Individual versus Household in Recreation Demand Models

Marcella Veronesi

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Abstract

This study proposes a novel approach to estimating a recreational demand model that accounts for intra-household resource allocation. The technique is based on an analogy borrowed from the literature of collective household behavior and, in particular, on Browning, Chiappori and Lewbel (2004)’s model. We formulate a collective recreational model that takes into account the role of each member’s preferences for consumption choices and that depends on how disposable income is divided within the household. We compare the collective recreational demand model with the traditional recreational demand model. This yields the identification of individual welfare measures such as compensating variation and consumer surplus for each household member. The policy maker can apply these welfare measures in order to find the best management strategy for a natural area. Finally, we provide some evidence of significant difference in recreational demand across six groups: single men, single women, wives and husbands with and without children.

*JEL Classification:* H0

*Keywords:* Collective Model, Consumer Surplus, Individual, Household, Recreational Demand Model.
1 Introduction

For a wide variety of environmental resources and public goods, the absence of markets makes it extremely difficult to establish a monetary value for access to these commodities. Whenever events or a proposed change in policy affect quality or availability of these market goods, either explicit or implicit cost-benefit analyses must often be undertaken.

For some time, economists have experimented with alternative methods of eliciting or inferring the social value of these non-market goods. The familiar Travel Cost Method (TCM) popularized by Clawson and Knetsch (1966) aggregates visitors to a recreational site into their zones of origin and it explains the change in visitors rates from each zone by the travel cost, the income, the socio-demographic characteristic of visitors and the characteristics of the alternative sites. More research has provided extensions to the original zonal travel cost method. Research shows efficiency gains in estimating recreational demand models using the observations of individuals themselves rather than traditional zone averages (e.g. Brown and Nawas, 1973; Willis and Garrod, 1991).

We argue that these models treat the term ‘household’ and ‘individual’ as synonyms. A household is defined by Becker (1965) as a ‘small factory.’ It consists of individuals motivated sometimes by self-interest, other times by altruism and often by both, or as if they agree on the best way to combine capital goods, time and home production activities. Traditional recreational models focused on defining a household as having the same utility level as a single individual, implying that intra-household resource allocation is irrelevant, or that it can be addressed within a dictatorial decision process.

In particular, the traditional travel cost method is limiting in that it can reveal consumer preferences for non-market goods by only capturing family behavior. It assumes that a household acts as an elementary decision making unit. This approach is said ‘unitary.’ However, a household consisting of several members does not necessarily behave as a single agent and individuals have utility, not households (Browning, Chiappori and Lewbel, 2003). Note that from this point we will refer to them as BCL.

In the recreational framework, consider, for example, the case of two spouses going to visit a natural park together and the case of an individual living alone who goes to visit the natural area. The main question to ask should be, ‘how much is an individual living
alone willing to pay to attain the same indifference curve over goods as an individual attains as a member of the household?"

The utility of this study can be derived from the observation that within households choices are affected by the presence of other adults and children. In addition, usually only the household’s total purchases are observed in recreational surveys and not their distribution and use among members. Thus we have to identify the individual’s preferences and since the distribution of resources within the household is not usually recorded, it has to be identified from the aggregate household demand. In order to identify the individual preferences we can use either information on exclusive goods consumption by individual living in the same households (Chiappori 1988’s approach), or information about the consumption of individuals living alone as if they were living in the family (BCL’s approach).

Still, a comprehensive study of the collective model applied to recreational demand models does not exist. This study proposes a novel approach to estimating a recreational demand model that accounts for intra-household resource allocation. The technique is based on an analogy borrowed from the literature of collective household behavior and, in particular, on the BCL model. Thanks to the BCL model, combining data from households and from people living alone, we can completely identify the sharing rule that expresses the bargaining power between household members.

The paper is organized as follows: Section II presents an overview of the literature about individual versus household in non-market valuation and the collective nature of household decisions. Section III outlines the BCL model’s basic structure; it presents the traditional recreational demand model and it derives our extension of the BCL model to the recreational demand model. Section IV provides some evidence of significant difference across six groups: single men, single women, wives and husbands with and without children. The last section summarizes and discusses the welfare implications of the framework for collective household model with suggestions for future research.

2 Literature Review

It is by now accepted that the distinction between individual and household in recreational models matters. Smith (1988) compares five methods for estimating travel
cost recreation demand models with microdata and argued that a component of research strategy should involve ‘systematic effort at understanding how individuals make their recreation choices and whether these are adequately described by any of these models’ (p.35). Quiggin (1998) considers whether the willingness to pay for the benefit generated by a public good should be elicited on an individual or a household level, in the context of contingent valuation.

Other authors (e.g. Haab and McConnell, 2002; Bockstael and McConnell, forthcoming) recognize that they ignore the distinction between household and individual in their work. In particular Bockstael and McConnell note that ‘the distinction between the individual and the household is a difficult one for which there is, to date, no adequate treatment. In the original paper on household production, Becker treated the household as the decision making unit, suggesting that intra-household allocations of consumption and production activities would be made ‘optimally’ (p.512). In the forty years since that paper, little progress has been made in explaining this intra-household allocation process or in reconciling the distinction between the household as decision maker and the individual members as consumers. We continue to use the terms individual and household interchangeably, but recognize that embedded in their distinction are potentially important considerations’ (p. 8, Chapter 4).

In the framework of revealed preferences, the only papers that we could find specifically addressing these issues are by McConnell (1999), Dosman and Adamowicz (2002), and Smith and Van Houtven (1998, 2004).

McConnell (1999) states that the fact that many studies do not distinguish between individual and household makes the empirical estimates ambiguous. Further, ‘economists need to think carefully about the individual versus the household in designing surveys and in measuring welfare’ (page 466). He attempts to address this issue by developing a recreational model based on two spouses sharing income and household production and earn different wages. The limit in this approach is that the basic structure of the model is the unitary model that assumes that a household has a single utility function and there is not bargaining and intra-household allocation of resources between household members.

Dosman and Adamowicz (2002) examine the choice of two spouses for a vacation site. They investigate intra-household bargaining using stated and revealed preference
data. They overcome the problem that individual preferences for the site are not observed using stated preference methods. They ask each partner to make choices in a stated preference experiment and they use these choices to develop estimates of the spouses’ preference parameters. Then they construct a bargaining model as the weighted average utility of partners’ preferences. Since the household decision about the vacation site is observed, they estimate the bargaining parameter as the value that provides the best fits between the actual household choice and the weighted utility. They do not distinguish between couples with and without children, they assume that the time cost of each partner is a fraction of the wage times the number of hours traveled and, finally, they do not consider economy of scope deriving from traveling together. They find that the probability that the household will choose the husband’s favorite vacation site is decreasing as the husband’s income is increasing. This is because the wife’s power for the vacation site decision is increasing as the partner’s income is increasing. The opportunity cost of time for the husband is higher and he spends less time in planning the vacation.


Chiappori (1988) propose the first collective model, which is a static labor supply model. This model assumes that the objective function of the household is the weighted sum of the utility functions for each member’s preferences. The weights represent the bargaining power of the household members in the intrahousehold allocation process. The rule that determines the sharing of total expenditure on private goods within the household is defined ‘sharing rule’. The bargaining power is affected by exogenous variables, called ‘distribution factors’ (Browning et al., 1994), which influence the decision process without affecting budget constraint. Examples are tax laws that differ according to marital status and the divorce law. Changes in these variables may effect outside opportunities of the household members and may have consequences in their bargaining power. An increase in an individual’s nonlabour income may shift bargaining power from one individual to the other and this affects the allocation of household
consumption and labour supply (see Vermeulen, 2002 and Browning, Chiappori and Lechene, 2004 for a detailed overview of collective models).

We identify two weaknesses in this model, and consequently in Smith and Van Houtven (1998, 2004)’s approach, since it follows Chiappori’s model. The first weakness is that they can identify the sharing, bargaining function only up to a constant; the second is that they can estimate this sharing function only by the estimation of two exclusive goods privately consumed. Smith and Van Houtven consider the case of a two-member household where each individual consumes two private goods and in addition each person consumes one of these goods exclusively, for example man sport fishing and woman swimming in the ocean. Finally, both members consume a third private good. They analyze the case where one member engages in a specific recreational activity affected by a change in environmental quality, and the other member does not. The authors do not investigate the case when both household members are affected by the change in environmental quality. They point out that it is still possible to recover individual preferences but that the problem is more complicated.

BCL (2003) propose an alternative approach. They overcome these weaknesses using household’s consumption aggregate data of singles and couples. They note that ‘In general, only household’s total purchases are observed, and not their distribution and use among members. This raises three questions. First, one has to identify individual preferences. Secondly, since the distribution of resources within the household is not recorded, it has to be identified from the aggregate household demand - a standard problem of the collective literature. Finally, household consumption entails shared consumption, and hence economies of scale and scope in consumption’. BCL show how to completely identify the joint consumption and the allocation of resources within a household by a consumption technology function and the sharing rule borrowed directly from Chiappori but without any assumptions regarding interpersonal comparability or utility cardinalizations. ‘The idea of the consumption technology function is that features of household consumption such as economies of scale or scope, joint use of resources, etc., can be defined as a technology that describes the set of options for the joint consumption of goods that are available to household members’ (BCL, p.5). The sharing rule describes the allocation of resources among household members. This framework is
similar to a Becker (1965) type household production model, except that instead of using market goods to produce commodities that contribute to utility, the household produces the equivalent of a greater quantity of market goods via sharing (BCL). The collective model accounts for the differences in preferences and consumption of the household members.

3 Models

3.1 The Benchmark Model: Browning, Chiappori and Lewbel (2003)’s Model

In this section we present BCL (2003)’s model of household behavior as the benchmark model that we use to develop a collective recreational demand model. BCL consider two cases: when the individual is living alone (‘single’) and when is a household member (‘couple’). This allows to use the demand data of people living alone to identify individual preferences leaving to household data the job of identifying the consumption technology and the sharing rule.

When the individual \(i\) is living alone the optimisation problem is

\[
\text{Max } U^i(\mathbf{z}^i) \text{ subject to } y^i = \mathbf{pz}^i
\]

where the utility function \(U^i\) is monotonically increasing, continuously twice differentiable and strictly quasi-concave; \(y^i\) is the exogenous income of individual \(i\); \(\mathbf{p}\) is the vector of prices of the goods \(\mathbf{z}^i\). The solution is the vector of Marshallian demands \(\mathbf{z}^i_m(\mathbf{p} / y^i)\). The corresponding indirect utility function is defined as

\[
V^i(\mathbf{p} / y^i) = U^i(\mathbf{z}^i_m(\mathbf{p} / y^i))
\]

Then, BCL consider the case where individual \(i\) is member of a household that consists of a couple living together (\(i = f\) or \(m\)). The couple’s utility maximization problem is

\[
\text{Max } U^f(U^f(x^f), U^m(x^m), \mathbf{p} / y) \text{ subject to } x = (x^f + x^m), \mathbf{z} = F(x), \mathbf{p}'\mathbf{z} \leq y
\]

where \(\mathbf{z}\) is the vector of inputs that the couple purchases; \(x, x^f\) and \(x^m\) are the quantities of the goods \(\mathbf{z}\) respectively consumed by the household and privately by each household member; \(\mathbf{p}\) is the vector of market prices; \(y\) is the household total income and \(F\) is the consumption technology function. The transformation from \(\mathbf{z}\) to \(\mathbf{x}\) embodied by the function \(F\) is intended to summarize all of the technological economies of scale and scope.
that result from living together. Consider the example of BCL (p. 10): ‘Let good \( j \) be automobile use, measured by distance travelled (or some consumed good that is proportional to distance, perhaps gasoline). If \( x_j^f \) and \( x_j^m \) are the distances travelled by car by each household member, then the total distance the car travels is \( z_j = (x_j^f + x_j^m) / (1 + r) \) where \( r \) is the fraction of distance that the couple rides together. This yields a consumption technology function for automobile use of \( z = x / (1 + r) \).’

Note that this framework is similar to a Becker (1965) type household production model but with the following main difference: the production function combines the inputs and generates the output, while the consumption technology function transforms the output \( x \), that is what the individuals consume, into the inputs that are purchased \( (z) \). Thus \( F(x) \) can be interpreted as an inverse production function\(^1\).

Further, note that \( U \) is a twice differentiable utility function that can be interpreted as ‘a social welfare function for the household,’ in which each household member has different bargaining power. In BCL the bargaining function \( U \) depends on the relative incomes in the household members, and each household member utility \( U_i \) also depends on demographic characteristics. Following Chiappori (1988, 1992), the utility function \( U \) can be written as the weighted sum of the utility functions for each member’s preferences

\[
U[U^f(x^f), U^m(x^m), p / y] = \mu(p / y) U^f(x^f) + U^m(x^m),
\]

where the weight \( \mu \) represents the bargaining power of the household members in the intrahousehold allocation process. Individual \( m \) receives a weight of one and individual \( f \) a weight of \( \mu \) in determining the intrahousehold decisions. Larger is \( \mu \) larger is the bargaining power of member \( f \) and so larger are the quantities \( x^f \) consumed by member \( f \) respect member \( m \). As BCL note, one limit using \( \mu \) is that it will depend ‘on the arbitrary cardinalizations of functions \( U^f \) and \( U^m \).’ The interesting contribution of BCL that distinguishes their work from Chiappori (1988, 1992) consists in the introduction of ‘the sharing rule’ \( \eta \), which ‘does not depend upon any cardinalization.’ The sharing rule describes the allocation of resources among household members. BCL specify the sharing

\(^1\) As BCL note, we can have more complicated consumption technologies. For example, ‘the fraction of time \( r \) that the couple shares the car could depend on the total usage, resulting in \( F \) being a nonlinear function of \( x \). There could also be economies (or diseconomies) of scope as well as scale in the consumption technology, e.g., the shared travel time percentage \( r \) could be related to expenditures on vacations, resulting in \( F(x) \) being a function of other elements of \( x \) in addition to \( x^f \) (p. 11).
rule as a function of distributional variables \( \mathbf{d} \) that affect the bargaining power, such as the wife’s share in total gross income, the difference in age between husband and wife, or the log deflated household total expenditure by a Stone price index. Note that instead the approach followed by Chiappori (1988, 1992) identifies the sharing rule up to a constant.

The BCL’s model for \( \eta \) follows the logistic form

\[
\eta = \frac{\exp(\mathbf{d}'\mathbf{\phi})}{1 + \exp(\mathbf{d}'\mathbf{\phi})} \quad \text{with } 0 \leq \eta \leq 1
\]  

(5)

where \( \mathbf{d} \) are the distributional variables and \( \mathbf{\phi} \) is a vector of parameters.

The household’s behaviour is equivalent to allocating the fraction of shadow income \( \eta_f = \eta \) to member \( f \), and the fraction \( \eta_m = (1 - \eta) \) to member \( m \).

Each member \( i \) maximizes own utility function \( U^i(\mathbf{x}^i) \) subject to the budget constraint \( \eta^i = \pi^i'\mathbf{x}^i \). The maximization problem for each household member is

\[
\text{Max } U^i(\mathbf{x}^i) \text{ subject to } \eta^i = \pi^i'\mathbf{x}^i
\]  

(6)

where \( \pi \) is the shadow price vector for the own private good \( \mathbf{x}^i \) and \( \eta^i \) is the own shadow income. BCL show that by homogeneity the price vector \( \pi \) can be normalized such that

\[
\pi'\mathbf{x} = 1, \quad \eta = \eta_f = \pi'\mathbf{x}^f \text{ and } \eta_m = (1 - \eta).
\]

The sharing rule is the fraction of the household’s shadow income that is allocated to member \( f \). Note that the household purchases the vector \( \mathbf{z} = F(\mathbf{x}^f + \mathbf{x}^m) \).

For simplicity BCL assume a Barten type technology function\(^2\), defined as \( \mathbf{z} = \mathbf{R}\mathbf{x} \), equivalent to the linear technology \( \mathbf{z} = \mathbf{R}\mathbf{x} + \mathbf{a} \) when the matrix \( \mathbf{R} \) is diagonal and \( \mathbf{a} \) are zero. In this case the constraint \( \mathbf{p}'\mathbf{z} = \mathbf{y} \) becomes \( \mathbf{p}'(\mathbf{R}\mathbf{x}) = \mathbf{y} \), which yields \( \mathbf{x} = \mathbf{y}(\mathbf{R}'\mathbf{p})^{-1} \). Since \( \pi'\mathbf{x} = 1 \), the shadow prices for this technology are

\[
\pi = \mathbf{R}'\mathbf{p} / \mathbf{y}, \quad (7)
\]

where the couple faces market price \( \mathbf{p} \) and total income \( \mathbf{y} \).

The second welfare theorem implies that the individual, facing price \( \pi \) and income \( \eta^i \), will choose the bundle \( \mathbf{x}^i \). The solution to the utility maximization problem is a set of Marshallian demands equals to

\[
\mathbf{x}^i_{\mathbf{m}}(\pi(\mathbf{p} / \mathbf{y}) / \eta(\mathbf{p} / \mathbf{y})) = \mathbf{x}^i_{\mathbf{m}} \left( \frac{\mathbf{R}'\mathbf{p}}{\mathbf{y}} \frac{1}{\eta(\mathbf{p} / \mathbf{y})} \right), \quad (8)
\]

\(^2\) Barten type technology function (1964) is a special case of Gorman’s (1976) general linear technology model \( z = \mathbf{R}\mathbf{x} + \mathbf{a} \), with \( \mathbf{R} \) diagonal and \( \mathbf{a} \) zero (see also Muellbauer, 1977).
which yields to the indirect utility function $V^i(\pi / \eta)^3$.

Then, since $\pi = \frac{R'p}{y}$, the household actually purchases the vector $z$ that becomes

$$z = R_x^m \left( \frac{R'p}{y} \frac{1}{\eta(p/y)} \right) + R_x^m \left( \frac{R'p}{y} \frac{1}{1 - \eta(p/y)} \right)$$

(9)

The relationship between the weight $\mu$ and the sharing rule $\eta$ can be written as

$$\mu = -\frac{\partial V^i(\pi/\eta)/\partial \eta}{\partial V^i(\pi/1-\eta)/\partial \eta}$$

(10)

where $V^i$ is the indirect utility function of member $i$ (see BCL p. 13 for a formal proof).

Note that one advantage of BCL model respect Chiappori (1988, 1992)'s model is that using data from households and from singles living alone the sharing rule is completely identified. BCL empirically estimate simultaneously a joint system consisting of a vector of budget shares for singles and a vector of budget shares for couple. They can do so because all the parameters in the singles model appear in the couple model. They use the demand data of people living alone to identify individual preferences, thereby leaving to household data the job of identifying the consumption technology and sharing rule.

### 3.2 Traditional Recreational Demand Model

In the traditional literature of recreational demand the terms individual and household are used interchangeably. Traditional analysis models the household as it was a single individual. The allocation of the resources among its members is ignored.

Following Bockstael and McConnell (forthcoming), individuals maximize utility $U$ which is a function of the number of trips ($n$) taken to a site, environmental quality at the site ($q$) and a composite commodity ($b$). The number of trips is produced using inputs $s$ such as gasoline, food and lodging. First, note that the number of trips is a weak complement with the environmental quality: $q$ does not affect the individual’s utility if she does not go to the site ($n = 0$); second, note that some of the goods that compose the vector $s$ are exclusive for the individual (e.g. sunscreen cream for woman and fishery equipment for man) and others are consumed and shared between members of the trip

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3 Note that $\pi(.)$ and $\eta(.)$ are functions and $p/y$ is their argument.

4 For simplicity we consider trips on a single site.
(e.g. gasoline and food), but for the moment, as traditional literature does, we assume that each individual that shares these goods consumes the same amount of them.

Then, consider the time constraint that limits the amount of time that can be spent on leisure activities. As Bockstael and McConnell (forthcoming) emphasize, not considering the time cost term in the demand function would produce a biased estimated cost coefficient that leads to an underestimate of the consumer surplus for access to the site. Then, the individual’s optimisation problem is

\[
\text{Max } U(n, b, q) \text{ subject to } y + wL \geq ps + b, T \geq L + tn \text{ and } g(n, s) = 0
\]

where \(y\) is exogenous, non-wage income, \(w\) is the after-tax wage rate, \(L\) is the total number of hours spent working, \(p\) is the vector of prices of the inputs \(s\), \(T\) is the total available time to the individual, \(t\) is the time cost of access to the recreational site, the price of the composite commodity \(b\) is normalized to 1 and \(g(n, s)\) is the household production technology. As Bockstael and McConnell note, \(g(n, s)\) implies a cost function that is the solution of the cost minimization problem

\[
C(n, p) = \min_s \{ps \mid g(n, s) = 0\}
\]

and if the cost function is linear in \(n\) than the marginal cost per trip equals the average cost per trip \(c(p)\). The maximization problem becomes

\[
\text{Max } U(n, b, q) \text{ subject to } y + wL \geq c(p)n + b \text{ and } T \geq L + tn.
\]

Since we assume that the individual can choose how to allocate his time between work \((L)\) and leisure \((t)\) the two constraints can be combined into one:

\[
\text{Max } U(n, b, q) + \lambda[y + wT - n(c(p) + wt) - b]
\]

which leads to the Marshallian demand \(n_m(c, q, w, T, y)\).

From the expenditure minimization problem

\[
\text{Min } \{c(p) + wt\} n + b - wT \text{ subject to } U = U(n, b, q)
\]

we derive the Hicksian demand \(n_h(c, q, w, T, u)\). Since weak complementary between \(n\) and \(q\), the compensating variation (CV) of a change in \(q\) from \(q_0\) to \(q_1\) is given by

\[
CV = \int_{c_0}^{c_1} n_h(c, q_1, w, T, U)dc - \int_{c_0}^{c_1} n_h(c, q_0, w, T, U)dc
\]

where \(c_0\) is the observed level of constant marginal cost and \(c\) is the choke price of the trip, that is the constant marginal cost at which the demand for trips is zero.
If income effects are negligible or if the underlying preference structure is consistent with the Willig condition we can approximate the compensated variation for a change of the environmental quality calculating the area between the Marshallian demands conditioned on a change of $q$, which is equals

$$
\int_{c_0}^{c} n_m(c, q, w, T, y)dc - \int_{c_0}^{c} n_m(c, q_0, w, T, y)dc
$$

(17)

where $c_0$ and $c$ are defined as before.

Note that in the traditional Travel Cost Method (TCM) the value of the site, which can be interpreted as the willingness to pay of the individual to access to the site, is derived calculating individual’s consumer surplus, that is the area behind the Marshallian demand for trips to the site

$$
CS = \int_{c_0}^{c} n_m(c, q, w, T, y)dc
$$

(18)

where $c_0$ is the observed level of constant marginal cost to produce trips $n$ and $c$ is the choke price of the trip: $n_m(c) = 0$.

Further, to be useful for policy purposes, the estimated consumer surplus can be aggregated across the population of recreational users. The total economic value of the site can be estimated as the sum of the consumer surplus of each individual going to the site:

$$
CS = \sum_{i}^{K} \int_{c_0}^{c} n_{im}(c, q, w_i, T, y)dc
$$

(19)

where $K$ is the total number of site’s users.

### 3.3 Collective Recreational Demand Model

In this section, we develop a collective recreational demand model applying the collective model of household behaviour of BCL (2003) to the traditional recreational demand model described in the previous section.

Since we are considering individuals living together their individual choice is conditioned by the presence of the other members. This is a more complicated case than BCL’s case. We have to consider not only the consumption technology function but also the household production function. The consumption technology function transforms what the individuals privately consume (e.g. number of trips taken to a site by member M
and F) into the inputs that the couple is observed purchasing (e.g. number of trips taken to a site by the household). The household production function combines inputs, such as food, gasoline, to generate the output ‘trips’.

Another issue is how the marginal cost of a trip changes when we consider the time cost of the recreational trip. ‘Time’ raises two problems. First, it is easier to pool money than to pool time in a household. For instance, the husband could spend wife’s money if he wants, but it is much harder that he can spend wife’s time to go to a recreational site. Second, the time costs are not shared in the same way of money costs. Suppose a couple takes jointly some recreational trips. The money costs are shared, e.g. the couple benefits from the same gasoline purchase. The time costs are not shared in the same way. If both husband and wife take the trip, then both husband and wife’s time costs must be charged. This problem makes the recreational demand model different from the BCL’s model.

First, we analyze the case of individuals living alone, and then the case of individuals living together. In fact, BCL use the demand data of people living alone to identify the Marshallian demand functions $x_i^m$, arising from the utility functions $U_i$, and the household data to estimate the household’s demand functions $z$, the consumption technology $F$ and the sharing rule $\eta$.\footnote{The author thanks Nancy Bockstael for having pointed out these problems.}

**Individuals Living Alone**

We apply the traditional recreational demand model described in Section 3.2 because we consider individuals living alone, thus, there is not intra-household allocation of resources and not shared travel costs or pooling time’s problems.

The utility optimisation problem of the individual $i$ is similar to that of the traditional recreational demand model. There are two differences. The first difference is in the notation. Each variable and the utility function of individual $i$ are characterized by the superscript $i$: if $i = f$ we refer to a woman; if $i = m$ to a man. The second difference

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5 The author thanks Nancy Bockstael for having pointed out these problems.
6 Note that pooling time is possible when household members reallocate household tasks. For example, the husband has more time for fishing if the wife cleans and cooks the fish.
7 BCL’s model assumes that marriage does not induce preference changes. They justify this assumption claiming that ‘it may be reasonable to assume that, at least for some goods, the dollar effect of a change in tastes is small.’
consists of replacing the implicit production function \( g(N_i, s) = 0 \) with \( N_i = B(s) \), where 

\( B \) is the transformation (production) function from inputs into the production of trips.

It is made explicit that the exogenous income \( (y') \), the number of trips to a recreational site \( (N_i) \), the composite commodity \( (b') \), the time costs of access to the recreational site \( (t') \), the after-tax wage rate \( w' \), the total number of hours spent working \( (L') \) and the vector of inputs used \( (s^i) \) refer to the site’s user \( i \) and not to the household as a single decision making unit.

Following the methodology presented in Section 3.2, we can derive the individual recreational demand for the recreational site, \( N_{im}(C, q, w, T, y) \) and \( N_{im}(C, q, w, T, y) \), where \( C_i \) is the constant cost per trip derived assuming marginal cost equal to average cost, and thus, the usual welfare measures of the traditional recreational demand literature (compensating variation and consumer surplus). Note that in this case, these measures refer to the welfare of an individual that lives alone.

\textit{Individuals Living Together}

Now, consider the case of two individuals living together, \( (i = m \text{ and } f) \), who can take trips separately as well as jointly.\(^8\)

As we pointed out at the beginning of Section 3.3, in this case travel costs will be shared if the two individuals take a trip jointly while the time costs are not shared. We deal with this problem expanding BCL’s model by including time constraints on each individual in the household maximization problem\(^9\). We evaluate time at different wage rates because we assume that the household members have different jobs.

The household’s optimisation problem becomes

\[
\begin{align*}
\text{Max } U(N, b, q, p/y) & = \mu \left( \frac{p}{y} \right) U_f(N, b, q) + U_m(N, b, q), \\
\text{subject to } & \\
N & = N_f + N_m, \\
Z & = F(N), \\
y + w_f L_f + w_m L_m & \geq ps + b, \\
T & \geq L_f + L_m.
\end{align*}
\]

\(^8\) We anticipate here that the behaviour of a group is assumed equal to the behaviour of a family, recognizing that important considerations are embedded in this distinction.

\(^9\) We thanks Nancy Bockstael for useful suggestions about this problem.
\[ T \geq L^m + t^m N^m \]
\[ Z = B(s) \quad (24) \]

where the weight \( \mu \) represents the bargaining power of the household members in the intra-household allocation process: individual \( m \) receives a weight of one, and individual \( f \) a weight of \( \mu \) in determining the intra-household decisions; \( U \) is a twice differentiable utility function ‘interpreted as a social welfare function for the household;’ \( U^i \) is the utility of member \( i \); \( p \) is the vector of prices for the inputs \( s \), such as gasoline, lodging and food; \( y \) the household total income; the price of the composite commodity \( b \) is normalized to 1; \( f^i \) and \( f^m \) are the time costs of each household member; \( L^f \) and \( L^m \) are the total number of hours spent working by individuals \( f \) and \( m \); \( w^f \) and \( w^m \) are the after-tax wage rate of each household member; \( Z \) is the number of trips the couple is observed taking to a site; \( N, N^f \) and \( N^m \) are the number of trips \( Z \) respectively taken by the household and privately by each household member; \( F \) is the consumption technology function that may capture some kinds of taste that result from traveling together and \( B \) is the transformation (production) function from inputs into the production of trips.

As in the traditional recreational demand model, we assume that the travel cost function is linear in the number of trips \( N \), than the marginal travel cost per trip equals the average travel cost per trip \( C(p) \).

We allow the two time constraints for the two household members to be collapsed in the money constraint.

The household’s optimisation problem becomes

\[ \text{Max } U[N^f, b, q, U^m(N^m, b, q), p/y] = \mu(p/y) U^f(N^f, b, q) + U^m(N^m, b, q). \quad (20) \]

subject to

\[ N = N^f + N^m, \quad (21) \]
\[ Z = F(N), \quad (22) \]
\[ y \geq C(p)Z - T(w^f + w^m) + (w^f t^f N^f + w^m t^m N^m) + b. \quad (23) \]

Note that empirically we observe the total household income and not the individual income. The household’s behaviour is equivalent to allocating the fraction of shadow (not observed) income \( \eta^f = \eta \) to member \( f \), and the fraction \( \eta^m = 1 - \eta \) to member \( m \), where \( \eta \) is defined in Equation (5). Each household member \( i \) maximizes own utility function \( U^i \)
subject to the budget constraint \( \eta^i = \pi N^i \), where \( \pi \) is the shadow price vector for the own number of trips \( N^i \) and \( \eta^i \) is the own shadow income.

The household purchases trips \( Z = F(N^f + N^m) \) and for simplicity BCL assume a Barten type technology function, defined as \( Z = RN \).

In this case the constraint

\[
[C(p)Z - T(w^f + w^m) + (w^f t^f N^f + w^m t^m N^m) + b] = y
\]

becomes

\[
[C(p) (RN) - T(w^f + w^m) + (w^f t^f N + N^m (w^m t^m - w^f t^f) + b] = y
\]

Substituting \( N^f = N - N^m \), it becomes

\[
[C(p) (RN) - T(w^f + w^m) + w^f t^f N + N^m (w^m t^m - w^f t^f) + b] = y
\]

which yields to

\[
N = \frac{y + T(w^f + w^m) - N^m (w^m t^m - w^f t^f) - b} {RC(p) + w^f t^f}.
\]

Since \( \pi N = 1 \) the shadow prices for this technology are

\[
\pi = \frac{RC(p) + w^f t^f} {[y + T(w^f + w^m) - N^m (w^m t^m - w^f t^f) - b] \eta(p / y)}
\]

where the couple faces constant cost per trip \( C(p) \) and total income \( y \).

By the second welfare theorem, the solution to the utility maximization problem is a set of Marshallian demands equals to \( N^i_m (\pi(p / y) / \eta(p / y)) \) and the indirect utility function is \( V^i (\pi / \eta) \).

Then \( Z \) becomes

\[
Z = RN^f_a \left( \frac{[RC(p) + w^f t^f]} {[y + T(w^f + w^m) - N^m (w^f t^f + w^m t^m) - b] \eta(p / y)} \right) + RN^m_a \left( \frac{[RC(p) + w^f t^f]} {[y + T(w^f + w^m) - N^m (w^f t^f + w^m t^m) - b] \eta(p / y)} \right)
\]

Note that the knowledge of the sharing rule permits the derivation of individual indirect utility and cost functions that can be used to perform both interpersonal and inter-household comparisons.

Further, following the traditional recreational literature and applying equation (18) we can calculate the welfare measure of consumer surplus for each household member and for the household accounting for the preferences of each individual and the intra-household allocation of resources.
Note also that this maximization problem requires the knowledge of the time costs of each individual. This information is not usually in the recreational demand dataset. We suggest dealing with this problem specifying another consumption technology function for time, or if Pareto allocations hold, investigating the possibility of using the same estimated sharing function for gasoline, for instance, also for time. The problem in this last case will be to test Pareto condition.

4. Some Empirical Analysis

Case Study Description and Data

The sample is drawn from the survey conducted by the Department of Economics of the University of Verona in Italy, on the West side of Garda Lake, in June October 1997. This survey was part of an integrated analysis on the multi-functionality of the West Garda Regional Forest in order to define cooperative policies between institutions, local operators and visitors. The survey took the form of on-site interviews of adult visitors (mean age of 39 years).

This area was picked because it was felt that there would be many single-destinations, single-purpose trips, which are a necessary assumption of the travel cost method (TCM) (Freeman, 1993). It was also felt that, due to Garda Lake’s popularity with tourists from throughout the country and abroad, there would be sufficient variation in distance travelled, time and trip cost.

Several questions were included in the survey to analyze the annual expenditure of the family. The first relevant question asked the respondent her mean monthly expenditure on food and leisure including the visit to the West Garda Regional Forest. The respondent was asked to recall the number of annual trips made to West Garda Regional Forest and the number of trips to other natural areas during the year, to allow screening of the sample between those visitors on single-destination and multiple-destination trips.

In order to have a double check on the declared costs, visitors were asked to specify their place of residence, the distance travelled between the natural area and their residence, the journey time and for those who were on vacation, the distance from the forest to the vacation lodging.
Moreover, the following data were collected for each individual: means of transportation used, number of passengers per means of transportation, how many were the family members and how many shared the expense of the trip; if stops were made at other places before going to the natural area; how many days the trip lasted; individual and family transportation expenditure to go to the forest; individual and family expenditure in food, lodging and free time activities during the trip. This information was used to construct three travel cost variables\textsuperscript{10}: cost per payer (\textit{sppag\_rt} – value mean 49.37 euros), cost per car, equal to the cost per payer times the number of paying passengers (\textit{spmac\_rt} – value mean 60.12 euros per 2.84 paying passengers), cost per family (\textit{spfam\_rt} – in mean 55 euros per 3.19 members).

In order to estimate the expenditure on alternative sites the visitor was asked about the distance from their residence, number of visits to each site, the quality of the area and the purpose of the trip.

Table 2 presents sample mean values by six groups: single men, single women, husbands and wives with and without children. Note that the head of household will spend more if her family members travel with her. The mean travel distance of a visitor travelling alone is about 185 km, while it is about 250 km if at least one member of the family participates in the trip. The number of trips to the natural area of singles women is greater than that of wives but there is not difference in the number of trips between women with and without children. Instead, men travel more if they have children.

The visitor was also asked how she allocated her time during the visit between naturalistic (such as going sightseeing), harvest (harvesting flowers, mushrooms, hunting and fishing) and recreational activities (mountain biking, horse riding, hiking, picnicking, visiting historic places), and how she would have wished to spend her time between these activities.

About 77 per cent of the visitors prefer spending their time into recreational activities (mountain biking, horse riding, hiking, picnicking, visiting historic places), about 20 per cent into naturalistic activities, such as harvesting flowers, mushrooms and going

\textsuperscript{10} Every travel cost variable comprehends the opportunity cost of time spent traveling to the natural area. Several studies apply and compare different values to estimate the opportunity cost of time (for example Cesario, 1976; McConnell and Strand, 1981; Johnson, 1983; Smith et al., 1983; Chavas et al., 1989; Bockstael et al., 1990; McKean et al., 1996). In this study we evaluate travel time at one third of the wage rate (Cesario, 1976).
sightseeing, and the remaining percentage into hunting and fishing. Couples with children do not wish hunting, they hike and bike less and they harvest more than couples without children.

**Empirical Model and Results**

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the ‘price’ of access to the site. Thus, people’s willingness to pay to visit the site can be estimated based on the number of trips that they make at different levels of expense on travel.

We want to test the null hypotheses that, after controlling for income and other socio-economic characteristics, the mean willingness to pay of single men is not different from the willingness to pay of single women; the mean willingness to pay of wives/husbands with children is not different from the willingness to pay of wives/husbands without children; the mean willingness to pay of husbands is not different from the willingness to pay of wives, and that the willingness to pay of singles is not different from the willingness to pay of married people.
An unrestricted Poisson model is estimated to allow for the possibility of taste differences across six groups: single men, single women, wives and husbands with and without children. The reference group is ‘single women’\(^{11}\).

Let \( X \) the vector of independent variables: education (\( istrz \)), age (\( eta \)), logarithm of the annual expenditure on leisure (\( ln\_sp2 \)), the quality of the natural area (\( qtai \)), the place where the survey was conducted (\( area \)), the logarithm of the travel cost per car to visit the natural area (\( spm \)), the logarithm of the annual travel cost per car to visit alternative sites different respect the natural area object of study (\( ln\_sp1mc, ln\_sp2mc \)), the logarithm of the individual \( i \)’s monthly net income from the previous year (\( ln\_clsr \)).

We allow for differences in responses by interacting the \( X \) vector with the dummy variables for sex (\( man = 1 \) if man, \( 0 \) if woman), number of children under 12 years old (\( fgs12 = 1 \) if number of children is greater than zero, \( 0 \) otherwise), the number of family members (\( nfml = 1 \) if the number of household members is greater or equal than two, \( 0 \) if the respondent is single).

The general form for the recreational demand for the natural area becomes:

\[
\text{nva}_{ai} = X' \beta + X' \text{nfml} \lambda + X' \text{man} \alpha + X' fgs12 \eta + X' \text{man} * fgs12 \gamma + X' \text{man} * \text{nfml} \delta + u_i
\]

where \( nva_{ai} \) is the annual number of visits to the natural area by individual \( i = \{1,...,K\} \); \( u_i \) is the stochastic term representing both measurement errors and information about the visitor unobservable to the researcher.

\(^{11}\) The choice of the reference group does not affect the results.
In equation (25) the $\beta$ parameters pertain to the coefficients values for the $X$ variables for the reference group of single women. The $\lambda$ parameters represent the difference in these parameter values for wives without children and single women. The $\alpha$ parameters represent the difference between single women and single men. The $\eta$ parameters represent the difference between wives with and without children. The $\gamma$ parameters represent the difference between husbands with and without children. The $\delta$ parameters represent the difference between husbands without children and single men.

Under the null hypothesis of no significant differences among groups the model collapses to the restricted traditional Poisson model that does not consider difference in gender and number of household members. The alternative hypothesis is that at least one element of the set of parameters is significantly different from zero, yielding different responses across groups.

Table 3 shows the parameter estimates for the unrestricted and restricted model. The signs and significance of variable coefficients are as expected: the number of visits to the natural area decreases if the travel cost per car ($ln_{spm}$) increases (all these variables have a negative sign and are significant at the 5 per cent level); if income ($ln_{clsr}$), age ($\eta$) and the expenditure in leisure ($ln_{sp2}$) increase then the number of trips increases. These variables have positive and significant coefficient at less than 1 per cent level of significance. Instead the negative and significant coefficients of the variables quality of the area ($qta$) and education ($istrz$) are the opposite of our expectations. Log-likelihood tests support the hypothesis of a significant difference in recreational demand functions across the six groups.

The willingness to pay, or consumer surplus, is estimated by calculating the areas below the demand curve and between the actual cost of traveling to the natural area and the maximum cost above which the number of visits to the natural area is zero. The consumer surplus is a monetary measure of the willingness to pay of the visitor for a trip to the natural area. These results are shown in Tables 4 and 5. They support the null hypothesis of no difference in mean willingness to pay between groups. While single women and wives without children are willing to pay less than men, and women with children are willing to pay more than men with or without children, these values are not significantly different from one another. Finally, the willingness to pay estimate derived
from the restricted traditional model appears to overestimate the willingness to pay of single women and women without children and underestimate the willingness to pay of men and women with children, however these values are not significantly different from one another.

5. Conclusions and Discussion

The main contribution of this paper to the recreational models literature is conceptual: we demonstrate that a utility theoretic framework derived from the collective model proposed by Browning, Chiappori and Lewbel (2004) can be used to formulate a collective recreational demand model.

First, we consider the case of an individual living alone. In this case, we find compensating variation (CV) and consumer surplus (CS) measures by applying the traditional recreational demand model. We will not incur the risk of estimating biased welfare measures, because we do not have intra-household resource allocation and the household expenditure in leisure and consumption goods is equal to that of the single individual.

Then, we consider the cases with intra-household allocation of resources. This situation refers to couples that go to visit a natural area or to people that are living and travelling together. In this case, the welfare measures (CV and CS), estimated using the traditional recreational demand model, assume that a household acts as a single decision unit, thought it consists of different individuals. Even if we are dealing with the value of a site for an individual, we are not making distinctions between individuals. It is assumed that there are not differences between household members in the preferences and allocation of time, and it assumed that the opportunity cost of time is the same for everybody. The collective recreational demand model allows the derivation of consumer surplus measure for each household member.

Instead, if we follow the traditional recreational literature, the amount a household member would pay or be paid to be as well off with or without the recreational site does not take into account the allocation of resources in the family, the differences in preferences or in the opportunity cost of time between the two individuals.
These two individuals can have different values for this quality change, depending on the opportunity cost of time for each, how the household income is allocated in the household, how much they like this particular site and how they use it.

Note also that when applying the collective recreational demand model, we consider what the two members might be willing to pay for the change in site’s quality because it also affects the other’s member recreational activity and not only their own. They can recognize that the degradation of the beach can cause a reallocation of income in the household. This can affect the change in exogenous income necessary to return the individual to the utility level that he/she experienced before the change. This yields different values for the quality change of the area, compared to the values derived using the traditional recreational model. Further, the aggregation of each individual member’s willingness to pay across household’s members will not equal the household WTP derived with the traditional approach.

With the collective recreational demand model, the policy maker can use the individual’s compensating variation and consumer surplus in order to know how to regulate the access of a recreational site, how much to compensate different individuals in case of degradation of a natural environment and how to target programs to individuals in certain recreational activities groups rather than to households.

One of the limitations of this model is that it includes children’s welfare by assuming that there is one altruistic member that takes into account household members’ well-being. Following BCL, we assume that the utility function of the woman and all the associated demand functions refer to the joint utility function of a woman and her children. This is a severe limitation. It is not simple to relax this assumption, however. Children consume the same kind of goods as their parents. For example, the expenditure in food includes the wife’s consumption, the husband’s consumption and the child’s consumption. The econometrician is not able to distinguish these components in the data.

Another restrictive assumption of the collective recreational demand model is that the behavior of a group is assumed equal to the behavior of a family. This allows accounting for those trips where individuals from different households choose to take a trip together. Relaxing this assumption will be the subject of forthcoming research applying the model by Chiappori and Ekeland (2002) about group behaviour.
At this point one could ask if the distinction between the traditional and the collective recreational model is merely an academic curiosity, or if differences in how resources are distributed within households reflect appreciable differences in the welfare measures.

In this paper, we make a first step in this direction. We estimate a recreational demand equation that allows for taste differences across six different groups: single men, single women, wives without children, husbands without children, wives with children and husbands with children. We find empirical evidence that there are statistical differences amongst groups. However, these do not translate into statistically different willingness to pay values. We find that, while single women and wives without children are willing to pay less than men, and women with children are willing to pay more than men with or without children, these values are not significantly different from one another. Further, the willingness to pay estimate derived from the traditional recreational model appears to overestimate the willingness to pay of single women and women without children and underestimate the willingness to pay of men and women with children, however these values are not significantly different from one another. We think that the main reason is that we estimated a model with no consumption technology and with equal sharing rule.

For an empirical application we need data about the expenditures in recreational sites of individuals living alone and together. This allows us to use the demand data of people living alone to identify individual preferences, thereby leaving to household data the job of identifying the consumption technology and the sharing rule. This will be the subject of forthcoming research.
Table 1 - Definition of the variables in Poisson model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>nvai</td>
<td>Annual number of visits to the natural area</td>
</tr>
<tr>
<td>ln_clsr</td>
<td>Log(annual interval income) in euros</td>
</tr>
<tr>
<td>ln_sp2</td>
<td>Log(annual leisure expenditure) in euros</td>
</tr>
<tr>
<td>spm</td>
<td>Travel cost per car in euros</td>
</tr>
<tr>
<td>ln_sp1mc</td>
<td>Log(annual travel cost per car for visits to 2nd alternative site) in euros</td>
</tr>
<tr>
<td>ln_sp2mc</td>
<td>Log(annual travel cost per car for visits to 1st alternative site) in euros</td>
</tr>
<tr>
<td>istrz</td>
<td>Education</td>
</tr>
<tr>
<td>eta</td>
<td>Age</td>
</tr>
<tr>
<td>area</td>
<td>Place where the survey was conducted</td>
</tr>
<tr>
<td>qta1</td>
<td>Quality of the natural area</td>
</tr>
<tr>
<td>Obs.</td>
<td>Number of Observations</td>
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Table 2 - Descriptive statistics for selected variables in Poisson model

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<tr>
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<tbody>
<tr>
<td>ln_clsr</td>
<td>3.657</td>
<td>0.519</td>
<td>3.388</td>
<td>0.480</td>
<td>3.064</td>
<td>0.337</td>
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<tr>
<td>ln_sp2</td>
<td>8.176</td>
<td>0.682</td>
<td>8.458</td>
<td>0.361</td>
<td>8.079</td>
<td>0.782</td>
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<tr>
<td>spm</td>
<td>116.372</td>
<td>211.254</td>
<td>155.636</td>
<td>231.302</td>
<td>65.000</td>
<td>77.000</td>
</tr>
<tr>
<td>ln_sp1mc</td>
<td>2.491</td>
<td>2.311</td>
<td>2.981</td>
<td>2.281</td>
<td>2.701</td>
<td>2.387</td>
</tr>
<tr>
<td>ln_sp2mc</td>
<td>1.065</td>
<td>1.936</td>
<td>1.445</td>
<td>2.196</td>
<td>1.538</td>
<td>2.186</td>
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<tr>
<td>area</td>
<td>2.717</td>
<td>1.494</td>
<td>2.636</td>
<td>1.465</td>
<td>2.950</td>
<td>1.432</td>
</tr>
<tr>
<td>qtai</td>
<td>7.378</td>
<td>1.255</td>
<td>7.727</td>
<td>1.077</td>
<td>7.750</td>
<td>1.333</td>
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<td>Obs.</td>
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<tbody>
<tr>
<td>ln_clsr</td>
<td>3.654</td>
<td>0.553</td>
<td>3.691</td>
<td>0.522</td>
<td>3.806</td>
<td>0.442</td>
<td>3.785</td>
<td>0.487</td>
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<tr>
<td>ln_sp2</td>
<td>8.351</td>
<td>0.643</td>
<td>8.256</td>
<td>0.661</td>
<td>8.187</td>
<td>0.724</td>
<td>8.097</td>
<td>0.516</td>
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<tr>
<td>spm</td>
<td>123.042</td>
<td>166.691</td>
<td>147.780</td>
<td>323.467</td>
<td>196.979</td>
<td>304.857</td>
<td>125.185</td>
<td>178.653</td>
</tr>
<tr>
<td>ln_sp1mc</td>
<td>1.883</td>
<td>2.309</td>
<td>3.137</td>
<td>2.286</td>
<td>2.712</td>
<td>2.404</td>
<td>1.773</td>
<td>2.451</td>
</tr>
<tr>
<td>ln_sp2mc</td>
<td>1.169</td>
<td>2.017</td>
<td>1.310</td>
<td>2.233</td>
<td>1.081</td>
<td>2.037</td>
<td>0.254</td>
<td>0.953</td>
</tr>
<tr>
<td>eta</td>
<td>44.711</td>
<td>15.910</td>
<td>43.000</td>
<td>13.060</td>
<td>39.170</td>
<td>5.475</td>
<td>37.630</td>
<td>6.800</td>
</tr>
<tr>
<td>area</td>
<td>2.974</td>
<td>1.568</td>
<td>2.933</td>
<td>1.874</td>
<td>2.851</td>
<td>1.459</td>
<td>3.259</td>
<td>1.559</td>
</tr>
<tr>
<td>qtai</td>
<td>7.342</td>
<td>1.169</td>
<td>7.150</td>
<td>1.240</td>
<td>7.617</td>
<td>1.311</td>
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<tr>
<td>Obs.</td>
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Table 3 – Poisson estimates of restricted and unrestricted model

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<th>Variable</th>
<th>Restricted</th>
<th>Unrestricted</th>
</tr>
</thead>
<tbody>
<tr>
<td>_cons</td>
<td>-0.197</td>
<td>0.290</td>
</tr>
<tr>
<td>ln_clsr</td>
<td>0.297 ***</td>
<td>0.045</td>
</tr>
<tr>
<td>ln_sp2</td>
<td>0.302 ***</td>
<td>0.033</td>
</tr>
<tr>
<td>spm</td>
<td>-0.005 ***</td>
<td>0.000</td>
</tr>
<tr>
<td>ln_sp1mc</td>
<td>-0.036 ***</td>
<td>0.011</td>
</tr>
<tr>
<td>ln_sp2mc</td>
<td>-0.019</td>
<td>0.013</td>
</tr>
<tr>
<td>istrz</td>
<td>-0.029 ***</td>
<td>0.006</td>
</tr>
<tr>
<td>eta</td>
<td>0.003 **</td>
<td>0.002</td>
</tr>
<tr>
<td>area</td>
<td>0.071 ***</td>
<td>0.013</td>
</tr>
<tr>
<td>qtai</td>
<td>-0.131 ***</td>
<td>0.016</td>
</tr>
</tbody>
</table>

| ln_clsr        | -         | -           | -0.937     | 0.237     |
| ln_sp2         | -         | -           | 0.068 **   | 0.138     |
| spm            | -         | -           | 0.005      | 0.002     |
| ln_sp1mc       | -         | -           | 0.088      | 0.059     |
| ln_sp2mc       | -         | -           | 0.064      | 0.071     |
| istrz          | -         | -           | -0.019 **  | 0.036     |
| eta            | -         | -           | -0.015 *** | 0.007     |
| area           | -         | -           | 0.399 **   | 0.103     |
| qtai           | -         | -           | 0.192 ***  | 0.077     |

| ln_clsr        | -         | -           | 0.934      | 0.334     |
| ln_sp2         | -         | -           | -0.314     | 0.217     |
| spm            | -         | -           | 0.001 ***  | 0.002     |
| ln_sp1mc       | -         | -           | -0.244     | 0.090     |
| ln_sp2mc       | -         | -           | 0.142      | 0.125     |
| istrz          | -         | -           | -0.045     | 0.073     |
| eta            | -         | -           | 0.003 ***  | 0.014     |
| area           | -         | -           | 0.492      | 0.122     |
| qtai           | -         | -           | -0.162 *** | 0.130     |

| ln_clsr        | -         | -           | -1.335 **  | 0.304     |
| ln_sp2         | -         | -           | -0.346 *   | 0.136     |
| spm            | -         | -           | 0.002      | 0.001     |
| ln_sp1mc       | -         | -           | -0.026 *   | 0.055     |
| ln_sp2mc       | -         | -           | 0.143 ***  | 0.083     |
| istrz          | -         | -           | 0.182 ***  | 0.038     |
| eta            | -         | -           | 0.060 ***  | 0.012     |
| area           | -         | -           | 0.238 **   | 0.072     |
| qtai           | -         | -           | 0.242 **   | 0.095     |
Table 3 – Poisson estimates of restricted and unrestricted model (cont’d)

| parameters | - | - | ln_clsr | -0.735 ** | 0.352 |
| - | - | ln_sp2 | 0.444 *** | 0.225 |
| - | - | spm | -0.007 ** | 0.002 |
| - | - | ln_sp1mc | 0.192 | 0.095 |
| - | - | ln_sp2mc | -0.071 | 0.130 |
| - | - | istrz | 0.101 | 0.075 |
| - | - | eta | 0.012 *** | 0.015 |
| - | - | area | -0.553 | 0.127 |
| - | - | qta | -0.137 | 0.137 |

| parameters | - | - | ln_clsr | 0.498 ** | 0.350 |
| - | - | ln_sp2 | 0.343 *** | 0.159 |
| - | - | spm | -0.005 *** | 0.001 |
| - | - | ln_sp1mc | 0.316 ** | 0.064 |
| - | - | ln_sp2mc | -0.210 *** | 0.091 |
| - | - | istrz | -0.156 *** | 0.043 |
| - | - | eta | -0.043 | 0.014 |
| - | - | area | -0.123 | 0.082 |
| - | - | qta | -0.036 | 0.109 |

Log lik. -2311.16 -1834.54

Note: *** 1% significant level; ** 5% significant level; * 10% significant level
### Table 4 – Mean willingness to pay for one day of visits for different groups

<table>
<thead>
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</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>7449.613</td>
<td>7851.384</td>
<td>6918.121</td>
<td>7692.233</td>
<td>6810.612</td>
<td>7891.968</td>
<td>7891.968</td>
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<tr>
<td><strong>Std.Err.</strong></td>
<td>137.126</td>
<td>684.413</td>
<td>500.703</td>
<td>437.728</td>
<td>432.308</td>
<td>383.106</td>
<td>837.163</td>
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### Table 5 - Are the Mean WTP figures significantly different at 5% level, across groups?

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<tr>
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</thead>
<tbody>
<tr>
<td><strong>Traditional</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<td>No</td>
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<tr>
<td><strong>Wald Test</strong></td>
<td>0.33</td>
<td>1.05</td>
<td>0.28</td>
<td>1.99</td>
<td>0.36</td>
<td>0.27</td>
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<tr>
<td><strong>Single man</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td><strong>Wald Test</strong></td>
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<td>0.03</td>
<td>1.52</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td><strong>Single woman</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Wald Test</strong></td>
<td></td>
<td></td>
<td>1.65</td>
<td>2.34</td>
<td>1.32</td>
<td></td>
</tr>
<tr>
<td><strong>Husband (without children)</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Wald Test</strong></td>
<td>0.04</td>
<td>1.35</td>
<td>2.05</td>
<td>0.00</td>
<td>0.04</td>
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<tr>
<td><strong>Wife (without children)</strong></td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Wald Test</strong></td>
<td>1.65</td>
<td>0.03</td>
<td>2.05</td>
<td>2.34</td>
<td>1.32</td>
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<tr>
<td><strong>Husband (with children)</strong></td>
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<td>No</td>
<td>No</td>
<td>No</td>
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<td>No</td>
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<tr>
<td><strong>Wald Test</strong></td>
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<td>1.52</td>
<td>0.00</td>
<td>2.34</td>
<td>0.05</td>
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<tr>
<td><strong>Wife (with children)</strong></td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Wald Test</strong></td>
<td>0.00</td>
<td>1.00</td>
<td>0.04</td>
<td>1.32</td>
<td>0.05</td>
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References


