The Travel Cost Method and the Economic Value of Leisure Time

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ABSTRACT

Recent estimates of high values for tourist related recreation USA amenity values indicate that allocation of basic water and terrestrial resources to recreation activities should be given precedence over conventional market oriented activities that often degrade or even extirpate the resource. We discuss at length the travel cost method (TCM), a survey based technique that quantifies the non-market benefits of trips to recreation sites. The TCM has been cast in the role of an ‘umpire’ in recent resource allocation debates. Understanding the key role of the TCM in the debate will aid tourist agency officials throughout the world. This article is a U.S. Government work and is in the public domain in the U.S.A.

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INTRODUCTION

In this paper we focus primarily on recreation tourism issues that fall neatly within the boundaries of economics. In particular, the analytical discussion is an assessment of the appropriate valuation of foregone wages in applications of the travel cost method (TCM). However, the critical applications of the conclusions that we reach have their provenance in bitter protracted USA resource allocation disputes. A larger theme of our discussion is that the role of resource economics in resolving the dispute has important implications for the management of global tourism.

ECONOMIC DEVELOPMENT AND THE GROWTH OF GLOBAL TOURISM

Many of the adverse anthropogenic effects of tourism in third world and developing nations also challenge developed nations (Mueller, 2000; Buckley, 2002a, b; Hillstrom and Hillstrom, 2003). Recreation and ecotourism in large ecologically diverse countries such as the UK, Australia and Canada pose challenges similar to those faced by Pakistan, various island nations, and the Maghreb region (Miller, 1993; Owen et al., 1993; Eagles and Cascagnette, 1995; Berriane, 1996; Buckley, 2002a, b). The preservation of biodiversity and rare botanical and animal species is a matter of high priority for local and national government officials in managing remote forest, coastal and mountain tourist sites (Kelly et al., 2003).

Thorny resource management issues become magnified if remote regions are used regularly by tourists. Foodstuffs and manufactured goods must be transported to remote tourist sites and carefully disposed of to main-

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tain the integrity of pristine air- and water-quality conditions of these remote areas (Mueller, 2000; Kelly et al., 2003).

However, there are some critical differences between the political and socio-economic evolution of tourist related resource management issues in the developed and third world. For example, recreation related tourism can drive environmental regulation and legislation in the USA and Canada that protects wildlife habitats (Ribaudo et al., 1990). Highly developed rural–urban highway transportation systems typically carry large numbers of tourist vehicles in the USA with little or no adverse risks to regional renewable resources (Douglas and Taylor, 1999a, b).

The travel cost method (TCM) is a survey based method that captures the positive economic impacts of regional tourist expenditures. The technique uses survey data to estimate a statistical demand curve for recreation trips to a site. One of the attractive features of the TCM is that the TCM measures the ‘non-market benefits’ provided by an outdoor recreation site with trip related regional expenditures (Loomis and Creel, 1990; Hof and King, 1992).

Unfortunately, it is not possible to apply the TCM in many undeveloped regions of the world in an advantageous manner. The transportation infrastructure of many areas is too frail to carry large numbers of tourist visits by car and bus with minimal adverse impacts on the countryside. Small businesses located on tourist routes or near recreation sites in Europe and North America are the recipients of the bulk of the tourist expenditures.

On the other hand, traditional economic activities such as irrigated agriculture can have sharp adverse impacts on pedological, forest, wildlife, water and fishery resources (Ribaudo et al., 1990).

In much of the world, this situation is reversed. Native tribal peoples have developed lifestyles and harvesting techniques that create minimal adverse impacts on fragile desert, mountain, tropical forest and coastal ecosystems (Caulfield, 1986). Commercially viable tourist activities in these regions often degrade water resources and landscapes (Berriane, 1996). In developing countries, tourist related commerce is often organised and managed by non-locals or foreigners who use the revenues and profits for investment activities that generate jobs and profits in urban commercial centres (Hillstrom and Hillstrom, 2003). In these circumstances, TCM data might overstate the benefits of enhanced tourism and regional authorities may find it useful to use an alternative technique.

The contingent valuation method (CVM) is the most widely used tool for attaching monetary values to enhancing, preserving, or restoring resource amenities (Loomis et al., 1990). The CVM is extremely flexible and can provide estimates of the benefits of clean air and water in heavily populated urban corridors and in remote wilderness settings. The CVM was applied in several policy arenas in the early 1990s; the CVM was used to provide the damage assessment estimates for the Exxon Valdez oil spill in Prince William Sound. The Exxon Valdez oil spill damage restoration estimates are CVM ‘existence benefits’ estimates (Welsh et al., 1995).

A CVM existence benefits estimate is based on answers to queries about the maximum amount respondents would be willing-to-pay (WTP) to restore or preserve an amenity (Loomis et al., 1990). The term ‘existence benefit’ refers to the fact that the typical respondent has never visited the site or used the amenity in question. Respondents to a ‘user survey’ have visited the site in question and provide WTP data used to estimate ‘user benefits’.

The Exxon corporation organised a series of symposia (the W-133 meetings) in the early 1990s in response to a large CVM existence benefits damage restoration estimate for the Exxon Valdez oil spill. The carefully orchestrated W-133 meetings featured presentations by prominent academic economists who reached sweeping negative conclusions about the CVM (Diamond and Hausman, 1993). Some of these academicians cast TCM estimates as a major corrective cure for massively inflated CVM existence benefits estimates (Diamond and Hausman, 1993; also see the version presented at the W-133 meeting held in 1992 at South Lake Tahoe, Nevada).

During this period well-known CVM existence benefits studies indicated that USA riverine water resources should be shifted from
conventional market uses such as the provision of irrigation water to more environmentally friendly tourist linked recreation uses (Loomis et al., 1990; Welsh et al., 1995).

The TCM is less controversial than the CVM because it is based on recreation trip survey based expenditure data, whereas the CVM is based on hypothetical responses to proposed changes. However, contingent use (CU) data are hypothetical responses to proposed site changes that can be conjoined to TCM data. The CU data indicate the trip increments that respondents would make as a consequence of proposed site enhancements. Moreover, CU responses are much easier to cross validate (by on-site counts) than CVM willingness-to-pay (WTP) data (Duffield et al., 1992).

There are three distinct ways to use TCM expenditure data to measure the impacts of trips to an outdoor recreation site including: (i) to estimate the consumer surplus (CS) provided by trips to the site, (ii) to estimate regional employment impacts of trips to the site, and (iii) to estimate the present value of regional trip related expenditures. Thus, TCM expenditure data can be arranged so that they can be compared with data that highlights the strengths of regional rural agricultural and extractive economic activities. In the final section of our paper we suggest ways that tourist bureaus can use TCM-CU data to enhance tourist revenues and fund regional infrastructure construction that will serve tourists.

THE ANALYTICAL FRAMEWORK

A TCM benefit estimate is a CS estimate (Just et al., 1982). The CS is the area above the price line underneath the demand curve of the good or service in question (see Figure 1). The rectangle in Figure 1 formed by the axes and the lines PP’ and AP’ represents total expenditures per unit time on the good. The area underneath the demand curve bounded by the quantity line AP’ minus total expenditures is the consumer surplus. The price of trips is expressed as either mean trip expenses ($E$) or as ‘travel cost’ ($TC$). If the per mile cost of travelling to the site is $c$, and $d$ is the one-way travel distance, $TC = 2cd$. A regression model linking the number of trips to $E$ or $TC$ (e.g. distance travelled) is the basis for microdata variant TCM benefits estimates (Creel and Loomis, 1990).

Let $N$ be the number of trips in the past 12-months to a specific recreation site, $E$ be mean trip expenses, $\tilde{z}$ a vector of covariates and $D$ the demand curve

$$N = D(TC, E, \tilde{z})$$

Let $U$ be upper limit of integration and use subscripts to designate sample means; then

$$CS = \int_{TC_m}^{Y} D(TC_m, E_m, \tilde{z}_m) dTC$$

The choice of the price variable — $E$ versus $TC$ — affects the value of the integral (Douglas and Taylor, 1999a).

A TCM CS estimate does not incorporate the value of leisure time. If the value of foregone wages is omitted, TCM estimates have a downward bias (Just et al., 1982). However, some economists use the wage rate to estimate the value of leisure time, whereas others use a modest fraction of real wages (Just et al., 1982, 1990).

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p. 292). Nevertheless, Becker (1965) and Just et al. (1982) clearly demonstrate that the value of a change in leisure time is equal to the correlative change in wage income (Just et al., 1982, p. 117). Our analysis provides a basis for using Becker’s (1965) theory and contingent use (CU) data to estimate marginal benefits conferred by improvements at a site (Duffield et al., 1992). The CU data play a critical role in converting TCM baseline benefit estimates into marginal values that can be compared with site improvement costs.

A MULTI-ACTIVITY MODEL

Let \( r > 0 \) be the non-wage income, \( w > 0 \) the wage rate, \( Y > 0 \) be the income of the consumer, \( \bar{a} > 0 \) be the leisure activity time vector, \( \bar{x} \) be a vector of market goods, \( \bar{p} \) be the price vector for the market goods, and \( h > 0 \) be hours worked. Income is \( Y = r + wh \), for \( w > 0 \) and \( h > 0 \). The time constraint is \([h + \sum(a_i)] \leq T\). The time constraint could be \(8760 = 365(24)\) or \( (7)(8)(52) = 2912 \) hr-yr\(^{-1}\). The value of foregone wages (FW) is independent of the definition of \( T\).

There are \( m \) activities and \( n \) market commodities. The consumer’s utility function is \( U(\bar{a}, \bar{x}) \); \( U \) is bounded from below by \( U(0, 0) = 0 \) and unbounded from above. \( U(\bar{a}, \bar{x}) \) is strictly concave, strictly monotonically increasing, continuous, and has continuous first- and second-order partial derivatives

\[
\frac{\partial U}{\partial a_i} = U_i > 0; \quad \frac{\partial U}{\partial x_j} = U_j > 0
\]

\[
\frac{\partial^2 U}{\partial a_i \partial x_j} = U_{ij} < 0, \quad \frac{\partial^2 U}{\partial a_i^2} = U_{ii} < 0, \quad \frac{\partial^2 U}{\partial x_j^2} = U_{jj} < 0,
\]

\[
\frac{\partial^2 U}{\partial a_i \partial x_j} = U_{ij} \geq 0
\]

The constraints are

\[
Y = wh + r \geq \sum p_i x_i; \quad T \geq \sum a_i + h
\]

Let \( \lambda \) and \( \gamma \) be non-negative Lagrange multipliers and \( G \) be the Lagrangean

\[
G = U(\bar{a}, \bar{x}) + \lambda (r + wh - \sum p_i x_i) + \gamma (T - h - \sum a_i)
\]

The first-order conditions (FOC) are

\[
\frac{\partial G}{\partial L_i} = \frac{\alpha_i U}{L_i} - \frac{\partial U}{\partial a_i} - \gamma = 0; \quad \frac{\partial G}{\partial x_i} = \frac{\beta_i U}{x} - \lambda p = 0;
\]

\[
\frac{\partial G}{\partial h} = \lambda w - \gamma = 0
\]

Equation (7) indicates that the wage rate is indeed the price of leisure.

We use a simpler model to derive sharper results for improvements in environmental amenities. Let \( U \) be utility, \( L_1 \geq 0 \) and \( L_2 \geq 0 \) be the time allocated to the leisure activities, and \( x \geq 0 \) the quantity purchased of the market good. The price of \( x \) is \( p > 0 \). Let \( r > 0 \) be non-wage income, \( Y = r + wh > 0 \) be total income, and \( T > 0 \) be the total time. Utility is the strictly concave, (twice) continuously differentiable function

\[
U = (L_1^{a_1} L_2^{a_2}) x^\beta; \quad \alpha_i > 0, \quad i = 1, 2; \quad \beta > 0
\]

Assume that \( (\alpha_1 + \alpha_2 + \beta) < 1 \) before and after any changes in the individual exponents. Let subscripts denote the first- and second-order partial derivatives of \( U \); the derivatives of \( U \) with respect to \( L_1 \) and \( L_2 \) are

\[
\frac{\partial U}{\partial L_1} = \frac{\alpha_1 U}{L_1}, \quad \frac{\partial U}{\partial L_2} = \frac{\alpha_2 U}{L_2}, \quad \frac{\partial^2 U}{\partial L_1 \partial L_2} = \frac{\alpha_1 \alpha_2}{L_1 L_2} \frac{U}{U} > 0
\]

\[
U \text{ is strictly concave if } (\alpha_1 + \alpha_2 + \beta) < 1 \text{ (Henderson and Quandt, 1980).}
\]

THE DEMAND FOR LEISURE AND THE SUPPLY OF LABOUR IN A MULTISITE MODEL

Let \( G \) be the Lagrangean expression for the maximization of \( U \) subject to the income and time constraints

\[
G = L_1^{a_1} L_2^{a_2} x^\beta + \lambda (r + wh - px) + \gamma (T - h - L_1 - L_2)
\]

Differentiating with respect to the decision variables

\[
\frac{\partial G}{\partial L_i} = \frac{\alpha_i U}{L_i} - \gamma = 0; \quad \frac{\partial G}{\partial x} = \frac{\beta U}{x} - \lambda p = 0;
\]

\[
\frac{\partial G}{\partial h} = \lambda w - \gamma = 0
\]
However, total leisure time $L = (L_1 + L_2)$ must rise and hours worked must fall if the quality of one of the sites increases

$$\frac{\partial L^*}{\partial \alpha_i} = \frac{\partial L^*_i}{\partial \alpha_i} + \frac{\partial L^*_i}{\partial \alpha_i} = \frac{w\beta(r + wT)}{q^2} > 0 \quad (20)$$

Our analysis of the current model indicates that enhancements increase leisure time allocated to trips at the improved site and time allocated for trips to competing sites decreases. Because the pecuniary cost of recreation trips is the key variable in TCM models we introduce a pecuniary cost for leisure activities in the next section.

MODELS WITH PECUNIARY COSTS

In the next model the pecuniary costs for the leisure activities are proportional to the total time allocated to the leisure activities, but the cost is the same for each activity; $E = L + px$, $L = L_1 + L_2$. To simplify the calculations, we replace $U$ with $U^* = \ln[U]$. The Lagrangean is now equation (21),

$$G = \alpha_1 \ln L_1 + \alpha_2 \ln L_2 + \beta \ln x$$

$$+ \lambda(r + wh - E) + \gamma(T - L - h) \quad (21)$$

The FOC are

$$\frac{\partial G}{\partial L_i} = \frac{\alpha_i}{L_i} - \lambda - \gamma = 0; \quad L_i = \frac{\alpha_i}{\lambda(w + 1)}, \quad i = 1, 2 \quad (22)$$

$$\frac{\partial G}{\partial x} = \frac{\beta}{x} - \lambda p = 0; \quad x = \frac{\beta}{\lambda p} \quad (23)$$

and

$$\frac{\partial G}{\partial h} = \lambda w - \gamma = 0; \quad \gamma = \lambda w \quad (24)$$

The optimal values are listed in equations (25) and (26). Define

$$q_1 = (w + 1)(\alpha_1 + \alpha_2 + \beta)$$

Then

$$L^*_i = \frac{\alpha_i(r + wT)}{q_1}, \quad i = 1, 2;$$

$$x^* = \frac{\beta}{p} \left[ \frac{r + wT}{\alpha_1 + \alpha_2 + \beta} \right] \quad (25)$$

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Equation (26) defines a positively sloping line in the \((w, r)\) plane that bounds two half-planes; for all tuples \((w, r)\) below this line, \(h^* > 0\); if \(h^* = \frac{w\beta T + T(\alpha_1 + \alpha_2 + \beta) - r(\alpha_1 + \alpha_2)}{q_1}\) (26)

\((w, r)\) is above the line, \(h^* = 0\). The derivatives are \((i = 1, 2; j = 1, 2)\)

\[
\frac{\partial h^*}{\partial r} = -\frac{\alpha_1 + \alpha_2}{q_1} < 0, \quad \frac{\partial x^*}{\partial r} = \frac{\beta(w+1)}{p q_1} > 0,
\]

\[
\frac{\partial L_i^*}{\partial r} = \frac{\alpha_j}{q_1} > 0
\]

\[
\frac{\partial L^*}{\partial w} = \frac{\alpha_i (\alpha_1 + \alpha_2 + \beta)(T - r)}{q_1^2},
\]

\[
\frac{\partial L^*}{\partial w} = \frac{(\alpha_1 + \alpha_2)(T - r)}{(w+1)q_1}
\]

\[
\frac{\partial x^*}{\partial w} = \frac{\beta T}{p(\alpha_1 + \alpha_2 + \beta)} > 0
\]

\[
\frac{\partial L^*}{\partial \alpha_i} = \frac{\alpha_j (w+1)(r+wT)}{q_1^2} > 0
\]

\[
\frac{\partial L_j^*}{\partial \alpha_i} = -\frac{\alpha_j (w+1)(r+wT)}{q_1^2} < 0
\]

\[
\frac{\partial L^*}{\partial \alpha_i} = \frac{\partial L_i^*}{\partial \alpha_i} + \frac{\partial L_j^*}{\partial \alpha_i} = \frac{\beta(w+1)(r+wT)}{q_1^2} > 0
\]

We can introduce distinct prices for the two leisure activities. Let the prices for the leisure activities be \(c_1 > 0\), and \(c_2 > 0\). The Lagrangean for utility maximisation subject to the constraints is now

\[
G = \alpha_i (\ln L_i) + \alpha_2 (\ln L_2) + \beta (\ln x)
+ \lambda(Y - E) + \gamma (T - L - h)
\]

\[
Y = r + wh; \quad E = c_1 L_1 + c_2 L_2 + px;
L = L_1 + L_2
\]

The first-order conditions are

\[
\frac{\partial G}{\partial L_i} = \frac{\alpha_j}{L_i} - \lambda c_i - \gamma = 0; \quad i = 1, 2
\]

and

\[
\frac{\partial G}{\partial x} = -\lambda p = 0; \quad \frac{\partial G}{\partial h} = \lambda w - \gamma = 0
\]

We use the FOC to derive explicit solutions for the decision variables. Let \(q_2 = (c_1 + w)[(\alpha_1 + \alpha_2 + \beta) > 0]\); then

\[
L_i^* = \frac{\alpha_i (r + wT)}{q_2}
\]

(36)

Note that

\[
\frac{\partial q_2}{\partial \beta} = \frac{\partial q_2}{\partial \alpha_2} = \frac{\partial q_2}{\partial \alpha_1} = c_1 + w > 0
\]

(37)

Also,

\[
\frac{\partial q_2}{\partial w} = \frac{\partial q_2}{\partial c_1} = (\alpha_1 + \alpha_2 + \beta) > 0;
\]

\[
\frac{\partial q_2}{\partial p} = 0
\]

(38)

The parametric derivatives of \(L_i^*\), are

\[
\frac{\partial L_i^*}{\partial \beta} = \frac{((c_1 + w)L_i^*)}{q_2} < 0;
\]

\[
\frac{\partial L_i^*}{\partial \alpha_2} = \frac{((\alpha_1 + \alpha_2 + \beta)L_i^*)}{q_2} < 0
\]

(39)

and

\[
\frac{\partial L_i^*}{\partial \alpha_1} = \frac{\alpha_1}{q_2} > 0;
\]

\[
\frac{\partial L_i^*}{\partial q_2} = \frac{((\alpha_1 + \alpha_2 + \beta)L_i^*)}{q_2} < 0
\]

(40)

The impact of an increase in \(\alpha_i\) on \(L_i\) is positive

\[
\frac{\partial L_i^*}{\partial \alpha_1} = \frac{(wT + r)}{q_2^2} \left[ \frac{q_2}{q_2} - \alpha_1 \frac{\partial q_2}{\partial \alpha_1} \right]
\]

\[
= \frac{1}{q_2^2} \left[ (r + wT)(c_1 + w)(\beta + \alpha_2) \right] > 0
\]

(41)

and for an increase in \(w\) it is ambiguous

\[
\frac{\partial L_i^*}{\partial w} = \left( \frac{\alpha_1}{q_2^2} \right) \left[ (\alpha_1 + \alpha_2 + \beta)(Tc_1 - r) \right]
\]

(42)

By symmetry, we can replace \(q_i\) with \(n\) and use equations (36)-(42) to derive analogous comparative statics expressions for \(L_i\)

\[
n = (c_2 + w)(\alpha_1 + \alpha_2 + \beta) > 0
\]

(43)

Moreover

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Travel Cost and Leisure Time

\[ x^* = \frac{B(r + wT)}{m} \; ; \quad m = p(\alpha_1 + \alpha_2 + \beta) > 0 \quad (44) \]

Differentiating the expression for \( x^* \)

\[ \frac{\partial x^*}{\partial \beta} = p(\alpha_1 + \alpha_2) \frac{r + wT}{m^2} > 0 \quad (45) \]

\[ \frac{\partial x^*}{\partial c_i} = -\frac{r + wT}{m^2} \left( \frac{\partial m}{\partial c_i} \right) = 0 \quad (46) \]

and

\[ \frac{\partial x^*}{\partial p} = -\frac{B(r + wT)}{m^2} (\alpha_1 + \alpha_2 + \beta) < 0 \quad (47) \]

Finally, an amenity improvement decreases expenditures on the market good

\[ \frac{\partial x^*}{\partial \alpha_1} = -\frac{Bp(r + wT)}{m^2} < 0 \quad (48) \]

Thus, an increase in site quality always increases the amount of leisure time allocated to the site in question and decreases leisure time allocated to other activities. However, an increase in pecuniary costs associated with one activity decreases the amount of time allocated to all leisure activities.

THE SUPPLY CURVE OF LABOUR

An apparent conflict between USA data and the model

We can find evidence of large co-movements in wages and hours worked in recent USA data. The labour force participation rate for married women 20–24 (25–34) years of age rose from 30% (27.7%) in 1960 to 63.5% (64%) in 1984 (U.S. Bureau of the Census, 1985, table 669, p. 398). This large increase in labour force participation was part of a longer larger swing. The percentage of married women in the labour force rose from 16.7% in 1940 to 53.3% in 1984 (U.S. Bureau of the Census, 1985, table 670, p. 398). The data demonstrate a rise in the first (1960–1970) and second half of the period (1970–1984). Married female participation rates level off in the late 1970s.

On the other hand, real mean weekly wages rise throughout the 1960s from $165 (1960) to $190.1 (1974) and decline during the second half of the period to $174.9 (1984) (U.S. Bureau of the Census, 1985, table 696, p. 417). Labour force participation rate increases generated an increase in mean real annual per capita USA incomes from $4265 in 1970 to $5471 in 1983 despite declines in wages during the period (U.S. Bureau of the Census, 1985, table 731, p. 440). The 1984 estimates indicate that median real household income, like real wages, rose from 1960 to 1974 and declined from 1974 to 1983 (U.S. Bureau of the Census, 1985, table 735, p. 442). However, the (apparently) revised 1996 estimates indicate that real median annual household income rose slightly from 1970 ($31341) to 1984 ($31972) (U.S. Bureau of the Census, 1996, table 710, p. 461). Thus, there are large swings in wages, per capita income and labour force participation rates during the 1960–1984 period. The increase in labour force participation rates seem to have offset declines in real wage rates and stabilised family income. Married female participation rates reach a plateau and level off during the period 1974 to present. Real wages are relatively also stagnate or are stable throughout most of this period. Thus, the data indicate that household hours worked do shift over time and some of the shift seems to be a response to economic conditions.

We tacitly assume that the impact of wages on labour force participation rates can be isolated (e.g. can be 'identified'). In particular, we assume that the full multi-equation structural labour participation model has an upper triangular matrix structure. Therefore, the coefficients of all of the exogenous (right-hand side) structural coefficients are exactly identified. Moreover, if the single equation estimates are unbiased they provide unbiased estimates of the coefficients for the system; each equation can be effectively estimated independently of the other equations (Fomby et al., 1984). Hence, there are no econometric issues caused by bi-directional causality.

Note that equations (18) and (19) indicate that wages and hours worked must rise and fall together. If the wage rate is the cost of an hour of leisure wages and hours worked should move together, and wages and leisure hours should move in opposite directions. However, the data seem to indicate that real wages fell and total household hours worked rose from 1974–1984. We need to reconcile...
Becker’s theory (1965) with our model and the data.

Equations (29) and (30) seem to offer a richer set of empirical outcomes than equations (17) and (18). The denominators of the expressions for $L$, in equation (29) and $h$ in equation (30) are identical. Hence, the leisure-to-hours worked ratio depends on whether the (sum of the two) numerator(s) of the expressions for $L$, in equation (29) and $h$ in equation (30) are identical. Hence, the leisure-to-hours worked ratio depends on whether the (sum of the two) numerator(s) of the expressions for $L$, in equation (29) and $h$ in equation (30) increase faster than the numerator of equation (30) as the wage rate increases. Let $N(w)$ be the difference between the (sum of the two) numerator(s) for $L$ in equation (29) and the numerator for $h$ in equation (31)

$$N(w) = [\alpha_1 + \alpha_2]wT + H$$

and

$$H = 2(\alpha_1 + \alpha_2)r - (\alpha_1 + \alpha_2 + \beta)T$$

Thus, $N(w)$ is a strictly monotonically increasing function of $w$ if $(\alpha_1 + \alpha_2) > \beta$ and a monotonically decreasing function of $w$ if $(\alpha_1 + \alpha_2) < \beta$. If $(\alpha_1 + \alpha_2) > \beta$, leisure hours rise as wages rise, and if $(\alpha_1 + \alpha_2) < \beta$ then leisure hours fall as wages rise. We label workers and households with a higher relative preference for leisure — agents for whom $(\alpha_1 + \alpha_2) > \beta$ — ‘white-collar’ workers. Workers (households) such that $(\alpha_1 + \alpha_2) < \beta$ are ‘blue-collar’ workers (households). We know of no other mathematical model that bridges the remarkably disparate behaviour of ‘blue collar’ and ‘white collar’ households with respect to responses to changes in the wage rate.

### Identifying the income effect

Anecdotal evidence suggests that few TCM demand studies identify a positive income effect (Hof and King, 1992; Douglas and Taylor, 1999a, b). The constraint set for a utility model for trips to an outdoor recreation site contains two terms and wages enter both terms. Wage payments enter into the expenditure-income constraint and are the cost of leisure in the time allocation constraint. Hence, if increases in income occur primarily in the form of increases in wage income, one would expect to find a positive income effect being leveraged through the expenditure-income constraint, but a sharp negative income effect being leveraged through the time constraint. Hence, wage driven increases in income generate ‘income effects’ that are hard to identify.

### TOURISM POLICY APPLICATIONS AND CONCLUDING REMARKS

Coastal tourism has been a major cause of marine resource degradation in North Africa (Berriane, 1996; Buckley, 2002b). A vigorous programme of regulatory initiatives is needed to halt the degradation of marine ecosystems in the Red and Black seas, Atlantic Ocean, the Mediterranean and Arabian seas, and the Persian Gulf (Hillstrom and Hillstrom, 2003). For example, Morocco needs to develop coastal housing, land-use and tourism-zoning regulation programmes to preserve the beauty of the Moroccan coastal areas from pollution (Berriane, 1996).

Berriane (1996) notes that the pollution occurs as human waste in coastal waters from the lack of sanitation systems for beach-front cottages and camp sites. The adverse anthropogenic beach impacts are exacerbated by the paucity of local agencies engaged in rubbish collection regulation enforcement (Berriane, 1996). Berriane cites unorganised building in dunes located near beaches as a major cause of beach-front degradation. The degradation of coastal zone groundwater resources from the depletion of coastal aquifers also causes water quality problems (Berriane, 1996). Both global and regional tourism have had major adverse impacts on Maghreb and North African coastal zone resources (Berriane, 1996; Hillstrom and Hillstrom, 2003).

Another set of problems is associated with the adverse water quality impacts of tourism in the Maghreb region and throughout coastal zones of the Middle East. Nutrient rich currents in the eastern Atlantic and western Indian oceans provide highly productive habitats for the coastal fisheries of the region (Hillstrom and Hillstrom, 2003). However, coastal fishery resources have been declining throughout the Maghreb and North Africa. Hillstrom and Hillstrom (2003) cite many reasons for the decline, but marine water quality degradation from the dumping of large quantities of untreated sewage in rivers and coastal zones is a major cause. Berriane (1996) links the decline in the productivity of Moroccan fisheries to...
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