>-0.0135***</td>
<td>0.8125***</td>
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<td>101.2</td>
<td>110</td>
<td>109</td>
<td>104.2</td>
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<tr>
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<td>7718.425</td>
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<td>4656.938</td>
<td>4268.913</td>
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<tr>
<td>$CS$</td>
<td>$589$</td>
<td>$841$</td>
<td>$1,137$</td>
<td>$1,688$</td>
<td>$1,725$</td>
<td>$2,515$</td>
</tr>
</tbody>
</table>

Legend: * p<.1; ** p<.05; *** p<.01

Table 2: Dependent variable is persontrips. TSP = Truncated and endogenously stratified poisson; TSNB = Truncated and endogenously stratified negative binomial; GTSNB = Generalised truncated and endogenously stratified negative binomial. W signifies the use of the weighted travel cost variable (WTCT) rather than CTC.
the same overdispersion parameter for all observations would be overrestrictive.

We can see that the goodness of fit as measured by the log-likelihood estimate improves as the model becomes more flexible. A likelihood ratio test comparing WGTSNB and WTSNB yields a test statistic of $\chi^2(6) = 351.25$ ($\text{Prob} > \chi^2 = 0.0000$). For unweighted case (GTSNB versus TSNB) $\chi^2(6) = 343.26$ ($\text{Prob} > \chi^2 = 0.0000$).

However, and contrary to our a priori hypothesis, weighting the travel cost variable according to the influence of the park in the decision to take the trip does not improve the goodness of fit. In fact, that correction results in a very slight decrease in goodness of fit, as measured by the Akaike Information Criterion. However, and as expected, accounting for the multipurpose/multidestination nature of trips does correct the estimate of consumer surplus downwards quite substantially. This is, of course, more likely to have policy implications than the effects on statistical goodness of fit.

The usual approach of dropping observations suspected to correspond to MDT and or MPT arguing that they would not fit so well with the travel cost model might be somewhat misguided. A proper correction for the importance of MDT and MPT is more what is needed to avoid biased estimates of consumer surplus.

Apart from the price variable (the travel cost variables CTC and WCTC), which presents the expected negative sign, the trip generation equation includes as additional variables income, expenses, dayspent, TerraNova and dummies for the cases with imputed income and expenses. Table 2 shows that income has a positive effect on the number of trips, making visit to Gros Morne a normal good.

Often income is found to be non-significant in travel cost studies. The remote location of Gros Morne makes the visit expensive enough for many visitors for visits to be a normal good. However, it is noteworthy that this effect appears significant only when the overdispersion parameter is allowed to vary according to several characteristics of the travelling party. These are camping (importance of camping activities in the decision to visit Gros Morne), the size (partysize) and age composition of the travelling party, through variables prop34-65 (proportion of members between the ages of 34 and 65) and propu17 (proportion of members under 17 years of age); flew, which identifies those visitors who entered Newfoundland by air and income itself. One of the effects of parameterising the overdispersion parameter consists of refining the estimated coefficients in the main equation (Martínez-Espiñeira and Hilbe 2008), so it is not surprising that allowing income to affect the degree of overdispersion in the distribution of the variable persontrip helps bring significance to this variable in the main equation.

Those who spent more during their last visit to the park tend to have made fewer trips to the park in the previous five years. This probably reflects that expenses are related to variable costs associated with staying at the park. Avid visitors will have invested in equipment (such as tents, recreational vehicles, etc.) that can substantially reduce the variable cost of the visit. Experienced outdoor enthusiasts may also have the extra knowledge that allows them to make their
stays cheaper and this would also apply to those who are more knowledgeable about Gros Morne and its facilities because they made more trips in the past.

The effect on trips of the length of stay (days spent) on the number of trips is significantly positive. This result agrees with the findings of Bowker et al. (1996) but it is at odds with those of Shrestha et al. (2002), Creel and Loomis (1990) and Bell and Leeworthy (1990). The fact that the length of stay appears positively correlated with the frequency of visits may be due to the remote geographical location of Gros Morne and the type of recreational activities that it offers.

Visitors were asked about whether they had visited a series of other recreational sites in Atlantic Canada. The variable TerraNova enters the final model with a negative sign. This confirms the a priori expectation that first time visitors to Gros Morne from outside Newfoundland were more likely to take advantage of the trip to also visit Terra Nova National Park. On the other hand residents of Newfoundland and Labrador and more experienced and knowledgeable visitors were less likely to visit Terra Nova, since Gros Morne appears to be the clearly preferred choice among most people who have experienced both sites.

The non-significance of variables missincome suggests that those who did not to reveal their income range were not significantly differ in terms of their recreational demand from those with an average income level. However, we suspect that those who failed to suggest a value for expenses appear to have expenses likely higher than the average visitor. This is because expenses itself has a negative effect on persontrips and missexp has a positive and somewhat significant effect on persontrips.

7.1 Welfare estimations

In Table 2, we report the corresponding estimated measures of consumer surplus per persontrip. These are obtained as the inverse of the negative of the travel cost coefficient. We use only the estimated coefficient of either CTC or WCTC to calculate welfare measures. The coefficient on the variable expenses is not considered, since these expenses are mainly endogenous, a choice of the user. It is true that expenses include some component of user fees, but these are usually relatively small compared with the full cost of the visit. In any event, the welfare measures reported should be regarded as a conservative lower bound for the full benefit derived by users.

It is noteworthy that the weighting of the travel cost according to the influence the site had in the decision to make the trip brings down the estimate of consumer surplus per persontrip (equal to $2,515 to $1,725 under the most flexible specification. This suggests that for the present data set, which includes many long distance travellers (average distance travelled is 2,787.4 Km) and therefore many MDT and MPT visitors, the estimate of consumer surplus would be exaggerated in almost 50% by ignoring the MDT and MPT nature of some of the trips. The adjustment affects in a very similar way the consumer surplus estimates obtained by the other econometric specifications
since $\frac{1,137}{1,688} = 0.67$ and $\frac{589}{841} = 0.70$

These estimates of consumer surplus are clearly larger than those estimated by Martínez-Espiñeira and Amoako-Tuffour (2008) from the same general dataset. This is partly because in the analysis presented here we do not drop the observations corresponding to those visitors travelling more than 7,500 Km to reach Gros Morne nor do we eliminate from the sample those visitors who declared not having been strongly influenced by Gros Morne when deciding to visit Newfoundland and Labrador. Under the weighted models, we do adjust the consumer surplus downwards for visitors who took MDT and/or MPT. And it is, as noted by Martínez-Espiñeira and Amoako-Tuffour (2008), likely that most of these MDT/MPT are long-haul visitors. However, even after the correction imposed by the weighting procedure used here, visitors who bear the travel cost of a very long trip add substantially to the average consumer surplus per trip.

However, not only are the estimates of consumer surplus larger than those estimated by Martínez-Espiñeira and Amoako-Tuffour (2008). The difference between consumer surplus under TSNB and under GTSNB is also much larger than it was in that earlier analysis. This is likely also because now we do not discard those visitors travelling the longest distances. For these visitors, the improvement in the estimation of the effect of income on the number of trips we achieve by allowing the overdispersion parameter to vary across observations and which makes the income coefficient significant in the trip generation equation is obviously much more relevant. Underestimating the effect of income for those consumers leads to a much more substantial overestimation of the effect of the price (travel cost) variable and therefore a much more substantial underestimation of the consumer surplus. This is because longer trips are more expensive, so their number is more strongly affected by the purchasing power of the visitor.

In more conventional samples made up of visitors living all relatively close to the site this would likely not be the case. But then again, the procedure suggested here is meant to avoid the need to trim the sample in order to make it better meet the requirements of single site single purpose of the traditional TCM.

As shown in Table 2, where $E(person\text{trip})$ is the mean of the predicted number of persontrips under each specification, the weighting of the travel cost according to the influence of the site in the decision to make the trip has the expected effect of decreasing the predicted consumer surplus per trip, but it also exerts the countervailing effect on the expected overall consumer surplus by correcting the predicted number of trips upwards. This two effects are

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23 These are only 8 visitors from our sample (N=986) but they travelled on average a distance over three times larger than the other visitors.

24 Note also that income is more statistically significant in the analysis of the larger sample presented here than in Martínez-Espiñeira and Amoako-Tuffour (2008).

25 Because long haul travellers are often not well described by the conventional recreational demand model, they are often dropped from the sample (Bowker at al. 1996, Bin et al. (2005). Beal (1995) discards all overseas visitors to Carnarvon National Park in Queensland.
analogous to the two effect (direct and indirect) that Kuosmanen et al. (2004) postulated when applying a similar type of corrections to the demand for trips. The calculation of the average consumer surplus per trip is based only on information about the estimated coefficient on the travel cost variable ($\beta_{(W)CTC}$), while the prediction of the expected number of trips uses information also about the model intercept.$^{26}$

Again, which of the two effects prevails will vary on a case-by-case basis.

8 Conclusions and suggestions for further research

In this paper we show the effects of correcting trip demand curves and associated consumer surplus measures to account for the fact that some visitors include the visit to a recreational site only as part of a more comprehensive trip and/or consider that visit only one of the purposes of the trip. We address this problem by weighting the values of the travel cost according to the influence visitors declared the visit to the site considered, Gros Morne National Park, had in their decision to vacation in Newfoundland and Labrador.

We find that for the case of a remote site such as the one analysed the effect of this correction can be very substantial. We also show that the effect over total estimated consumer surplus can be the result of countervailing effects on the estimated consumer surplus per trip and the predicted number of trips.

Accounting for MDT and MST does not seem to improve goodness of fit measures relative to the often applied strategy that treats both types of trips as single purpose/destination trips.

The results suggest that it would be desirable for researchers to inquire about the nature of trips for the visitors when conducting surveys aimed at developing travel cost method analyses. This confirms recommendations from the previous literature that favour the use of approaches based on information from the visitors to handle the problem of multipurpose and multidestination trips.

References


$^{26}$The prediction of the number of trips under the truncated and endogenously stratified negative binomial models is based on $E(Y_i|x_i) = \lambda_i(1 + \alpha_i\lambda_i)$ (Englin and Shonkwiler 1995), which accounts not only for the value of the overdispersion parameter $\alpha$ but also the predicted count rate, which is determined by the values of all the coefficients in the model. The TSP models are based on a simple Poisson regression whose predictions also use information from the whole set of estimated coefficients.


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