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Summary

The paper proposes an approach for evaluating the effect of flow fixed costs on the evaluation of environmental benefits with travel cost method. On a full annual perspective when recreational users incur relevant annual direct fixed expenses, their behaviour could be influenced by them. The approach introduces a) the notion of the minimal number of annual visits that justifies the annual fixed expenses incurred by the user and b) a method to estimate it. The estimate of this minimal number permits to forecast the user behaviour on a full annual perspective, taking into account a more accurate estimate of the number of visits at different additional fees.

Keywords: Travel cost method, fixed cost

JEL: D1, D4, Q3

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INDIVIDUAL TRAVEL COST METHOD AND FLOW FIXED COSTS

Abstract

The paper proposes an approach for evaluating the effect of flow fixed costs on the evaluation of environmental benefits with travel cost method. On a full annual perspective when recreational users incur relevant annual direct fixed expenses, their behaviour could be influenced by them. The approach introduces a) the notion of the minimal number of annual visits that justifies the annual fixed expenses incurred by the user and b) a method to estimate it. The estimate of this minimal number permits to forecast the user behaviour on a full annual perspective, taking into account a more accurate estimate of the number of visits at different additional fees.

1. Introduction

Travel cost method (TCM) has been developed by Clawson [1959], initially suggested by Hotelling [1949], in order to estimate social benefits from recreation in natural sites.

The method is based on the assumption that the recreational benefits in a specific site can be derived from the demand function, estimated observing users' behaviour, in relation to the costs sustained by them per number of visits. In other words, the classical model derived from economic theory of consumer behaviour postulates that a consumers' choice is based not only on price but on all sacrifices made to obtain the stream of benefits generated by a good or service. Obviously, if the paid price (p) is the only sacrifice made by consumer, the demand function for a good, with no substitutes, is $x=f(p)$, given his income and preferences.

However, the consumer often incurs other costs (c), in addition to the paid price, i.e. disbursements, travel expenses, time loss and stress from congestion and/or competition, e.g. crowded local markets. In this case, the demand function is the following: $x = f(p, c)$[1]. In other words, the price is an imperfect measure of the good's cost incurred by the purchaser. Under these conditions, the utility maximising consumer's behaviour should be reformulated in order to take into account such costs: given two goods or services (x_1, x_2), the prices (p_1, p_2), the access costs (c_1, c_2) and the income (R), the utility maximising choice of the consumer will be obtained as follows:

$$\begin{aligned} &\max U = u(x_1, x_2) \\ &\textit{subject to}: \\ &(p_1 + c_1)x_1 + (p_2 + c_2)x_2 = R \end{aligned} \qquad [1]$$

Now, assuming x_1 the aggregate of priced goods and services, x_2 the number of annual visits to a recreational site, negligible access costs to the market goods ($c_1=0$) and a free access to the recreational site ($p_2=0$), [1] can be written:

$$\begin{aligned} &\max U = u(x_1, x_2) \\ &\textit{subject to}: \\ &p_1 x_1 + c_2 x_2 = R \end{aligned} \qquad [2]$$

Under these conditions, the utility maximising behaviour of the consumer depends on: a) his preferences [$u(x_1, x_2)$], b) his budget (R), c) the prices of the private goods and services (p_1) and d) the access cost to the recreational site (c_2). Figure 1 shows the optimal choice between private goods and recreational activity, given the budget constraint: the point where the marginal rate of substitution is equal to the slope of the budget line and/or where the weighted marginal utility is equal $\frac{Um_1}{p_1} = \frac{Um_2}{c_2}$. Figure 1 also highlights other important issues that will be useful later, when analysing the impact of different type of cost on consumers' optimal choice. First of all, the utility function shows that the user could renounce the recreational activity considered in the figure, allocating his budget only on x_1, while he could not set x_1 to zero (the utility function curve cuts only the Y-axis in x_1^*).

In other words, access to the recreational site could be considered if the income is over a specific threshold, once other needs[2] have been satisfied. With an increased income, the marginal rate of substitution grows and the optimal solution moves from the corner solution [R/p_1], on the Y-axis, to point E[3]. TCM is based on the hypothesis that changes in the access costs to the recreational site

[1] Suppliers often internalise the difficulties faced by consumers in founding a good into their pricing policies using price differentiation.
[2] In other words, consumer utility function is non-homothetic.
[3] Given that $u(x_1^e, x_2^e) = u(x_1^*, 0)$ and setting $R^* = p_1 x_1^*$, the willingness to accept a compensation (WTA) to renounce to x_2^e visits is WTA = $R^* - R$. In other words, WTA increases as marginal rate of substitution increases.

(c_2) have the same effect as price variations: as the number of visits to a site decreases as the cost per visit increases. If the implicit assumptions in [2] are reasonable, then the demand function of the recreational site is $x_2=f(c_2)$ and it can be estimated using the number of yearly visits and different costs per visit observed. There are two basic approaches to TCM: the Zonal approach (ZTCM) and the Individual approach (ITCM). The two approaches share the theoretical premises, but differ in the operational point of view. ZTCM takes into account the users frequency rate coming from different zones with increasing travel costs. ITCM, however, examines the behaviour of the single user in choosing the number of visits per time period, usually a year. The latter approach can be considered a refinement or a generalisation of ZTCM [Ward and Beal, 2000].

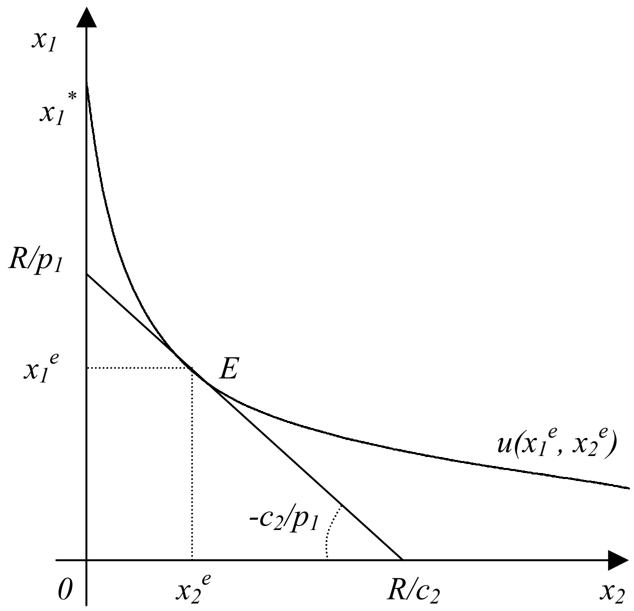

Fig. 1 – Utility maximization of a private and public recreational services user

ITCM, developed by Brown and Nawas [1973] and Gum and Martin [1974], estimates the consumer surplus by analysing the individual visitors' behaviour and the cost sustained for the recreational activity. These observations are used to estimate the relation between the number of individual's visits in a stated time interval, usually a year, the cost per visit and socio-economic variables. Figure 2 highlights the expected relation between the number of visits and cost per visit, given the other variables. It also shows that the number of visits decreases as the cost per visit increases. If we assume that all users have the same preferences and the same income, the number of visits are a function of the cost per visit:

$$x_2 = g(c_2) \qquad [3]$$

Therefore, if an individual incurs c_2^e per visit, it carries out x_2^e visits a year and if the cost per visit increases to c_2^p the number of visits will decrease to x_2^p. In other words, for a homogenous group of individuals[4], [3] shows the relationship between the number of visits and the cost per visit. The cost *cap* is the choke price: the cost per visit that sets the number of visits to zero. Equation [3] is the individual demand function for the recreational site use referred to an "average user". The annual user surplus can be easily obtained integrating the demand function from zero to the present number of yearly visits and subtracting the visits costs.

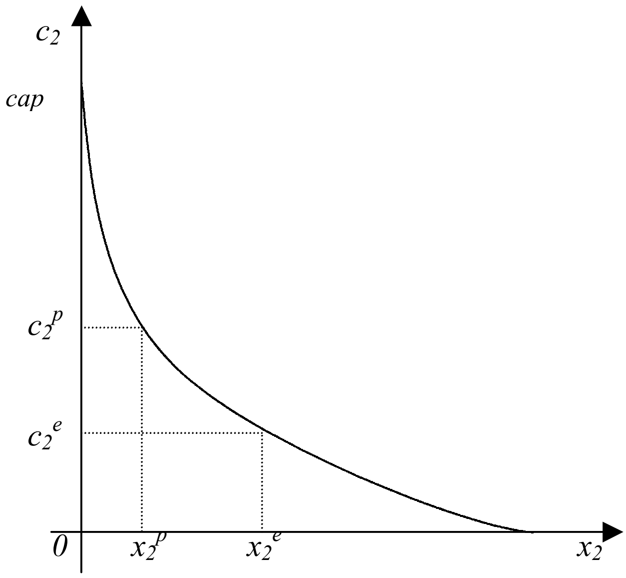

Fig. 2 – Individual's recreational demand function

Figure 3 shows the user's behaviour with increasing additional costs per visit. Briefly, the additional cost (*ca*) modify the slope of budget line that gradually reduce the number of visits until the point in which, for the aggregate effect of the reducing of the marginal rate of substitution and the increasing of slope of the budget line, the optimal solution excludes the visit (x_2), and the entire budget is spent on x_1. The additional cost setting the visits to zero is *cap*, the choke price. Increasing the cost for visit to *cap,* the consumer's utility will be reduced to $u(R/p_1, 0)$. The demand function, subtracting the present travel cost, [$x_2=z(ca),\ ca=\delta(x_2)$] is the curve *I* of figure 4.

The aggregate demand function (*A*) [$x_2 = h(ca), ca = \varphi(x_2)$] is obtained summing up the individual demands (*i*) at the different additional costs. It cuts the X-axis at the total present visits' numbers $\left(\sum_i x_{i2}^e\right)$, and the Y-axis at the maximum additional cost incurred by the users. The

[4] The function can also be estimated for non homogeneous sub-samples introducing among the independent variables income and socioeconomic variables expressing individual preferences [Hanley and Spash, 1993, p. 84].

recreational users' surplus is obtained taking the present value of the definite integral of the aggregate demand function (*A*) from zero to total annual visits' number. That is:

$$S = \frac{\int_0^{\sum_i x_{i2}^e} \varphi(x_2)dx_2}{r} \quad [4]$$

where r is an appropriate discount rate.

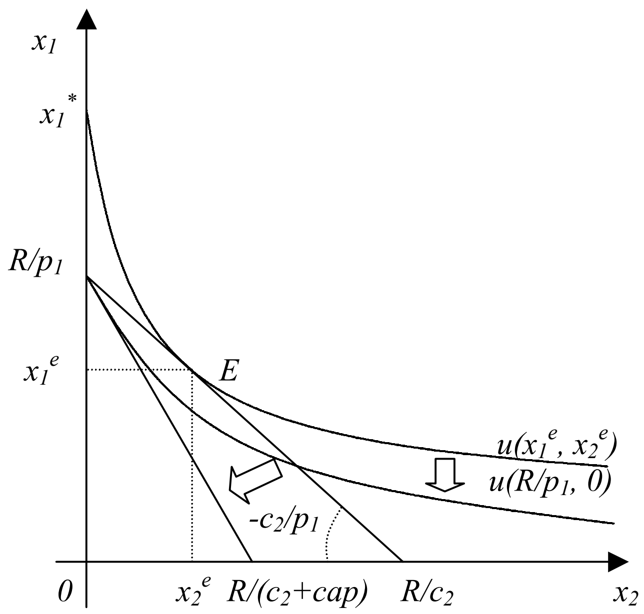

Fig. 3 – User's behaviour at increasing additional fees

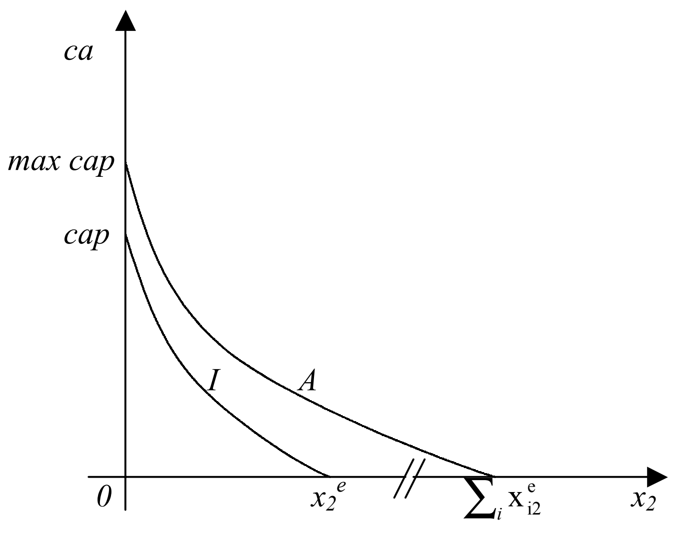

Fig. 4 – Individual's and aggregate recreational demand function

2. Types of Cost and User's behaviour

The previous model shows that the aggregate recreational demand function is closely related to a "travel generator function" [3] that includes the costs perceived as relevant by the users in their decision-making process in establishing the number of annual visits. Some relevant costs for the decision-making process are often not measurable and/or subjective[5] [Randall, 1994; Common, Bull, Stoekl, 1999]. Usually, these costs are substituted with observable proxies. ITCM takes into account direct variable costs only (i.e. fuel, tolls, tickets, etc). On the other hand, the recreational use of natural resources often involves annual fixed costs, independent of the number of visits carried out. For example, with recreational fishing in open waters or sea, it is necessary to pay for an annual fishing licence and to incur boat-related annual expenses (i.e. laying-up, maintenance and assurance), generally independent from the annual number of visits. Such costs are irrecoverable in the short period (sunk costs), that is, on an infra-annual perspective, while, extending the analysis to a full annual perspective, they can be avoided, renouncing the recreational activity[6]. For example, the expenses in laying-up and for fishing licences, sunk costs already incurred, can be avoided the following year, renouncing the visits. With a longer time scale, the capital locked up in the boat is, at least partially, recoverable when selling it.

The literature on fixed costs and TCM is rather elusive. Some authors [Hanley and Spash, 1993, p. 88] argue that the welfare measures vary including the fixed costs or not and they suggest to exclude the fixed travel costs as "Individuals, maximising utility, are assumed to compare the marginal utility with the marginal costs of consumption". Likewise, Walsh [1986, p. 100] suggests considering the direct costs only since ″.. the concept of fixed costs is not applicable to consumer decisions to take an additional trip to recreation site ". Ward and Beal [2000, p. 44], assert "TCM uses the cash costs directly incurred by visitors to travel to given the demand equation to that site″. Ward and Beal [2000] argue, moreover, that the presence of high fixed costs related to specific equipment required for the recreational activity, reduces the price elasticity of the demand.

These assumptions seem reasonable when a) the amount of flow fixed costs is low in comparison to the variable costs, b) it is referred to multi-purpose equipment or costs (i.e. car) and, above all, c) the analysis is closely of short period.

But are these assumptions reasonable in presence of relevant, specific annual fixed expenses and when the benefits' estimate are used to support medium-long run public decisions, i.e. a fee-policy? In our view, in these cases the opportunity cost of flow annual fixed expenses has to be taken into account, therefore conditioning the choices of the users on a full annual perspective. Indeed, a more

[5] I.e. the problem of valuing travel time.

accurate approximation to the decision making process faced by a recreational user is needed in order to forecast better the number of visits with additional entry fees. In the case of recreational fishing and/or boating, for example, the decision-making process faced annually from a user involves two sequential decisions:

a) *'Do I fish/boat this year?'* (full annual perspective). This decision to sustain the annual fixed costs related to the recreational activity (i.e. payment of the licence, boat-related expenses), or to assign the saved money to other goods, or recreational activities. This decision depends on the comparison between a subjective, generally optimistic, forecast of the number of visits he will carry out during the year and a minimal threshold. In general, this estimate, carried out annually, can be considered analogous to that one operated preliminarily with the investment in the recreational activity related equipment, but it is supported by past experience, of the estimate of the number of annual visits, the variable costs and annual fixed expenses.
b) *'Do I fish/boat today?'*, (infra annual perspective). After having incurred annual fixed expenses, the user decides on the number of visits to carry out on the base of the variable cost per visit. Obviously, the recreational demand function estimate, being based on the observed user's behaviour facing the direct variable travel cost, allows the modelling of the second step of the decision-making process only. However, this two step annual decision-making process, already highlighted by other authors [Walsh, 1986]: a) justifies the assumption not to include the equipment depreciation fixed costs in the cost per visit, but b) suggests taking into account annual fixed expenses, giving important influence both on the choke price and on surplus estimates in an annual perspective. The influence of flow fixed expenses can be measured estimating the minimum number of visits per year that allows the individual to sustain them, thus *'to remain in play'*.

This issue suggests to redefine the utility maximising behaviour of a recreational user incurring both a variable cost per visit and also an annual fixed cost (c_0). Assuming R the available budget (net from the annual fixed expenses, already sustained), p_1 the price of the other goods and services (x_1) and c_2 the variable direct cost per visit (x_2), on a full annual (or inter-annual) perspective, the optimal choice can be obtained solving:

[6] The existence of fixed costs depends closely on the temporal interval considered [Tirole, 1991, p. 532]. I.e. the cost of a annual licence is fixed if an inferior interval to 12 months is considered; vice versa it is variable if the temporal horizon is extended to one year.

$$\begin{aligned} &\max U = u(x_1, x_2) \\ &\textit{subject to}: \\ &p_1 x_1 + c_2 x_2 = R \qquad se\ x_2 > 0 \\ &p_1 x_1 = R + c_o \qquad se\ x_2 = 0 \end{aligned} \qquad [5]$$

The solution can be found comparing the utility $\left[u\left(\frac{R+c_o}{p_1},0\right)\right]$, reachable spending $R+c_o$ in x_1, with the utility $[u(x_1^o,x_2^o)]$ obtained spending actual income (R) on the optimal combination between x_1 and x_2. The optimal solution depends on the parameters of [5]: the shape of the utility function, the ratio between prices and variable average cost per visit, the budget constraint line and the annual fixed cost.

The presence of a annual fixed expenses does not modify the slope of the budget line but it produces a similar effect to an income variation. If the demand of the recreational site is elastic in regards to the income, then budget variations will modify the marginal rate of substitution. In other words, a low budget will favour the corner solution allocating all the income on x_1. With the augmentation of income, the increase of the MRS favours intermediate solutions. It seems useful to thoroughly explore the equilibrium condition (indifference) between the recreational site use x_2 and the exclusive consumptions of x_1. Such condition can be obtained solving the following equation:

$$u(x_1^m, x_2^m) = u\left(\frac{R+c_o}{p_1},0\right) \qquad [6]$$

where x_1^m and x_2^m are the *optima* when the user accepts to incur annual direct fixed costs for recreational activity x_2 (fig. 5). Assuming a convex utility function, monotonic and non-homothetic, a relevant annual fixed expense implies the existence of a minimum number of yearly visits per user x_2^m, generally greater than zero. In fact, starting from optimal point M, an increase of the cost of recreation (increase of the annual fixed cost and/or the variable cost per visit) will not set the visit to zero. In other words, as costs increase, the recreational demand function does not approach to zero but x_2^m.

As a consequence, taking into account only the variable cost, we ignore the user's alternative of deciding every year, even with some rigidity due to an optimistic forecast of the number of visits, not to incur the annual fixed costs, freeing therefore an additional budget to be spent on other goods: in other words, it is assumed a decisional scenario, on an infra-annual base, more rigid than the real one.

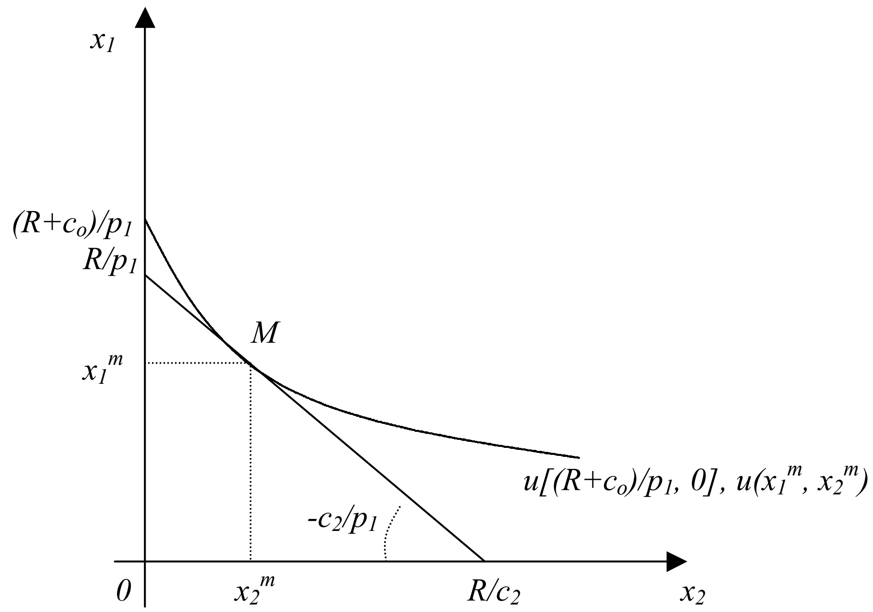

Fig. 5 – Utility maximization of a private and public recreational services user with annual direct fixed costs

3. ITCM and Flow Fixed Costs

When the user decision-making process is similar to that outlined above, the ITCM has to take into account the alternative of not incurring the annual fixed expenses. Therefore, on a full annual base, the estimated number of yearly visits decrease with increasing entry fees, will be higher than the reduction predicted on an infra-annual base. Further additional unit cost increases ultimately reduce visits to a minimal value x_2^m greater than zero. The minimal yearly visits number can be obtained from the equation [6] taking into account its corresponding 'choke' price (point M , fig. 6). In this particular case, the so-called 'choke' price is not the price at which all visits cease on an infra-annual perspective, but the price at which the user decides to avoid annual fixed costs. As a result, the 'choke' price on an annual perspective is lower than one on an infra annual perspective, when periodic fixed costs are not involved (cap^* , fig. 7).

On an annual perspective, with relevant fixed costs, the individual's recreational demand function needs to be estimated using variable costs and the number of visits, based on observed data, per user. However, in order to avoid the overestimation of a recreational user's surplus the demand function has to be truncated to the minimal number of visits (x_2^m), justifying the annual fixed cost (fig. 7)[7].

[7] Ward and Beal [2000, p.151] suggest to add the average unit annual fixed cost per visit to unit variable cost in a ZTCM approach, in order to eliminate extremely high predictions from nearby zones of origin.

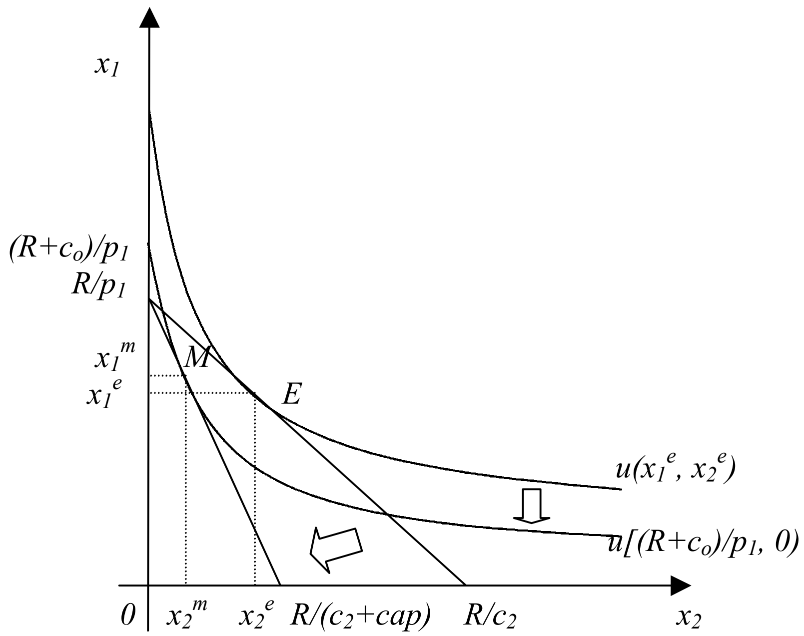

Fig. 6 – User's behaviour at increasing additional fees with annual direct fixed costs

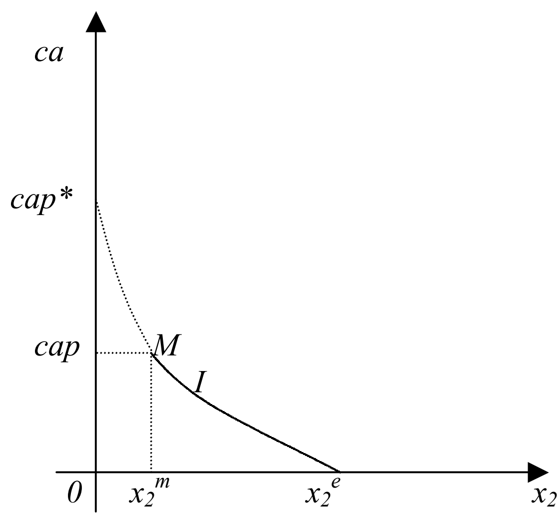

Fig. 7 – The individual's recreational demand function with annual fixed costs

Now we have to estimate x_2^m and/or *cap*. The minimal number of visits (x_2^m), is not observable, because it is evaluated by the user in phase (a) of his decision-making process, but it can be obtained from the equilibrium conditions of figure 6. Under this conditions, consumer surplus derived from allocating his entire budget (R+C_0) for the consumption of x_1, is equal to the surplus that he obtains in M; since:

$$x_1^m = \frac{R - cap\, x_2^m}{p_1}$$

[6] can be written as:

$$u\left(\frac{R + C_o}{p_1}\right) = u\left(\frac{R - cap\, x_2^m}{p_1}, x_2^m\right) \qquad [7]$$

assuming a marginal consumer and placing:

$p_1 = 1$

$cap = \delta(x_2^m)$

$u(x_2^m) = \int_0^{x_2^m} \delta(x_2)dx_2$

$u[C_0 + x_2^m \delta(x_2^m)] = C_0 + x_2^m \delta(x_2^m)$

we have:

$$C_0 + x_2^m \delta(x_2^m) = \int_0^{x_2^m} \delta(x_2)dx_2 \qquad [8]$$

Solving [8] x_2^m can be obtained. Taking into account x_{i2}^m for every user i, based on his annual fixed expenses, the total recreational benefit of the site is:

$$S = \sum_i \frac{\int_0^{x_{i2}^e} \delta_i(x_2)dx_2 + \frac{\int_{x_{i2}^m}^{x_{i2}^e} \delta_i(x_2)dx_2}{r}}{1 + r} \qquad [9]$$

We have to take into account x_2^m due to annual fixed costs sustained mainly when users are able to estimate with precision their future visits. On the other hand, x_2^m can be ignored when fixed costs do not influence the user decisions; in particular: a) when the fixed costs have been sustained a long time before the recreational activity, b) when the number of expected annual visits per user significantly differs from the real ones. In fact, as we said before, the investment in recreational equipment is based on an optimistic forecast of annual visits. By the way, usually, the best two days in a boat owners life is the day he buys the boat and the day he sells it to someone else.

4. A numerical example

In order to verify the impact of the proposed method both on the reduction of the number of annual trips due to increasing fees and on welfare measures, a numerical example has been carried out, referring to recreational use of the Venice lagoon (boating and fishing). A detailed description of the collected data set can be found in a previous paper [Defrancesco, Rosato, 2000], showing the results of an on-site survey carried out during spring and summer 1999, aimed to estimate recreational benefits of the lagoon, using both contingent valuation and ITCM.

This exercise is based on an homogeneous sub-set of 129 recreational users, obtained selecting the visitors incurring high annual fixed expenses, paying an annual price to keep their boat in a marina. However, given the limited, non-random, sample size, our results have to be considered as an example and they can not be extended to the recreational users population of the lagoon.

ITCM has been based on the number of annual trips declared by those interviewed. The variable costs include: a) the direct variable cost sustained by each user in order to reach the boarding point, off-site travel time valued in proportion of wage (6€ per hour), b) the cost of fuel for the boat, c) the cost for food and beverages, d) in the case of the fishermen, the cost of bait. The annual fixed cost takes into account the cost sustained in order to keep the boat in a marina, boat insurance and maintenance costs, and, if applicable, the annual cost of fishing license (tab. 1). The estimated recreational demand function [3] predicts the individual annual trips as a linear function of the logarithm of variable costs per visit and income, closely fitting the data (adj R^2=53%).

	Mean	Standard Deviation
Annual trips	26,8	5,8
Direct Variable Costs per Trip (€)	59,0	27,7
Annual Direct Fixed Expenses (€)	1071,0	592,9
Annual Income (.000€)	17,5	15,3

Tab. 1 - Descriptive statistics on variables

The OLS estimated coefficients (tab. 2) differ significantly from zero (α=1%) and have the expected sign. In order to evaluate the individual recreational surplus the demand function, being asymptotic to the Y-axis, has been truncated to one visit [Ward and Beal, 2000], valuing the first trip on the base of its marginal benefit obtained solving the demand function for the cost that would produce one trip. On an infra annual perspective, the net recreational surplus of an user is equal to the difference between the total yearly surplus (the area under the demand function between one visit and the actual trips, plus the surplus related to the first trip) and the total variable cost sustained.

The mean recreational surplus per visit is equal to 611,80€, the standard deviation over the mean equals to 48% and the median value is 567,3€[8].

		Coefficient	Standard Error
Constant	(c)	42,56	2,25
Ln(Direct Variable Cost per Visit)	(α)	-6,94	0,62
Ln(Annual Income)	(β)	4,44	0,50

Tab. 2 – The individual's recreational demand function coefficients

On the other hand, under a full annual perspective the behaviour of the lagoon recreational user is influenced by annual fixed expenses sustained for recreation, given his income. So, his unobservable x_2^m has to be estimated, imposing the equality [8]. In this specific case, [8] is:

$$C_0 + x_2^m e^{\frac{x_2^m - (c+\beta \ln R)}{\alpha}} = \frac{1-(c+\beta \ln R)}{\alpha} + \int_1^{x_2^m} \left(e^{\frac{x_2 - (c+\beta \ln R)}{\alpha}} \right) dx_2 - cax_2^m$$

where:
R = user income;
C_0 = annual fixed costs;
ca = variable cost per visit.

In this case, the annual recreational surplus of the user is equal to the difference between the definite integral of the demand function from x_2^m to actual number of yearly trips, and the related total variable costs. In other words, if the agency managing the lagoon estimates the net recreational users' surplus in order to better define a fee policy, it has to take into account the surplus under a full annual perspective, estimated using x_2^m. By increasing entrance fees many users could decide to renounce a visit the lagoon, because of the relevant annual fixed cost which involves a number minimal of annual visits.

In this particular case, this adaptation of TCM highlights:

a) The individual minimal number of visits per year ranges between 2 and 12; the mean x_2^m is equal to 3,36 and standard deviation equals 1,22. The estimated coefficients of a regression model (tab. 3), expressing x_2^m as a function of logged income, logged variable cost and annual fixed costs (adj R^2=0,85), show that the minimal number of visits per user decrease with the increase of income and is positively related to the amount both of fixed and variable costs.

[8] The high mean value is due to the algebraic form of the demand function and, above all, to the particular sub-sample analysed.

	Coefficient	Standard Error
Constant	4,89	0,28
Annual Fixed Costs	0,002	0,00
Ln(Variable Unit Cost)	0,182	0,08
Ln(Annual Income)	-1,62	0,07

Tab. 3 – The minimum annual number user's visits function

b) The number of visits carried out by all users decreases more rapidly on a full annual perspective, i.e. taking into account their behaviour facing annual fixed cost. In fact, figure 8 clearly highlights that, extending the analysis in the medium run, an annual additional fee higher than 500€ several results in users renouncing recreational activity, due to the number of yearly visits that would be less than the minimum justifying the annual fixed costs sustained. Therefore, the dotted line showing annual trips taking into account the annual fixed cost lies under the line of visits on a infra-annual perspective (based only on variable cost). Obviously, the distance between the lines increases as additional fees increase.

c) On a full annual perspective, the net mean surplus per visit is equal to 377,8€, the standard deviation over the mean equals 55% (median 352,1€). The unit mean surplus is, therefore, 38% less than the unit welfare estimate obtained applying the traditional TCM (infra-annual perspective). So, the exercise clearly highlights the impact of the varied estimation approaches on the lagoon's total recreational value.

5. Concluding remarks

The aim of this paper is to propose a modified ITCM approach, taking into account flow fixed costs. A full annual perspective, in our view, when recreational users incur relevant annual direct fixed expenses, their behaviour could be influenced by them, on a full annual perspective. As a result, the agency managing a natural site for outdoor recreation should use caution when valuing recreational users surplus, which has to be estimated on a full annual perspective, mainly in order to define a proper fee policy.

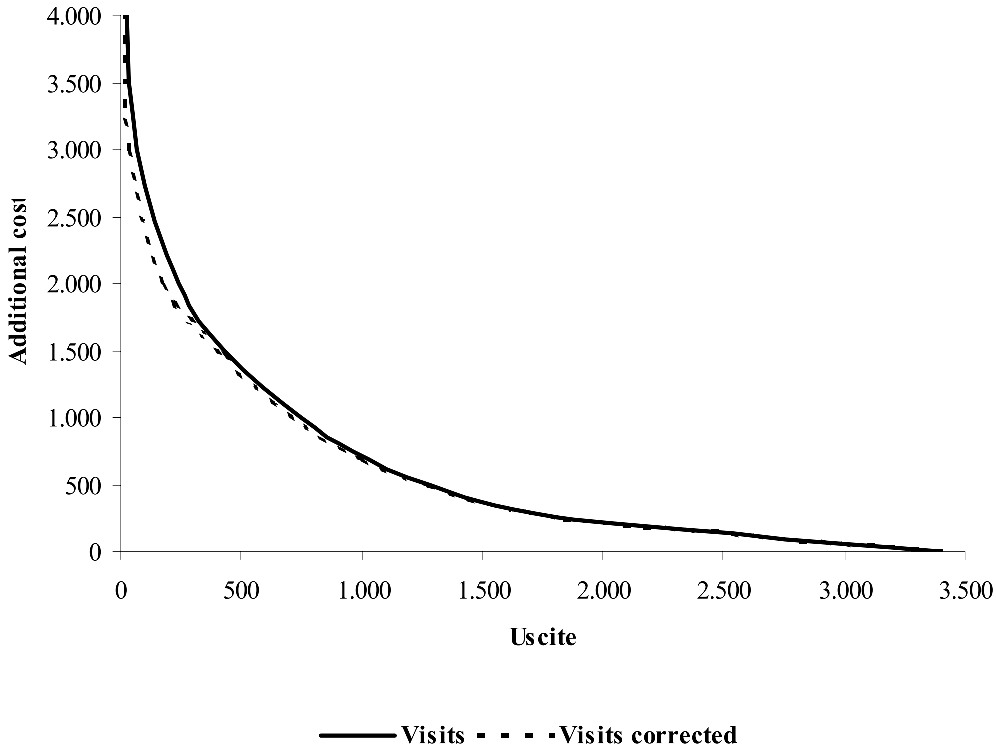

Fig. 8 – Number of total annual visits at increasing additional fees on an infra-annual perspective (traditional TCM) and taking into account yearly fixed expenses on a full annual perspective

By ignoring flow fixed costs TCM, both surplus estimate and yearly number of visits at different additional fees could be overestimated. So, on a medium run perspective it could be useful to take into account the annual fixed expense which is directly connected to recreation. When flow fixed costs are relevant in respect to variable costs, the proposed approach works as it follows:

a) based on observable users' behaviour, the individual's recreational demand function, as usual, has to be estimated on actual yearly trips and related unit variable costs (infra annual perspective).
b) users face a full annual decision-making process, involving the amount of direct fixed expenses. This process is unfortunately unobservable. It could be valued by introducing the notion of the minimal number of annual visits (x_2^m) that justifies the annual fixed expenses incurred by the user;
c) using x_2^m the user behaviour can be described on a full annual perspective, taking into account a more precise estimate of the number of visits with different additional fees. Under a infra-annual perspective, i.e. ignoring x_2^m, both recreational surplus and the number of annual trips, at increasing additional fees, could be overestimated, in order to use them for medium-long run decision-making processes (i.e. fee policies). In actual fact, traditional

TCM approach could produce questionable results, when annual direct fixed costs are relevant.

On the other hand, the minimal number of annual visits x_2^m closely depends on both the amount of the direct annual fixed expenses incurred by the user and the accuracy of the perceived fixed cost by him. In conclusion, further investigations are needed, in order to achieve a better definition of the types of cost really valued by the users in their decision-making process, when relevant annual fixed costs are incurred.

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(lii) This paper was presented at the International Conference on “Economic Valuation of Environmental Goods”, organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001
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