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Predicting Tourist Demand for Beach Days
in the Two-Constraint Recreation Demand Model

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Abstract

A recreation model where days onsite and trips to a site are chosen jointly, given time and money constraints, is developed. Relative time-intensities of activities are important determinants of choice; given recent empirical estimates the model shows unambiguously that tourists travelling great distances take fewer trips of longer duration.

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In the study of recreation demand, a question of some enduring interest has been the response of length of stay onsite at a recreation destination to differences in the cost and other parameters a recreationist faces. Most state-of-the-art models of recreation demand (e.g., McConnell; McConnell and Strand; Bockstael *et al.*) presume that an individual chooses to take recreation trips of fixed, predetermined length, more as a concession to the difficulty of modelling the length of stay choice jointly with trips than as a reflection of reality. As McConnell points out, if the quantity choice in a recreation demand model is the number of trips taken to a destination, the relevant price is the marginal cost of a trip. Thus, most contemporary recreation demand models are of the "travel cost" variety, relating the trip cost (price) and other shifters to the number of trips taken (quantity).

The choice of length of stay has received some attention in the literature, however. In one of the earliest treatments of the subject, Edwards *et al.* showed that in a model where an individual chooses the length of a single trip taken, an increase in the on-site price reduces the individual's length of stay while an increase in travel cost increases the length of stay. Smith and Kopp argued that the assumption of homogeneous trip length imposes spatial limits on the travel cost model, since visitors who come long distances are often observed to stay longer at their destinations.

Bell and Leeworthy have sounded a similar theme, noting several more recent papers in which travel cost positively affects the length of stay onsite. They propose a model which attempts to provide the theoretical foundation for the intuitively-sensible and often observed phenomenon of increasing on-site time as travel cost increases. Comments on this work indicate both the keen interest in this important dimension of recreation choice and the fact that the issue of incorporating length of stay onsite into recreational choice models is far from satisfactorily resolved. Shaw takes issue with a number of modelling decisions made by Bell and Leeworthy in their empirical application, noting that the decision process behind their model is not fully or clearly specified. Hof and King interpret their model as an "onsite-cost model," illustrating a method of welfare measurement provided a suitable version of weak complementarity holds, and demonstrating that the model may be more difficult to implement in practice than the standard travel cost model.

While the Bell-Leeworthy paper represents a very useful attempt to model recreation choices that involve both trips taken to and length of stay (or, equivalently, the total days of recreation) at a distant site, one of the fundamental difficulties with their model has gone as yet unnoticed. The difficulty arises because the notion of recreation quantity is treated too simply, which leads to an inconsistency between the visual and intuitive description of the tradeoffs an individual makes and the mathematical model used to motivate it.[1] The blurring of the distinction between separate quantity choices (of trips and of days) and their respective marginal prices also leads to erroneous interpretations of the response of recreation days to changes in travel cost as own price responses.

The purpose of this paper is to introduce and analyze a model of joint quantity choices by a recreationist facing time and money constraints, as it can clarify issues raised in the papers just mentioned and aid in the analysis of the comparative statics of recreation choices. The model postulates that individuals value both days at a site *and* trips taken; the former because recreation at the site yields utility, and the latter because trips themselves yield utility. Trips can yield utility either because travel time itself is enjoyable, or because changing the number of trips to accomodate a given total number of days onsite affects the duration of trips, i.e., the average length of stay onsite.

The model of joint quantity choices addresses some of the most troublesome issues in contemporary recreation demand analysis, including making the choice of time onsite endogenous and allowing for travel time to have a non-zero marginal utility. The joint recreation choices of days and trips, and the comparative statics of parameter changes, can be analyzed conveniently in two-space by conditioning the constraints on the choice of all other goods and using the likely substitution relationship between recreation and other goods. Relative time-intensities of different activities, such as spending time onsite, travelling, and in consuming other goods, play a major role in determining the effects of parameter changes on trips and days taken for recreation at a given site. Given the relative time-intensities likely to be encountered in practice, the model shows that the effect of increasing distance on length of stay per trip is unambiguously positive, which provides the formal answer to the speculations of Bell-Leeworthy and others. It also can be used to gain insight into the comparative statics of other parameter changes, which can be notoriously difficult in two-constraint models because the smallest Hessian to be evaluated in a meaningful choice problem is five by five and many terms of potentially conflicting sign must be evaluated.

The Two-Constraint, Joint Recreation Choice Model

Consider an individual who allocates scarce time and money income in choosing consumption of three goods: total recreation days d at a distant site, number of trips r to take to the site, and all other goods z, in order to maximize the utility function u(d,r,z). Each good has both a time price and a money price of consumption. The money cost of travel to the site is $\gamma \cdot n$, where γ is the money cost per mile (fixed for a given individual but possibly varying across individuals) and n is the number of miles travelled; while the time cost of travel is $\alpha \cdot n$, with α representing the time cost per mile (i.e., the inverse of miles per hour), which is similarly exogenous to the individual. The money cost per unit of time onsite (e.g., per day) is δ, while the time price of time spent onsite is β; often β will be taken to be fixed at 1.0, meaning an hour spent onsite costs an hour of time.[2] The time price of consuming the composite good z is t_z, while the money price of consuming z is taken to be unity, since money prices are normalized over the price of z.

A point to emphasize is that the model being developed is a *two*-constraint model; by definition, the individual *cannot* trade time for money at an observable marginal wage rate, since that opportunity allows the two constraint model to be collapsed into a standard single constraint choice problem subject to full income and prices (Becker; Bockstael *et al.*). Thus, the problem can be thought of as one involving an individual's allocation of fixed money income M and discretionary time T among competing recreation and other activities, with both M and T varying across individuals and determined largely (or perhaps completely) by an exogenous labor-leisure choice and other institutional constraints.

The two budget constraints the individual faces can therefore be written as

$$(1) \qquad M = \gamma n \cdot r + \delta d + z \qquad \text{(money)}$$

$$(2) \qquad T = \alpha n \cdot r + \beta d + t_z z \qquad \text{(time)}$$

The choice of r is assumed continuous for simplicity in exposition of the model; one could make the trips choice discrete at the cost of somewhat greater complexity, without substantially affecting the results. Both constraints are assumed to bind throughout the analysis.

Two clarifying comments concerning the arguments of the preference function are in order. First, in addition to days onsite, which is the quantity of recreation consumed, the number of trips taken is valued by the individual. A change in the number of trips, *ceteris paribus*, potentially affects utility in two ways: through its effect on total time spent travelling, which is a source of (dis)utility directly, and through its effect on trip length, changing the utility derived from a given number of total days onsite. Second, the utility arguments themselves are defined in time units; d is the total time spent on site, while r implies a time expenditure of $\alpha n \cdot r$ units of time in travel, and z is the time spent in consuming other goods. Note that both z, the time spent in consuming all other goods, and the constant time price of all other goods, t_z, can be determined from the constraints given knowledge of the individual's optimal choice of days and trips and their prices; letting d^* and r^* denote these optimal choices, the optimal time spent consuming other goods, z^*, is $z^* = M - \gamma n r^* - \delta d^*$ from (1), while $t_z = [T - \alpha n r^* - \beta d^*]/[M - \gamma n r^* - \delta d^*]$, from (1) and (2).

The choice problem for the individual is, therefore,

$$(3) \qquad \max_{d,r,z} \; u(d,r,z) \qquad \text{s.t.} \quad (1), (2)$$

which yields (Marshallian) demands of the form $d^* = d(\phi)$, $r^* = r(\phi)$, $z^* = z(\phi)$, where for notational convenience ϕ is the vector of all parameters of the problem: $\phi = (\alpha, \beta\gamma, \delta, n, t_z, M, T)$. From here on, d, r, and z will be taken to be chosen optimally and the asterisks suppressed for brevity.

At this point the nature of the relationship between travel (money) cost, γ, and days onsite d becomes clearer. (This was a point of speculation in the Bell-Leeworthy paper.) For the choice of days onsite (d) in the joint quantity, two-constraint model, own prices are δ (money cost per day onsite) and β (time cost per day onsite), whereas for the choice of trips, the own prices are γn (money cost of travel per trip) and αn (time cost of travel per trip). Travel cost per trip, γn, is a *cross*-price (substitute or complement) in the days onsite demand equation, as is travel time αn. Similarly, δ and β are cross-prices in the trips demand function. This contrasts with the Bell-Leeworthy interpretation of onsite price as an own price of trips, and their assertions that the "traditional hypothesis" is that the effect of travel cost on beach days is negative. In fact, interpreting travel cost as a substitute price leads to the opposite conclusion: that its influence on beach days is positive, as their (and one of their reviewers') empirical work demonstrates.[3]

To get a visual fix on the comparative statics of days, trips, and average length of stay (the ratio d/r of total days to total trips), consider an equivalent, indirect representation of the problem which first optimizes out the consumption of good z and then considers the remaining choice of d and r given the (prior) choice of optimal z. This version of the problem is useful because, by properly accounting for how the optimal choice of z conditions the feasible choice set for d and r, the optimal choices of d and r are apparent immediately in d-r space from the intersection of the two conditional constraints. This simplifies the visual understanding of relationships between goods in the two-constraint model, and allows one to develop comparative statics results based on relative prices and knowledge of substitution relationships, without direct reference to the preference map.

Substituting z(ϕ) obtained from (3) above into the preference function, and noting that the time and money available for choice of d and r are reduced because of the choice of z, the choice problem can also be written as

(4) $$\max_{d,r} u(d,r,z(\phi)) \quad \text{subject to the conditional budgets}$$

(5) $$M_{dr} \equiv M - z = (\gamma n)r + \delta d \qquad \text{(conditional money budget)}$$

(6) $$T_{dr} \equiv T - t_z z = (\alpha n)r + \beta d \qquad \text{(conditional time budget).}$$

Because the constraints are independent, a single d-r combination solves the conditional problem (4) since there are two unknowns and two equalities to be satisfied. The solution to this problem yields conditional demands of the form

(7) $$d = \hat{d}(\alpha,\beta,\gamma,\delta,n,M_{dr},T_{dr})$$

(8) $$r = \hat{r}(\alpha,\beta,\gamma,\delta,n,M_{dr},T_{dr})$$

which are identical to the unconditional demands that solve (3). That is, the same first order conditions hold for the conditional choice functions $\hat{d}(\cdot)$ and $\hat{r}(\cdot)$ in (7) and (8) and for the unconditional $d(\phi)$ and $r(\phi)$ that solve (3).[4] However, by solving the conditional budget constraints for $\hat{d}(\cdot)$ and $\hat{r}(\cdot)$, a convenient visual depiction of comparative statics results.

Figure 1 gives the visual setup for analyzing the comparative statics of changes in days and trips. The two conditional budget constraints, M_{dr} and T_{dr}, represent possible allocations of money and time expenditure between days onsite (d) and trips (r), conditional on the optimal choice of the composite good, z. The optimal choices of days and trips, d_0 and r_0, are identified by the intersection of the two conditional constraints; there is no need to introduce the preference map to find them. As opposed to the standard analysis, though, both conditional budgets depend on all parameters of the problem, so each will shift when any parameter changes.

The effect of parameter changes on average length of stay is also easy in principle to identify from Figure 1, since it is simply the slope of the chord from the origin to the intersection of the conditional constraints at (d_0,r_0). Algebraically, it is simply the ratio of equations (7) and (8); for small changes in an exogenous parameter the sign of the change in average length of stay with a parameter is simply the difference in percentage changes of days and of trips.

Defining Relative Time Intensities

As a preliminary to comparative statics, some relationships that prove important to the analysis of the two-constraint model are defined and explained. The first set of relationships concerns relative time-intensity of goods, which is determined by the relative slopes of the time and money budget lines for pairs of goods. Days onsite (good d) is time-intensive relative to trips (good r) if the ratio of its time to money price is higher; i.e., if $\frac{\beta}{\delta} > \frac{\alpha}{\gamma}$, a day onsite is relatively more time-intensive than a day spent in travel.[5] Figure 1 is drawn so that d is time-intensive relative to r, in keeping with both intuition and the empirical evidence in Bell and Leeworthy, and in Hof and King.

The relative time-intensities of travel versus days onsite in the study by Hof and King are reported in their Table 1 (page 287). The time intensity of travel is α/γ=(74.8 hours/trip)/($131/trip) $\doteq$ (3.12 days/trip)/($131/trip) $\doteq$ .024 days/$, whereas the time intensity of days onsite is β/δ = (1day/day)/($3.74/day) = .267 days/$. In this case study, days onsite is more time-intensive than trips; i.e., $\beta/\delta > \alpha/\gamma$.

The relative time and money prices of days onsite and trips can also be inferred, approximately, from the information Bell and Leeworthy report. Two travel modes are discussed: flying, with a dollar cost per mile of $.135, and driving, with a dollar cost per mile of $.08. A rough idea of the time intensity of each of these travel modes can be gotten by dividing the inverse of these costs per mile by the rate of speed for each mode, approximated as 400 miles per hour for flying and 40 miles per hour by car; these result in time intensities of travel of roughly .0005 days/\$ for air travel and .0116 days/\$ for car travel. In contrast, it can be inferred from the regression coefficient, reported elasticity, and the mean number of beach days that the money cost onsite is approximately $\delta \doteq \$21/\text{day}$; thus the time intensity of days onsite in this study is $\beta/\delta = (1\text{day}/1\text{day})/(\$21/\text{day}) \doteq .048$ days/\$. Once again, $\beta/\delta > \alpha/\gamma$: days onsite is relatively more time-intensive than trips.

In light of this empirical evidence about days onsite being more time-intensive than trips, and the intuition that recreation generally is a more time-intensive activity than consumption of other goods, the analysis will focus on the case where

$$\beta/\delta > \alpha/\gamma > \mathrm{T/M} > \mathrm{t}_z; \tag{9}$$

i.e., days onsite, travel, all activities, and non-recreation activites rank from highest to lowest in time-intensiveness. The analysis is easily modified to account for other cases with different orderings of time-intensities, as demonstrated later.

Two other characteristics of the time-intensive (d) and money-intensive (r) goods can be noted from Figure 1. Days onsite can also be termed *time-constrained*, because

$$\frac{\mathrm{M}_{dr}}{\delta} > \frac{\mathrm{T}_{dr}}{\beta}; \tag{10}$$

that is, the maximal days onsite feasible under the (conditional) time budget is less than under the money budget, given the relative money (δ) and time (β) prices of d. Similarly, trips can be termed *money-constrained* because

$$\frac{\mathrm{T}_{dr}}{\alpha} > \frac{\mathrm{M}_{dr}}{\gamma}, \tag{11}$$

and the conditional money budget relative to money price is more binding on maximum trips than is the conditional time budget. These both follow from (9), and are consistent with the way that Figure 1 is drawn.

Comparative Statics of the Two-Constraint Model

By solving the two constraints (5) and (6), the conditional demands $\hat{\mathrm{d}}$ and $\hat{\mathrm{r}}$ can be written as functions of relative time-intensities and the conditional budgets, *viz.*,

(12) $$d = \hat{d}(\alpha,\beta,\gamma,\delta,M_{dr},T_{dr}) = \frac{\frac{T_{dr}}{\alpha} - \frac{M_{dr}}{\gamma}}{\frac{\beta}{\alpha} - \frac{\delta}{\gamma}}$$

and

(13) $$r = \hat{r}(\alpha,\beta,\gamma,\delta,M_{dr},T_{dr}) = \frac{\frac{M_{dr}}{\delta} - \frac{T_{dr}}{\beta}}{n(\frac{\gamma}{\delta} - \frac{\alpha}{\beta})}$$

where the pre-conditioned optimal consumption of z enters through the conditional budgets $M_{dr} \equiv M - z$ and $T_{dr} \equiv T - t_z z$. Equations (9)-(11) imply that the numerators and denominators in (12) and (13) are all positive; thus the analysis focuses on interior solutions where d and r are strictly positive.

For comparative statics, it is more useful to make the (optimal choice of the) composite good z explicit. Substituting for M_{dr} and T_{dr} in (12) and (13) and gathering terms, the conditional demands for days and trips can be written parametrically in terms of z as

(14) $$d = \frac{\overset{\{-\}}{\left\{\frac{T}{\alpha} - \frac{M}{\gamma}\right\}} + \overset{\{+\}}{\left\{\frac{1}{\gamma} - \frac{t_z}{\alpha}\right\}}z}{\underset{\{+\}}{\frac{\beta}{\alpha} - \frac{\delta}{\gamma}}}$$

and

(15) $$r = \frac{\overset{\{+\}}{\left\{\frac{M}{\delta} - \frac{T}{\beta}\right\}} - \overset{\{+\}}{\left\{\frac{1}{\delta} - \frac{t_z}{\beta}\right\}}z}{\underset{\{+\}}{n(\frac{\gamma}{\delta} - \frac{\alpha}{\beta})}},$$

where the signs above and below the individual terms follow from (9).

Parameter changes will induce both a direct response in the conditional demands, as consumption of other goods (z) is held constant; and an indirect effect, with parameters at their new values, as z adjusts and *both* constraints adjust simultaneously (since z is an argument of both). They are easily analyzed algebraically, using (14) and (15), and graphically, using the conditional budget constraint approach. This is illustrated by considering the question of trip lengths for tourists versus locals.

Tourist Demand For Beach Days

The effect of increasing distance from a site on an individual's choice of how long to stay, on average, can be evaluated by determining the comparative statics of miles travelled, n, on both trips and days.

Consider first the effect of a change in miles travelled on total days taken. From (14), the direct effect is zero, since n is not an argument of (14) outside $z(\phi)$. That is,

$$\left.\frac{\partial d}{\partial n}\right|_{z} = 0.$$

Defining $D_d \equiv (\beta/\alpha - \delta/\gamma) > 0$ as the denominator of (14) to simplify notation, the indirect effect of the change in n, through z, is

$$\left(\frac{\partial d}{\partial z}\cdot\frac{\partial z}{\partial n}\right) = \frac{\left\{\frac{1}{\gamma} - \frac{t_z}{\alpha}\right\}\frac{\partial z}{\partial n}}{D_d} > 0,$$

from the signs in (14) and given the fact that all other goods z is a substitute for recreation trips. The increase in miles travelled leads to increases in both travel time and travel cost, and the rise in the cost of recreation trips leads to an increase in consumption of z (i.e., $\partial z/\partial n > 0$). Thus, an increase in n leads to an increase in total days onsite.

Now consider the effect of increasing distance on trips taken. The direct effect, from (15), is

$$\left.\frac{\partial r}{\partial n}\right|_{z} = -\frac{r}{n} < 0,$$

while the indirect effect is

$$\left(\frac{\partial r}{\partial z}\cdot\frac{\partial z}{\partial n}\right) = -\frac{\left\{\frac{1}{\delta} - \frac{t_z}{\beta}\right\}\frac{\partial z}{\partial n}}{D_r} < 0,$$

where $D_r \equiv n(\gamma/\delta - \alpha/\beta) > 0$ is the denominator of (15); so the effect of increasing distance is to reduce the number of trips taken, an intuitively sensible result since travel time and travel cost are own prices for trips taken.

Note that the effect of increasing distance on average length of stay is unambiguous: *the individual takes longer trips, but fewer of them, for a net increase in days onsite.* This result is shown graphically in Figure 2. The individual is initially taking r_0 trips, consuming d_0 days onsite, and staying an average of d_0/r_0 days per trip. A person who is otherwise identical, but who lives farther away from the site, faces both higher travel time and travel cost, as indicated by the clockwise rotations of both the time and money budget constraints, from M^0_{dr} and T^0_{dr} to M^1_{dr} and T^1_{dr}. The direct effect of the increase in n leaves the individual consuming fewer trips (r' instead of r_0) but the same number of days onsite, d_0.

The indirect effect of the change in n can be represented in Figure 2 by noting that the adjustment in z as n changes is a simultaneous realignment of both conditional budget constraints, since z enters both M_{dr} and T_{dr}. The response of z to a parameter change induces an *adjustment locus* of intersections of the conditional time and money constraints. The slope of this adjustment locus in d-r space can be determined from the parametric representation of the conditional demands in (14) and (15): as z increases, it can be seen that d increases and r decreases. That is,

$$\frac{\partial d}{\partial r} = \frac{\partial d/\partial z}{\partial r/\partial z} = \frac{\left\{\frac{1}{\gamma} - \frac{t_z}{\alpha}\right\}/\left\{\frac{\beta}{\alpha} - \frac{\delta}{\gamma}\right\}}{-\left\{\frac{1}{\delta} - \frac{t_z}{\beta}\right\}/n(\frac{\gamma}{\delta} - \frac{\alpha}{\beta})}$$

$$= -n\left\{\frac{\alpha - \gamma t_z}{\beta - \delta t_z}\right\} < 0$$

after gathering terms and simplifying. The adjustment locus is drawn as the heavy dark line through (d_0, r') and extending northwest in Figure 2, because z increases as miles travelled increases (since $\partial z/\partial n > 0$); the final equilibrium consumption of days, d_1, and trips, r_1, is a point on this locus.[6] It is not possible to tell where exactly on the adjustment locus (d_1, r_1) is without consulting the preference map, but it is clear from the fact that z increases that average length of stay increases, to d_1/r_1 from d_0/r_0.

It is important to emphasize that this is due to a *substitution* relationship between days onsite and travel to the site. Because days and trips are substitutes, an increase in the price of trips increases the quantity of onsite days taken. This relationship would be reversed (days and trips would be complementary) if, in equation (9), travel were less time-intensive than all other goods (i.e, if $\beta/\delta > t_z > \alpha/\gamma$, in which case it would have to be true that $T/M > \alpha/\gamma$). In this situation, both trips and days onsite would drop as travel cost increased, and an increase in average length of stay would remain likely (due to the direct effect on trips) but not be assured.

One of the criteria for judging a model useful is the extent to which it provides testable hypotheses about behavior. The two-constraint model is rich in testable hypotheses about price and income effects on both recreation quantities, in addition to the question of differing choices by tourists versus locals. Space constraints prevent development of these here, but they are contained in a working paper by the authors.

Conclusions

This paper has introduced a simple graphical and algebraic framework for analyzing the comparative statics of two-constraint models. The two-constraint framework is well-suited to recreation choice problems, because consumption of recreation goods can require substantial amounts of time, and the presence of a binding time constraint in addition to a binding money constraint is very plausible.

By letting both days at the distant site and trips to the site enter the preference function, distinct motivations for choosing both the total days of recreation to consume during a time period, and the number of trips to take are introduced. The motivation for taking an additional day onsite is the extra enjoyment that marginal day brings, while the marginal trip can be taken either because the marginal utility of travel is high or because of its beneficial effect on trip length.

This model explicitly allows the marginal utility of travel time to be nonzero; even when travel to a site is distasteful and yields negative marginal utility, there may be good reason to take an additional trip in order to best enjoy the optimal number of total days onsite which are demanded. The model also provides a natural way to model endogenous onsite time, determined implicitly as the ratio of two goods which are direct sources of value to the consumer. Many comparative statics results can be obtained without recourse to the preference map, given observable information about the relative time-intensities of the different consumption goods and the likely substitution relationship between recreation and all other goods.

The model is first applied to the question, of continuing interest in the recreation demand literature, of how increasing (time and money) costs of travel affect the duration of a recreation trip. Under what appears to be the most plausible ordering of relative time-intensities of the different consumption goods, the effect of increasing distance on trip length is unambiguously positive, while the number of trips taken decreases, confirming speculations of a number of authors. The two-constraint model provides the formal framework within which such results can be derived.

Some limitations of the present formulation should be noted. The assumption of continuously binding time and money constraints, which seems quite plausible in many recreation contexts, may not always hold in practice. In particular, there may be situations where the wage rate serves as an observable parameter that identifies the scarcity value of time (e.g., following Bockstael *et al.*), so that the two constraints are linearly dependent and the constraints can be collapsed, as suggested originally by Becker. However, this requires an assumption that the marginal utility of work time is zero, which seems unlikely (see, e.g., Chiswick and Johnson), and the present approach avoids that requirement. Also, substitute sites are not explicitly incorporated into the notation and analysis (they are implicitly in z), but making their presence explicit does not greatly complicate matters or alter the analysis significantly.

Perhaps the most important contribution of the paper is to show how testable hypotheses about the structure of recreation demand with two constraints can be generated. While clearly many types of qualitative results are possible depending on relative time-intensities and, for example, the appropriateness of the separability assumption, the two-constraint model provides a structure for evaluating the adequacy of the assumptions made or, if appropriate, imposing it in estimation.

Footnotes

1. Given that the individual values "beach days" (the product of trips and average days per trip), and faces a constant price per beach day and a constant travel cost per trip, the optimal solution is to take only one trip; there is no interior solution in the individual's tradeoff between trips and length of stay, contrary to Bell-Leeworthy's Figure 2. A secondary problem is that the budget constraint in their Fig. 2 is not linear: a change in *average* days onsite by one day is a change in beach days of r, at a cost of rδ, where r is the number of trips taken and δ is the constant price per beach day. As r varies at each point along the constraint, it is nonlinear.

2. The unitary onsite time price means that all time spent onsite yields utility. This needn't always be the case: onsite time price could be higher than unity if there was a difference between the total time spent onsite and the amount of that time which was actually spent in the utility-yielding activity d. An example would be having to wait in line for an hour in order to take a two-hour boat cruise; the onsite time price is 1.5 hours per hour of d, which is the total amount of onsite time required to yield an hour's worth of utility.

3. One could also argue for a complementarity relationship between trips and days onsite, which would imply a negative cross-price effect. Some evidence for this relationship between trips and days is provided by Hof and King. As shown later, it is possible for the trips-days relationships to simultaneously exhibit *both* Marshallian complementarity and substitution.

4. If there were degrees of freedom for choosing $\hat{d}$ and $\hat{r}$ (as would be the case, for example, if there were only one constraint instead of two), they would also depend on z directly as it affects the shape of the preference map, in addition to its indirect effect through M_{dr} and T_{dr}; that is, d $= \hat{d}(\alpha,\beta,\gamma,\delta,n,z,M_{dr},T_{dr})$ and $r = \hat{r}(\alpha,\beta,\gamma,\delta,n,z,M_{dr},T_{dr})$. However, by design the conditional budgets solve directly for $\hat{\delta}$ and $\hat{r}$, so is no opportunity for variations in z to affect the choice of d and r when the conditional budgets are fixed.

5. Using the same logic to define the notion of *relatively money-intensive*, it follows immediately that if d is time-intensive relative to r, r is money-intensive relative to d, since the relationship can also be written as $\gamma/\alpha > \delta/\beta$.

6. From equation (9) t_z varies from 0 to $\alpha/\gamma < \beta/\delta$, which means the slope of the adjustment locus ranges from 0 to $-n\alpha/\beta$, where the latter is the slope of the time constraint. Thus, the adjustment locus in Figure 2 is drawn with a flatter slope than the time constraint.

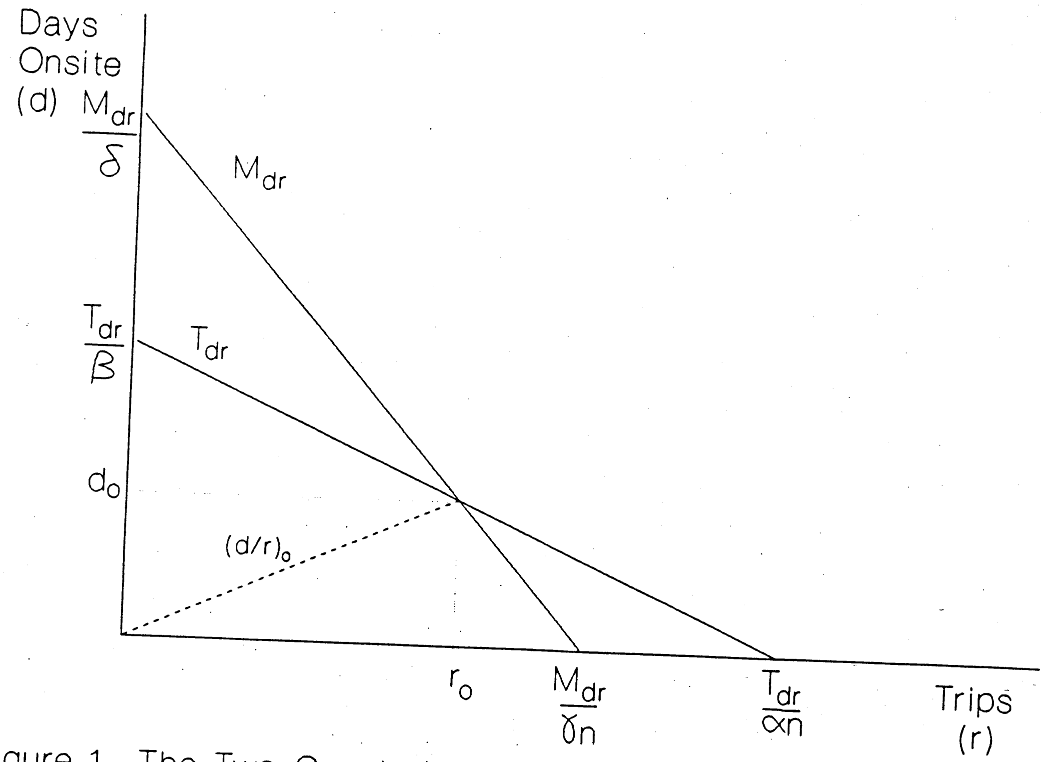

Figure 1. The Two-Constraint Model of Recreation Choice

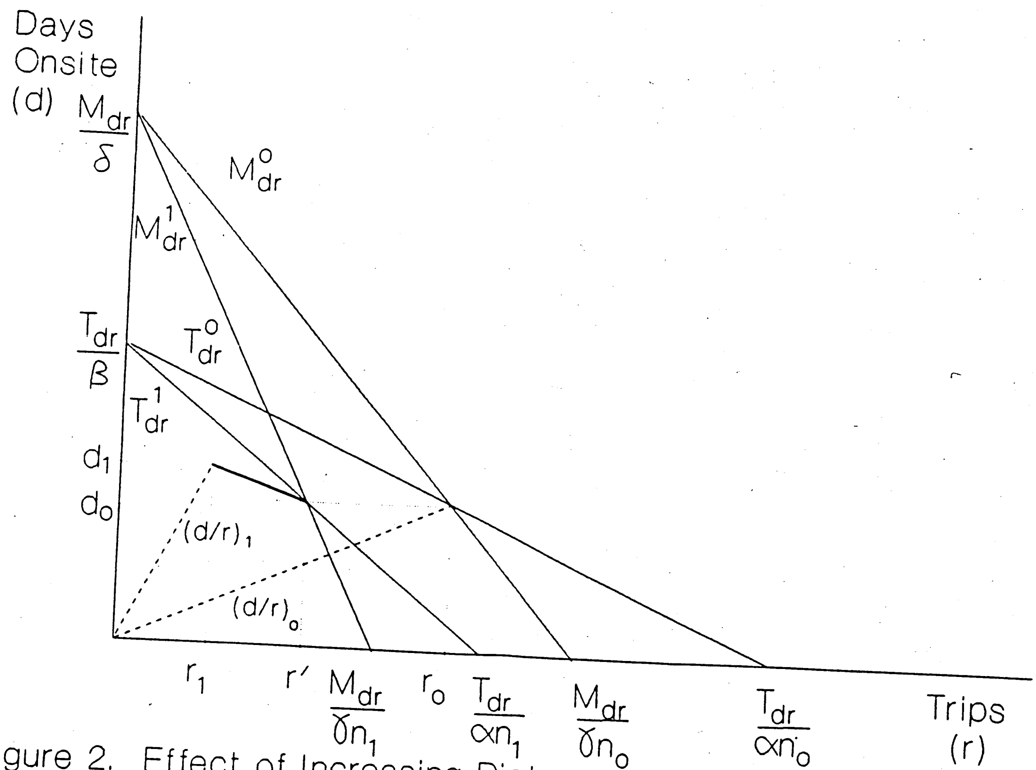

Figure 2. Effect of Increasing Distance on Trips, Days, and Average Length of Stay

References

Authors. "Comparative Statics of the Two-Constraint Recreation Demand Model." Unpublished working paper, October 1992.

G. A. Becker. "A Theory of the Allocation of Time." *Econom. J.*, 493-517 (1965).

F. W. Bell and V. R. Leeworthy. "Recreational Demand by Tourists for Saltwater Beach Days." *J. Environ. Econom. Management* 18, 189-205 (1990).

N. E. Bockstael, I. E. Strand, and W. M. Hanemann. "Time and the Recreation Demand Model." *Amer. J. Agr. Econom.* 69, 293-302 (1987).

F. J. Cesario. "Value of Time in Recreation Benefit Studies." *Land Econom.* 52, 32-41 (1976).

J. A. Edwards, K.C. Gibbs, L.J. Guedry, and H.H. Stoevener. *The Demand for Nonunique Recreational Resources: Methodological Issues.* OR State Exp. Stat. Tech. Bull. 133, Corvallis, OR, 1976.

J. G. Hof and D. A. King. "Recreational Demand by Tourists for Saltwater Beach Days: Comment." *J. Environ. Econom. Management* 22, 281-291 (1992).

J. L. Knetsch. "Outdoor Recreation Demands and Benefits." *Land Econom.* 39, 387-96 (1963).

K. E. McConnell. "Some Problems in Estimating the Demand for Outdoor Recreation." *Amer.J. Agr. Econ.* 57, 330-339 (1975).

K. E. McConnell and I. E. Strand. "Measuring the Cost of Time in Recreation Demand Analysis: An Application to Sportfishing." *Amer. J. Agr. Econ.* 63, 153-156 (1981).

W. D. Shaw. "Recreational Demand by Tourists for Saltwater Beach Days: Comment. *J. Environ. Econom. Management* 20, 284-289 (1991).

V.K. Smith and R.J. Kopp. "The Spatial Limits of the Travel Cost Recreational Demand Model." *Land Econom.* 56, 64-72 (1980).

Wilman, Elizabeth A. "The Value of Time in Recreation Benefit Studies." *J. Env. Econom. Management* 7(1980):272-86.

13 p.