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Revealed Preference Approaches to Valuing Outdoor Recreation

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Revealed preference approaches for estimating the demand for recreation are becoming increasingly more sophisticated and relevant. Whereas the earlier techniques could only value the consumers' surplus of a single site, the more recent approaches value entire systems of sites and/or value site qualities. In this paper, we critically review a broad set of revealed preference approaches bearing on outdoor recreation demand, from the simple travel cost to the more complex hedonic travel cost and demand system models. As with any developing science, not all approaches have borne fruit and a number of problems remain. We attempt to highlight the weaknesses of the less successful approaches and indicate the relative strengths of the remaining alternatives.

In Section I, a model of the household production function of recreational outputs such as trips and kill is presented. The well known identification problems which plague this technique are highlighted. The simple travel cost method, which focuses on the cost of getting to (purchasing) a site, is described in Section II. Travel cost, by evaluating only the demand for inputs into the recreation experience, avoids the identification dilemma of the household production function approach. The simple travel cost approach, however, ignores substitute sites and the value of the characteristics of sites. This oversight is addressed in different ways by three advanced travel cost approaches: the own price/quality, demand system for sites, and hedonic travel cost models. The relative strengths of all three advanced approaches are compared in Section III.

Household Production Function

For years the economics profession, Gorman,[1] Becker,[2] Lancaster,[3] and others, has explored ways of analyzing quality and other non-market commodities purchased in bundles by modeling an implicit market inside the household. Instead of the traditional model where goods enter the utility function of the individual subject to a budget constraint defined on goods prices, the household market approach assumes that utility is

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1. W. GORMAN, A POSSIBLE PROCEDURE FOR ANALYZING QUALITY DIFFERENTIALS IN THE EGG MARKET (Discussion Paper 134, London School of Economics, 1976).
2. Becker, *A Theory of the Allocation of Time*, 75 ECON. J. 493 (1965).
3. Lancaster, *A New Approach to Consumer Theory*, 74 J. OF POL. ECON. 132 (1966).

defined over commodities subject to a budget constraint defined on commodity prices. These commodities are produced via a household production function from the goods inputs and usually time provided by the household.

The intuitive appeal of the household production approach lies in its emphasis on commodities such as driving, comfort, kill, days of experience or trips, which appear to be the goals of market purchases, rather than on goods such as automobiles, recreation sites (Yosemite), and three bedroom houses. This search for the roots underlying traditional demand functions for goods, however, is not without cost. The household production function approach leads one into a world with endogenous marginal prices, joint production, and missing variables. Whether these additional econometric hurdles are worth the additional information provided is the crucial question to be answered before the household production function is used. We sketch the approach below.

Let us assume that utility is defined over a set of commodities (X) produced by the household:

$$(1) \quad U(X_1, X_2, \ldots, X_n)$$

The commodities are produced by a representative household using a household production function:

$$(2) \quad X_i = g(Q_1, \ldots, Q_K, T_i) \qquad i = 1, \ldots, n$$

Where Q_i are goods purchased in the market and T_i is time provided by the household to produce the i^{th} good. Given the exogenous price of goods (P) and a marginal wage rate, W, which may depend on the amount of time worked, T_L, there is a cost function for commodities:

$$(3) \quad C(X, P, W(T_L))$$

In the first stage of a two stage problem, the consumer discovers his cost function, the least cost way to produce X given input prices and the wage relation.[4]

The consumer's income depends upon return from non-labor factors of production (α) and labor income:

$$Y \equiv \alpha + \int_O^{T_L} W(\tau)d\tau$$

The consumer's second stage problem is to maximize:

$$(4) \quad \underset{X, T_L, T_i}{\text{MAX}} \; U(X_1, \ldots, X_n)$$

4. It is a bit paradoxical that the household approach is labeled by its production function since it is usually the dual relation, the cost function, which enters the analysis.

subject to

$$Y - C(X,P,W(T_L)) = O$$
$$\bar{T} = T_L + T_f + \Sigma T_i$$

where T_f is leisure and $\bar{T}$ is total time available. Differentiating (4) with respect to X yields the familiar first order conditions

$$(5) \quad U_i/\lambda = C_{X_i} \equiv \Pi_i (X,T_L) \qquad i=1,\ldots,n$$

where λ is the marginal utility of income.

Demand functions for the commodities (X) can be derived from the first order conditions. Marginal values and consumers' surplus for quality can also be computed in principle. The arguments of the demand functions include the unobserved commodities' prices, not the observed goods' prices.

The household production approach works best when all inputs are purchased and the technology is linear. For example, suppose big game density is available at a fixed and constant price per trip, as is small game density. Each type of trip provides a different combination of meat and congestion produced by a constant return to scale production function. In this case one can estimate the demand functions for quantities (big game and small game trips) and for commodities (big game and small game meat and congestion)[5] as a function either of the observed goods' prices or of the implicit prices of the non-market goods.

The assumption of linear technology is strong. It implies that increasing all relevant inputs such as miles traveled, entry fee if any, and so forth, by a constant factor, changes *all* desired characteristics, such as success, and congestion by that constant factor. All the difficulties associated with joint production arise when there is a non-linear production technology and recreationists value more than one characteristic. Regardless of the number of desirable characteristics, non-linear production produces non-constant marginal costs or shadow prices. Characteristic prices are no longer exogenous to the household. Households now face a non-linear budget constraint, and the characteristics prices depend on the tastes of the consumer. Price differences across consumers are the joint result of differences in taste and technology.[6] Barnett[7] and Deaton and Muellbauer[8] have shown that the major problem is not an analytical one. Rather it is

5. Even in this case, Deaton and Muellbauer argue that the commodity prices depend on wage rates that differ across households so that aggregating demand functions is not a simple matter (see DEATON & MUELLBAUER, ECONOMICS AND CONSUMER BEHAVIOR 249 (1980)).

6. Pollak & Wachter, *The Relevance of the Household Production Function and Its Implications for the Allocation of Time*, 83 J. OF POL. ECON. 255 (1975).

7. Barnett, *Pollak and Wachter on the Household Production Function Approach*, 85 J. OF POL. ECON. 1073 (1977).

8. A. DEATON & J. MUELLBAUER, ECONOMICS AND CONSUMER BEHAVIOR (1980).

an econometric one of obtaining unbiased estimates for a non-linear equation system. The absence of exogenous prices places additional demands on other exogenous parameters in order to identify the commodity supply and demand curves.[9] Briefly, if there are n demand functions and a cost function to estimate when characteristics prices are non-linear, then there must be at least n + 1 exogenous variables because each equation has to have a unique variable. Rarely do we have the luxury of a data set so rich that we can find variables (except for prices) which help to explain the demand for one good which does not enter any other demand equation.

A second potential difficulty with the household production function approach is the assumption that consumers share a common production function. This may not be a bad assumption in the context of firms in a competitive economy because firms which use inferior technologies do not survive very long. There is no such outside corrective mechanism when unmarketed commodities or characteristics are being produced by each household. It requires considerable faith to assume that observed differences in behavior across households are caused solely by goods prices or taste variables and not by unobservable differences in the household production function.

A third limitation of the household production function is that it requires extensive information about all goods (inputs) in the household production function as well as a complete list of commodities (outputs). For example, if clothing and equipment enter in the production of camping experiences and they are not measured, the cost function will be specified incorrectly. If bird sightings, clear nights, or collected wildflowers are important commodities to the recreation user but go unmeasured, both the supply and demand of measured commodities are likely to be distorted.

In order to assess the usefulness of the household production function, it is important to remember that the fundamental purpose of recreation analysis is to determine the value of the quality and quantity of the public good, the recreation site. The recreation site is a good which enters like other goods as an input into the household production function. The critical issue is to value the site or its objective qualities in terms of the price of the site or the price of each quality. It is not necessary or even particularly useful to know the value of the commodities produced at the site unless they lead to valuing the site itself. There are more direct ways to estimate the value of goods than to estimate the value of commodities produced from the good. For example, it is not necessary to know how much a person values Monday night football in order to know what he would pay for a television set. We only have to estimate directly the

9. Bockstael & McConnell, *Theory and Estimation of the Household Production Function for Wildlife Recreation*, 8 J. OF ENVTL. ECON. AND MGMT. 199 (1981).

demand for television sets. Instead of valuing kill and other activities at the site, analysts should be focusing upon more direct measures of the value of sites and their objective characteristics. Further, as Pollak and Wachter[10] note, if inputs are valued in terms of input prices, all the econometric problems connected with valuing outputs (commodities) become irrelevant.

It is clear the profession needs to focus on valuing sites, not the activities which occur at the sites. Although the household production function may be able to provide insights about why people exhibit certain tastes for goods (sites), the tool is an unnecessarily cumbersome approach to measure the value of sites or their qualities.

The Travel Cost Technique

The oldest and most frequently used method for valuing a recreation site is the travel cost technique recommended to the National Park Service by Harold Hotelling[11] and developed further by Clawson and Knetsch.[12] The travel cost technique exploits the fact that people from different origins bear different travel costs in order to reach a common site and therefore can be expected to participate or visit the site at different rates. Converting travel time and distance to a travel cost, assuming that individuals take trips until the marginal cost of the trip equals its marginal value, and regressing the number of trips on price (marginal cost) and demographic variables, reveals the demand function for trips to a site. For a searching description and evaluation of the technique, see Dwyer and Kelly.[13] A classic example of a travel cost study is the evaluation of the Oregon salmon and steelhead sport fishery.[14]

The travel cost approach estimates the demand for an input (the site) not the joint outputs (experiences, kill, and so forth) of the household recreation production function. The technique can be used to impute a value to the site which, in turn, can be expressed either as an average value per trip *or* an average value of success. But more information is necessary in order to determine how much value should properly be placed on specific outputs such as kill. For example, Bockstael and McConnell show that when the marginal cost of a trip is constant for each participant (but varies across participants) and the output of each trip is exogenous,

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10. Pollak & Wachter, *supra* note 6, at 272.

11. Hotelling's letter is reproduced in W. BROWN, A. SINGH, & E. CASTLE, AN ECONOMIC EVALUATION OF THE OREGON SALMON AND STEELHEAD SPORT FISHERY (Oregon Agr. Expt. Sta. Tech. Bull. 74, 1964).

12. M. CLAWSON & J. KNETSCH, ECONOMICS OF OUTDOOR RECREATION (1966).

13. J. DWYER, J. KELLY, & M. BOWES, IMPROVED PROCEDURES FOR VALUATION OF THE CONTRIBUTIONS OF RECREATION TO NATIONAL DEVELOPMENT (University of Illinois, Report 128, 1977).

14. W. BROWN, A. SINGH, & E. CASTLE, *supra* note 11, at 266–79.

i.e., success per trip is fixed, then there is no distinction between the demand for trips to the site and the demand for the output produced by each trip.[15] Only under these unrealistic assumptions can the travel cost procedure compute the value of a single commodity such as kill or site quality.

Because the focus is on observable purchases of inputs in recreation production, the travel cost approach avoids the identification problems surrounding the household function approach.

There are a number of important issues concerning simple travel cost analysis:

1) At the heart of the travel cost technique is the assumption that recreationists travel purely for the pleasure of traveling. The travel expenditure is made to obtain access to another good, the recreation site.
2) Generally it is assumed that the only purpose of the trip is to visit the specified site; that is, only the marginal travel costs associated with the site should be included.
3) Individual sites are evaluated in their entirety. The process yields no insight about the value of the site if some part of it is physically altered (e.g., stocked with fish, clear cut, or mined).
4) The prices of substitutes are assumed to be independent of the travel cost of the site and are omitted from the analysis. How the qualities of alternative sites might affect the demand for the measured site cannot be gleaned from simple travel cost studies.
5) The prices of other inputs used to produce a recreation experience such as time on the site, eating and lodging, or equipment expenses generally should not be included in the travel cost analysis unless there is some reason to believe that the marginal utility of eating, lodging, and so forth is zero.

The analyst who fails to recognize when recreationists take a trip for any reason in addition to visiting a site, will overestimate the value of the site. Some means has to be found to allocate total costs among the multiple purposes travel is providing. For example, Haspel and Johnston divide the travel cost of a user equally among multiple destination sites, an ad hoc but reasonable approach.[16] This is not simply a theoretical point. In one study of wilderness areas in Washington, Brown found the value of site increased four-fold when reported distances were used rather than using just travel within the state of Washington. It is likely that

15. Bockstael & McConnell, *supra* note 9, at 204–206.
16. Haspel & Johnson, *Multiple Destination Trip Bias in Recreation Benefit Estimation*, 58 LAND ECON. 364 (1982).

people from distant states enjoyed other places en route, so the cost of their entire trip is probably an overestimate of the marginal value associated with the wilderness site.

The purpose of travel cost analysis is to value the site, not the outputs (for example, kill) that are produced at the site. The value of the site, at the margin, is the cost of obtaining the site, i.e., the expense of traveling to the site. In contrast, expenses incurred at the site, such as the opportunity cost of time on the site and food and lodging expenditures are associated with inputs used to produce specialized commodities or services such as sumptuous food, fashionable dress, and commodious accommodations. Demand functions for these commodities can be estimated using the price of commodities, estimated from the on-site expenditures or, more precisely, the input price-quantity data. However, non-travel expenditures, such as on-site time, should not be included as travel costs to estimate the value of a site because these expenditures are not related to the individual's marginal cost of obtaining the site. In fact, the *levels* or total expenditures on non-travel inputs should generally not even be included in the trip regressions, contrary to McConnell[17] and Wilman.[18] Only the *prices* of non-travel inputs play a role in the demand for a site (if they are site specific).[19] As Knetsch and Cesario assert, if the purpose of the analysis is to value the site, on-site time should not be included as part of travel cost.[20]

Another issue confronting researchers is how to value travel time. If the travel provides as much disutility as working, then a reasonable valuation of time is the wage rate. On the other hand, studies of the modal choice of commuters suggest they value travel time at about one-third of their wage rate.[21] Commuting travel time evidently provides utility. Given that trips to recreational sites are often more attractive and unique than commuting, there is every reason to believe that recreational travel time also provides utility. Further research pinning down the value of recreational travel is clearly needed.

17. McConnell, *Some Problems in Estimating the Demand for Outdoor Recreation*, 57 AM. J. OF AGRIC. ECON. 330 (1975).

18. *See* Wilman, *The Value of Time in Recreation Benefit Studies*, 7 J. OF ENVTL. ECON. AND MGMT. 272 (1980). One exception to this rule is a suggestion by V. Kerry Smith that at least the nature of the activities at a site could be included in the trip regressions to identify different types of demanders.

19. In parallel fashion, in conventional demand analysis, the price of substitutes or complements surely enters the demand function for a commodity of interest, but expenditures on quantities of the substitutes (complements) surely are not embedded in the price of the own good to estimate its demand function.

20. Knetsch & Cesario, *Some Problems in Estimating the Demand for Outdoor Recreation*, 58 AM. J. OF AGRIC. ECON. 596 (1976).

21. Nelson, *Accessibility and the Value of Time in Commuting*, 43 S. ECON. J. 1321 (1977).

Advanced Travel Cost Techniques

Ten years ago, Burt and Brewer made an important improvement in the traditional travel cost approach.[22] They estimated a demand system which recognizes explicitly the substitution possibilities among heterogeneous recreation sites. Their system is built by computing the price for each type of recreation site for every resident. Sites are classified and for each class of sites, the number of trips to those sites are regressed on the price of those sites as well as substitutes. The result is a set of demand curves, one for each of the n classes or types of recreation destinations:

$$(6)\quad Q_1 = f_1(P_1, P_2, \ldots, P_n, W)$$
$$Q_2 = f_2(P_1, P_2, \ldots, P_n, W)$$
$$\vdots$$
$$Q_n = f_n(P_1, P_2, \ldots, P_n, W)$$

Where Q_i is the number of trips to site i, P_i is the travel cost to site i, and W is a vector of demand shift parameters. The significance of this advance is that close substitutes can be explicitly recognized and incorporated within the demand system.

Burt and Brewer applied their technique to a sample of lakes in Missouri.[23] Unique natural lakes had inelastic demand whereas the Corps of Engineers' man-made lakes for which there were many substitutes were highly price elastic. Regrettably, Burt and Brewer were not able to take the natural next step, to measure the characteristics which make each of their types of lakes unique. Thus, it is not possible from their formal analysis to instruct the Corps of Engineers about the level of characteristics which ought to be included in man-made lakes to make them as valuable as natural lakes for recreational purposes.

In their study of quality and quantity, Vaughan and Russell have pioneered another travel cost extension which we label the own price/quality model.[24] In the first stage of the own price/quality model, a traditional travel cost model is estimated for a single site. This process is then repeated for a number of additional sites. For example, one could estimate:

$$(7)\quad Q_{ij} = a_i + b_i P_{ij} \qquad i=1,\ldots,1 \quad j=1,\ldots,s$$

where Q_{ij} is the trips to site i, taken by the j^{th} individual and P_{ij} is that individual's price of the site. The estimated demand parameters for site

22. Burt & Brewer, *Estimation of the Net Social Benefits From Outdoor Recreation*, 39 ECONOMETRICA 813 (1971).

23. *Id.* at 821–26. Another application is to ski areas: Cicchetti, Fisher & Smith, *An Econometric Evaluation of a Generalized Consumer Surplus Measure: The Mineral King Controversy*, 44 ECONOMETRICA 1259 (1976).

i are a_i and b_i. In the second stage, these demand parameters are regressed on the n characteristics of (Z) of each site:

$$(8)\quad a_i = c_0 + c_1Z_1 + c_2Z_2 + \ldots + C_nZ_n$$
$$b_i = d_0 + d_1Z_1 + d_2Z_2 + \ldots + d_nZ_n.$$

The attractiveness of this approach over the simple travel cost approach is that multiple characteristics can be included.

The problem with the own price/quality model, in this simple form, is its omission of substitutes. Solving equations (7) and (8) results in a single equation model which can be more generally expressed:

$$(9)\quad Q_K = g(P_K, Z_K, W)$$

The number of trips to the K^{th} site depends solely on the set of characteristics (Z_K) of the site and the price (P_K) of that site. An individual will travel to site K, Q number of times, regardless of the prices or the qualities of other sites according to this model.

The Vaughan-Russell model has taken the Burt-Brewer formulation, equation (6), and essentially forced all the cross price effects across sites to zero:

$$Q_1 = f(P_1, W)$$
$$Q_2 = f(P_2, W)$$
$$Q_n = f(P_n, W).$$

If, in fact, the actual prices of all substitute sites are so large that no one enjoys any substitute sites, then this simplification is justified because substitute sites would be empirically irrelevant. Feenberg and Mills rigorously prove that if the public good's quality is exogenous, it is theoretically possible to estimate the demand for quality across sites.[25] However, if the level of quality facing the consumer is a choice variable for the user and he can substitute across sites, then the own price/quality model is logically inconsistent with itself. The assumption that the prices of other sites are irrelevant is tantamount to assuming that the characteristics and their levels across sites are irrelevant. If the effect of characteristics is assumed to be unimportant in the determination of quantity demanded (7), characteristics cannot suddenly be the crucial determinant of the parameters underlying demand in (8). From an econometric perspective, if prices of other sites (qualities) left out of (7) are to have an unbiased

24. W. VAUGHN & C. RUSSELL, THE NATIONAL BENEFITS OF WATER POLLUTION CONTROL: FRESH WATER RECREATIONAL FISHING (1982). The Vaughn-Russell model is a simplification of a model shown in M. FREEMAN, THE BENEFITS OF ENVIRONMENTAL IMPROVEMENT 210–14 (1979).

25. D. FEENBERG & E. MILLS, MEASURING THE BENEFITS OF WATER POLLUTION ABATEMENT (1980).

effect on the intercept term (a_i) in (7) which becomes the dependent variable in (8), then $\frac{\partial Q_i}{\partial P_i} + \frac{\partial Q_i}{\partial P_z} + \ldots \frac{\partial Q_i}{\partial P_n} = 0$ for all P_k and P_i.

Let us turn to a hypothetical example. Suppose we observe two sites A and B which are both 30 miles away from users and have identical qualities. In the region surrounding A, suppose additional quality can be purchased by traveling only five miles further. For users of B, additional quality can only be obtained by traveling 50 miles further. The price of characteristics, the additional cost of obtaining marginally superior quality, is consequently much higher for users of B than for users of A. According to the own price/quality framework, both sites are equally attractive because the only difference between the sites is the proximity of other sites. The own price/quality model essentially assumes that people choose a level of quality without regard to its price. Given this implicit assumption in equation (7), the results of equation (8) cannot be interpreted as what people are willing to pay for quality. In fact, by careful selection of the sites to be included in the own price/quality model, virtually any figure can be generated for the value of quality.[26]

The third approach, the hedonic travel cost method, treats the choice of characteristics by recreationists explicitly.[27] Each recreation site is viewed as a bundle of characteristics. By traveling an extra mile to obtain a site with more of a desired attribute, the consumer makes a purchase in this implicit market for additional characteristics. By examining the choices of individuals from a specific residential area, it is possible to estimate how many miles have to be traveled to purchase various levels of charcteristics. For each residence zone, travel cost (distance) TC, is regressed on the characteristics of destination sites:

(10) $TC = V(Z)$.

For example, if there are 62 relevant origins, 62 regressions will be run. Characteristics in the hedonic travel cost approach refer to objective qualities of the site such as elevation, ecosystem type, game density, size of trees, and so forth. Commodities which are produced by the user at the site, such as kills or days of skiing, are not characteristics of the site itself. The price of a marginal unit of characteristic, $V'(Z)$, is an independent variable in the second stage estimation of the demand for attributes.

26. The quality coefficient will be biased if there is a sample correlation between quality and the omitted set of variables, substitutes. For example, imagine a sample with no correlation between distance and price (orthogonal between P, Z). If all the high (low) quality sites also have many substitutes and the low (high) quality sites have no substitutes, then the coefficient on quality will be biased downwards (upwards).

27. G. BROWN & R. MENDELSOHN, THE HEDONIC TRAVEL COST APPROACH (University of Washington, 1980).

$$(11) \quad Z = f(V'(Z),W)$$

where W is a vector of demand shift variables. The second stage is estimated across persons from different residences who face different travel opportunities.

For example, using a sample of Washington State steelhead fishermen, Brown and Mendelsohn calculate the price of fish density, scenery, and congestion for 62 residence zones.[28] Because of the geographic distribution of steelhead density, areas close to high quality coastal fisheries have low fish density prices whereas more remote interior residences have high fish density prices. Regressing the level of fish density purchased on the price of fish density reveals the demand function for fish density. Steelhead fishermen who face higher prices tend to buy less fish density than their otherwise similar coastal neighbors. However, fish density for steelhead fishermen is very price inelastic (.1). Thus, using average not marginal values for density will underestimate the total loss when density is decreased and overestimate gains when density is augmented.

An analysis by Mendelsohn and Roberts of hikers in the Olympic Peninsula reveals that the rain forest and access to the Pacific Ocean are the most valuable characteristics of the Olympic National Park.[29] By comparing the hiking choice of residents of a number of surrounding Washington towns and cities, the demand functions for several characteristics have been estimated. As the prices of waterfalls, loop trails, lakes, beaches, and rain forest increase, people tend to choose sites with less of each characteristic. However, the demand curve for both rain forest and ocean beaches is very inelastic, suggesting large consumer surpluses for both characteristics.

All of the advanced travel cost approaches share one feature in common. They all require substantial data. In addition to detailed origin (residence)-destination (site) histories, the advanced travel cost methods require objective descriptions of the site characteristics. Because they attempt more subtle measurements, the advanced travel cost methods are probably more sensitive to the absence of demand shift variables and measurement error in the included variables. The advanced travel cost techniques consequently require more extensive and higher quality data than simple travel cost studies often utilize.

Policy Analysis

Each of the available approaches to evaluate recreation sites has strengths and weaknesses. In order to gain perspective about the usefulness of each

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28. *Id.* at 9–17.

29. R. MENDELSOHN & P. ROBERTS, ESTIMATING THE DEMAND FOR THE CHARACTERISTICS OF HIKING TRAILS (University of Washington, 1982).

approach, we outline the circumstances in which each method does well. The principal factor in choosing among the approaches is the policy question to be answered. The nature of the recreational choice and the available data tend to narrow the remaining choices to a final best approach.

If the purpose of the analysis is to determine the all or nothing value of a single existing site, the simple, inexpensive travel cost approach is quite adequate. As long as alternative sites are not expected to change, the simple travel cost gives a reasonable approximation of the value of a single site.

If the purpose of the analysis is to value products such as kill, experiences, or photographs generated by users, the most useful approach is the household production function. Although joint production and the complex role of time as both an input and output create very substantial econometric difficulties, the household production function is the only technique which values the outputs of users as opposed to the physical attributes of the sites (inputs to users).

If the purpose of the analysis is to examine the value of changing a characteristic of a site, the advanced travel cost methods are most useful. If individuals can choose only one site from their residence, the own price/quality model is best. However, if individuals can choose from a variety of sites, either the hedonic travel cost or demand system approach is best. The hedonic travel cost is relatively more adept at handling system-wide changes in characteristics and in dealing with a large number of attributes. The demand system approach, on the other hand, is more appropriate when there are a limited number of site types and when the quality of only a single or few sites are to be altered.