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ECONOMIC VALUE OF WATER-ORIENTED RECREATION QUALITY

by

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DEPARTMENT OF ECONOMICS

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Utah Water Research Laboratory
Utah State University
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SUMMARY

Objectives

The objectives of this study were: (a) to develop a system of analysis which permits segregation of total site values into quality and location components, (b) to make empirical estimates for pleasure boating in Utah and Idaho, (c) to identify site characteristics that explain site quality differentials, (d) to compare site value estimates based on the concepts of economic rent and consumer surplus.

Activities

1. A linear programming system was developed to segregate total site values into location and quality components.

2. Empirical value estimates, both aggregate and quality, were made for 42 boating sites in Utah and 69 sites in Idaho.

Results and Conclusions

1. The estimated aggregate value for Utah, based on the rent model, was $1,113,577, and for Idaho $4,601,125.

2. Quality values accounted for approximately 82 percent of total value in Utah and 74 percent in Idaho.

3. In Utah, differences in site quality were significantly related to lake size and campsite facilities. The partial regression coefficients were both positive and statistically significant at the 1 percent level. The model R^2 was .81.

4. In Idaho, site quality differences were significantly related to variation in boat launching ramps. The partial regression coefficient was positive and statistically significant at the 1 percent level. The model R^2 was .76.

5. A mathematical comparison of the estimates of site value based on the concepts of economic rent and consumer surplus revealed that rent estimates typically exceed those of consumer surplus. However, the empirical estimation procedures can cause the relationship to fluctuate depending upon the expansion methodology used to derive population estimates from sample data.

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Introduction

Outdoor recreation resources pose special problems in management and investment decision processes because services provided by these resources are not typically bought and sold in markets as conventionally defined. Information on prices and resource value which are essential for efficient allocation and management of these resources is not directly available. It is for this reason that indirect measures of recreation resource values have been proposed and developed in recent years as a means for introducing conceptual rigor and quantitative market-type information into those decision processes pertaining to non-marketed outdoor recreation resources.[1]

Earlier empirical work in this research area dealt with estimating recreation site values within the conceptual context of consumer demand theory. Variable costs of time, travel, and use costs at the recreation site are substituted for market prices and activity levels (either recreation days or number of trips) serve as surrogate for quantity in the demand analyses. Demand functions generated statistically and estimates of resource value are developed based on consumer's surplus which provides a useful measure of consumers willingness to pay. Resource values of this sort do not distinguish between location and quality characteristics. Although both are important, the management perogative potentially associated with at least some quality characteristics appear to justify further investigation.

The quality component of total site value has received only limited attention in the methodological procedures developed to date. Yet most allocation decisions that involve recreation investments are concerned with altering or improving site quality.

Generally, a quality variable (such as fishing success) has been included in the demand equation.[2] But values have not been derived that separate the respective proportions assignable to location and quality factors, nor have significant site-specific variables which affect site quality been identified for various types of outdoor recreation. Thus it appears that investment and management decisions could be improved by developing methods for relating resource quality values to investment and management possibilities which affect quality characteristics of a recreation site.

Objectives of the Study

The objectives of this study were:

1. To develop a system of analysis that will permit the segregation of total site values into component parts representing quality and location.

2. To empirically estimate these values for pleasure boating recreation in Utah and Idaho.

3. To identify site characteristics for pleasure boating that are significant in explaining differentials in site quality values.

4. To compare site value estimates based on the concepts of economic rent and consumer surplus.

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[1] For a summary review of the literature, see: Harold Hotelling, "The Economics of Public Recreation," *The Prewit Report*, Washington, D.C., 1949, unpaged. Marion Clawson, "Methods of Measuring the Demand for and Value of Outdoor Recreation," Resource for the Future, Report 10, February, 1959. Andrew H. Trice and Sammuel E. Wood, "Measurement of Recreation Benefits," *Land Economics*, August, 1958. William C. Brown, Ajner Singh, and Emery Castle, *An Economic Evaluation of the Oregon Salmon Steelhead Sport Fishery*, Oregon Experiment Station Bulletin 78, September, 1964. Jack Knetsch, "Outdoor Recreation Demand and Benefits," *Land Economics*, November, 1963. James A Crutchfield, "Valuation of Fishery Resources," *Land Economics*, May, 1962. E. Boyd Wennergren, "Valuing Non-Market Priced Recreation Resources," *Land Economics*, August, 1964. Peter H. Pearse, "A New Approach to the Evaluation of Non-Priced Recreation Resources," *Land Economics*, 1968.

[2] For examples of the treatment of the quality variable to date see: Joe B. Stevens, "Recreation Benefits from Water Pollution Control," Water Resources Research, Vol. 2, Second Quarter, 1966. Herbert H. Stoevener, et al., "Multi-Disciplinary Study of Water Quality Relationships," Special Report 348, Oregon Agricultural Experiment Station, February, 1972.

Theoretical Model[3]

The concept of recreation quality

The reality of recreational site quality is intuitively obvious to any one observing recreationist activity. People select recreation sites and activity levels in large part on the basis of quality characteristics that provide desired satisfactions. The conceptual basis for the existence of recreation quality can be demonstrated in the theory of consumer demand. Recreation services produced at or associated with each recreation site generate a unique marginal value function (MV) that expresses the value of the added utility received by a recreationist as additional amounts of recreation are taken. A marginal value function of this type for a recreation site A can be illustrated as MVA in Figure 1. Price or cost (which is assumed to represent value) is measured on the vertical axis and number of trips (as a measure of activity) on the horizontal axis.

The MVA function follows the conventional form normally ascribed to any commodity and relates the value of additional utility derived from increased numbers of trips per unit of time. The MVA represents a conglomerate of site-associated characteristics that make the site attractive to the recreationist and yield utility to him, given his set of individual preferences. The greater the attraction or quality of the site, the higher the level of the marginal value function. Thus, for a given level of activity at each of two sites, the site of higher quality will yield the greater value (utility) to the recreationist. This is illustrated in Figure 1 by a second marginal value function, MVB, as associated with site B, which is of higher quality than site A. For a given number of trips (OS) to each site, the recreationist's marginal value is greater for site B than for site A by the amount $OP_b - OP_a$.

To illustrate how to measure recreation quality, consider the use cost (or price) of alternative rates of activity for the two sites as it relates to the recreationist's utility-maximizing behavior. In the absence of a perceived quality differential between the sites, the recreationist could be expected to make marginal adjustments in activity between the sites until the marginal values of utility derived from each site are equal. The rates of activity at each site should also be equal unless capacity constraints or quality differences are encountered. In the presence of perceived quality differences, however, marginal adjustments will be made in activity levels between the sites, and the rates of activity will not be equal. Such a condition is depicted for sites of differing quality in Figure 1 when no active budget constraint exists. If we postulate equal prices or costs, say at OP_a for both sites, the recreationist will take (OS) units of activity from the lower quality site A and (OT) of the higher quality site B, such that both MVA and MVB are equal to OP_a.

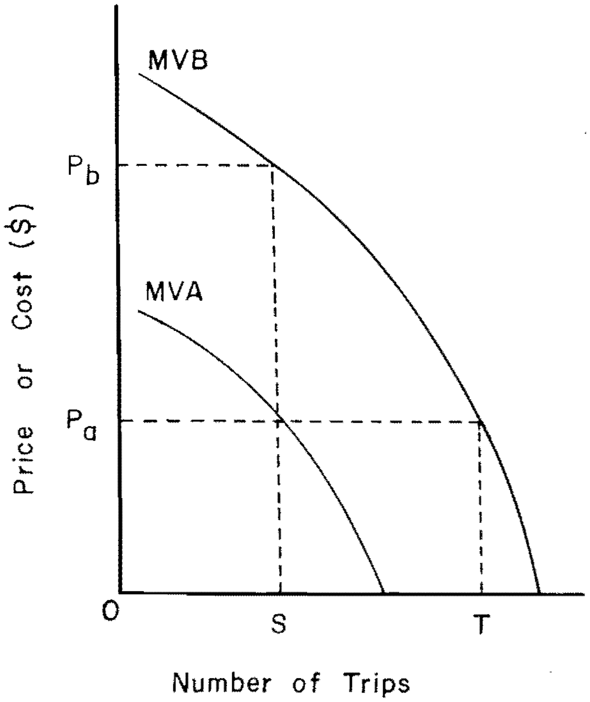

Figure 1. Illustration of an individual user's marginal value utility function for two recreation sites.

An assumption of equal prices or use costs for sites A and B also suggests equal location costs for both, if no other variable costs influence the recreationist's behavior. Thus, we might conclude that if two sites involve equal user costs and offer no quality differences, the same level of activity will be taken from each. It follows, therefore, that if different quantities are taken at a given level of user cost, quality advantages are perceived to be associated with one of the sites. Since the location costs of the two sites are equal, location cannot be a

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[3] The general theoretical model is reproduced here in essentially the same form as previously published in E. Boyd Wennergren, Herbert H. Fullerton, and Jim C. Wrigley, "Estimation of Quality and Location Values for Resident Deer Hunting in Utah," Utah Experiment Station Bulletin 488, August, 1973. Some adaptations are included to reflect the special case of boating. Development of the general model was in process at the time the boating study began and was subsequently published prior to completion of this work.

factor in explaining the different quantities of recreation taken. Therefore, the quality advantage associated with the use of site B over site A is expressed by variation in activity rate or trip numbers.[4]

While quality differences can be expressed by variations in quantities purchased at equal prices, they are perhaps more logically described by differences in the prices that consumers pay for given quantities of consumption. This point has been argued by Micholson in relation to consumer goods.[5]

> If a single consumer or producer at a single point in time pays, or is willing to pay, different prices for two grades of a particular commodity, the difference in price must represent a true difference in quality. For, if he knowingly pays more for one grade, he must consider it worth just that much more to him than the other; and his assessment is sufficient.

Recreation site quality can be illustrated by the price differential depicted in Figure 1. If recreationists can take or purchase (OS) trips, they would pay price (OP_a) for this quantity at site A, or price (OP_b) at site B. The price differential (P_aP_b) indicates the extent of their willingness to pay for the higher quality recreation at site B and is an expression of the quality value.

Thus, quality differences can be expressed by variations in the quantities of recreation purchased (trips) at a single price (distance interval) or by differences in the prices (variable cost) that consumers pay for given quantities of recreation activity.

Recreationists routinely choose among recreation sites of varying quality. Their frequent selection of sites farther away from their place of residence in preference to less-distant sites indicates perceived differential site quality. Many site characteristics probably affect the recreationist's evaluation of alternative recreation sites. Among the especially important factors, in addition to natural site endowments and man-made facilities, one might logically include relative site congestion, familiarity with a site, anticipated length of stay, and intensity of desire for kinds of recreation experiences which only other sites can produce.

The concept of economic rent

Much of the conceptual and empirical methodology related to estimating recreational site values has been based on consumer demand formulations and the concept of consumer surplus. Given the statistical estimation of demand, the consumer surplus is readily determinable as an espression of the value recreationists receive in addition to the costs of recreating.[6] The consumer surplus is often described as a measure of recreationist's "willingness to pay." Economic rent, on the other hand, has been less widely used as a measure of value, even though the comparability of this measure and that of consumer surplus as indicators of changes in social well-being has been argued.[7] With the possible exception of the early work of Trice and Wood,[8] the economic rent measure has rarely been applied nor its conceptual basis formulated, as related to recreation resource valuation.

The concept of economic rent has, however, been used extensively in the literature of economics, especially in dealing with valuation issues related to productive factors such as natural resources (land, etc.). Ricardo,[9] in his formulation of the rent concept in relation to corn land values in England, is generally credited with the initial effort. He argued that only the most fertile land would be brought into production and that, with only one productive class of land, no economic rent

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[4] The reader should be careful to note the distinction here between equal "location costs" and "equal distance" of the two recreation sites with respect to a given recreationist's origin. The two concepts are not equivalent. Equality in "location costs" permits variation in road systems, etc., used by recreationsists in reaching the site. Also, the reference to the "site" should be viewed in somewhat general terms since the quality differential can be related to positive and negative utilities generated by the trip itself. These utilities may arise from experiences or consumption occurring en-route to the site or other activities which are not completely site specific. However, the nonsite utilities are associated with use of the site and therefore create no critical problems to the general argument as to the existence and measure of recreation quality. The question raised here, however, may have relevance to the issue of imputing estimated values to a specific site.

[5] J. L. Micholson, "Measurement of Quality Changes," *Economic Journal*, Volume 77, 1967.

[6] For one explanation of consumer surplus valuation, see: E. Boyd Wennergren, "Valuing Non-Market Priced Recreation Resources," *Land Economics*, August, 1964.

[7] Mishan, E. J., "Rent as a Measure of Welfare Change," *American Economic Review*, Volume 49 (1959), pp. 386-394.

[8] Andrew H. Trice and Samuel E. Wood, "Measurement of Recreation Benefits," *Land Economics*, August, 1958.

[9] Ricardo, David, *The Principles of Political Economy and Taxation*, London, 1817, Everyman's Edition, J. M. Dent & Sons, Ltd., 1911.

would accrue through its use. Rent would arise on these lands, however, when increasing population and demand pressures generated higher product prices and resulted in less-productive lands being brought into production. To quote Ricardo:

> If all land had the same properties, if it were unlimited in quantity, and uniform in quality, no charge could be made for its use, unless where it possessed peculiar advantages of situation. It is only, then, because land is not unlimited in quantity and uniform in quality, and because in the progress of population, land of an inferior quality, or less advantageously situated, is called into cultivation, that rent is ever paid for the use of it. When in the progress of society, land of the second degree of fertility is taken into cultivation, rent immediately commences on that of the first quality, and the amount of that rent will depend on the difference in the quality of these two portions of land.
>
> When land of the third quality is taken into cultivation, rent immediately commences on the second, and is regulated as before, by the difference in their productive powers. At the same time, the rent of the first quality will rise, for that must always be above the rent of the second, by the difference between the produce which they yield with a given quantity of capital and labour. With every step in the progress of population, which shall oblige a country to have recourse to land of a worse quality, to enable it to raise its supply of food, rent, on all the more fertile land, will rise.[10]

Thus, economic rents for land of relatively higher productivity are determined with respect to the least-productive land. Rent can be defined as the difference between product selling price and unit productive costs incurred on the most productive land and those from the least productive lands.

Ricardo's explanation of economic rents assigns much importance to differences in land quality, but gives little attention to the location factor. By contrast, Petty and Von Thunen emphasized this important factor when they observed the location effect of equally-fertile lands more distant to the established markets.[11]

Our contemporary concept of economic rent still defines a logical theory consisting of the difference between product selling price and unit production costs expended in using the most productive resource. Differences in land rents can be attributed to variations in quality, fertility, accessibility, and location.

Rent values in recreation resource use

The implications of the economic rent concept and the respective factors that give rise to economic rent values are applicable to the problems of recreation resource valuation and the logic can be illustrated by the following model:

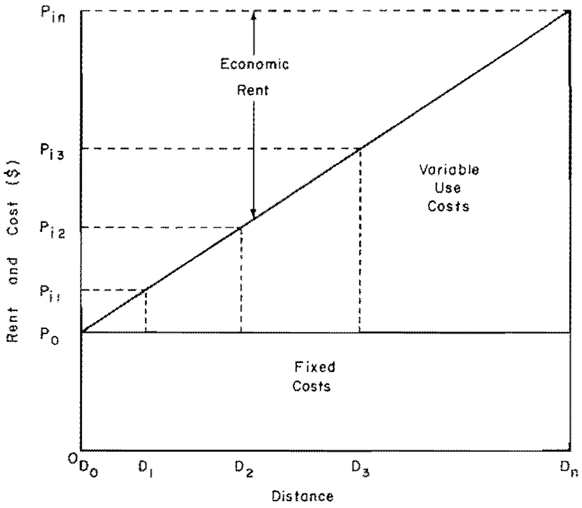

Figure 2. Illustration of economic rent.

where:

$D_0 \ . \ . \ . \ D_n$ = distance from various origins $(O_1 \ . \ . \ . \ O_n)$ to site i

$P_0 \ . \ . \ . \ P_{in}$ = variable costs from origins $(O^1 \ . \ . \ . \ O_n)$ to site i

$D_0 \ D_n$ = distance from the most distant origin to the site i

P_{in} = the variable cost from the most distant origin using the site i, and

OP_0 = the fixed cost of recreational use for the site i.

The rent-generating factors are related to the variable use costs of distance associated with the site. Since all points of origin are spatially related to the site, those in closest proximity extract an economic rent relative to those most disadvanta-

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[10] *Ibid.*, p. 54-55.

[11] Von Thunen, Johana Henrich, *Isolated State*, English Edition of *Dar Isolierte Staat*, Translated by Warten-Carlam, New York, New York: Pergamon Press, 1966.

geously located with respect to the site. For example, recreationists living at an origin point zero miles from the site have fixed costs of OP_0. Because their variable costs are zero, these recreationists extract a rent in relation to the most distant origin, which has a distance cost P_0P_{in}. This rent is equal to P_0P_{in} - P_0 and is generated for each unit of activity taken from that particular origin. As a recreationist's point of origin moves outward from the site (say to D_1), fixed costs remain constant, but distance costs increase to P_0P_{i1}. The rent per unit of activity at D_1 is also generated in relation to origin D_n with its distance cost of P_0P_{in} - P_0P_{i1}. As distance increases, the rent per unit of activity obviously decreases until, at the most distant origin (D_n), there is no rent (P_{0in} - $P_0P_{in} = 0$). Differences in rent may arise from differential quality or productivity of the resource and/or from location or accessibility advantages relative to points of origin. High rent values are associated with high resource values and low rent values with low resource values since the value of the resource (including land values) is a function of the capitalized value of the rents generated in a particular use.

Recreation sites possess both quality and location characteristics that are similar to those assigned to agricultural land. These characteristics produce a commodity of value that is in scarce supply. Resource values may logically be calculated from rents arising from location and quality characteristics. In the same sense that highly productive agricultural land earns more rent than does less productive land, higher quality recreation sites generate greater rents than do lower quality sites. Furthermore, the recreation sites located most advantageously relative to user origins earn relatively more economic rent than those located less advantageously or more distantly.

As in the case of other applications of rent models such as wheat production in agriculture, the total rent value for a given production site is a product of the sum of all per unit rents and the number of units associated with each location. Thus, for wheat land, the total rent value is the sum, for all locations, of the rent per bushel multiplied by the number of bushels produced at each location. In recreation cases, it is the summation of rents per unit of activity multiplied by the total units of activity from each origin. Recreation activity is often expressed in units such as number of trips, recreationist days, activity days, etc.

Methodology for estimating location and quality values

The sources and types of data used to estimate recreation values normally reflect the combined influence of both location and quality on site usage. This is obviously the situation with measures of any recreationist's level of activity, i.e., number of trips or recreation days. The methodology formulated in this study provides a way to estimate both the total value for a recreation site and the location value associated with that site. One calculation is based on the total recreationist activity related to the recreation site. The second calculation is based only on location or distance considerations. The difference between these two values constitutes a quantitative estimate of site quality value.

Given the common condition in which recreation sites and recreationist origins are spatially distributed within a given geographic area, the total level of activity from each point of origin to each site of use can be observed. The nature of the data distribution can, perhaps be best viewed in terms of a matrix arrangement (Figure 3).

The matrix encompasses the distribution of total observed activity from all origins to all recreation sites where:

O_i = origins from which recreationists come to use each site ($i = 1 \ldots n$);

S_j = recreation sites used ($j = 1 \ldots m$);

X_{ij} = the volume of observed activity between origin (i) and site (j). In this analysis, the measure of activity is defined as number of trips;

B_i = total number of trips from an origin (i); and,

T_j = total number of trips to a site (j).

Given such a distribution of recreationist activity among spatially dispersed origins and sites, values can be estimated. Calculation of the total rent value for an individual site is illustrated below. The reader may find it helpful to refer to Figure 2 in following the explanation. For purposes of illustration, assume the use costs for each site-origin combination are known as in Figure 3. For site S_1, the most distant origin of use, O_n, is equivalent to D_n in Figure 2, and has a cost represented as P_0P_n. The total rent value is estimated as follows:

		Sites							Total
		S_1	S_2	S_3	·	·	·	S_m	
Origins	O_1	X_{11}	X_{12}	X_{13}	·	·	·	X_{1m}	B_1
	O_2	X_{21}	X_{22}	X_{23}	·	·	·	X_{2m}	B_2
	O_3	X_{31}	X_{32}	X_{33}	·	·	·	X_{3m}	B_3
	·	·	·	·	·	·	·	·	·
	·	·	·	·	·	·	·	·	·
	·	·	·	·	·	·	·	·	·
	·	·	·	·	·	·	·	·	·
	O_n	X_{n1}	X_{n2}	X_{n3}	·	·	·	X_{nm}	B_n
Total		T_1	T_2	T_3	·	·	·	T_m	

Figure 3. Matrix of conceptual distribution of observed recreationist activity.

$P_n - P_1 = R_1, R_1 \times X_{11} = N_1$

$P_n - P_2 = R_2, R_2 \times X_{21} = N_2$

$P_n - P_n = R_i, R_i \times X_n = N_n$

Total site rent = $\sum_{i=1}^{n} R_i X_{11}$

where:

P_0P_n = variable use cost per unit of activity from the most distant origin using the site;

$P_0P_i \ldots P_0P_n$ = variable cost per unit of activity from each individual origin using the site;

$R_1 \ldots R_n$ = economic rent per unit of activity for each origin;

$X_{11} \ldots X_{n1}$ = level of recreationist activity (number of trips in this case) from each origin to the site; and

$N_1 \ldots N_n$ = the total economic rent for each origin using the site.

A total rent estimate is based on the values related to $RS_1 \ldots R_n$ and $X_{11} \ldots X_{n1}$. The observed distribution of data for the spatial relationships between sites and origins yields an estimate of total economic rent related to the site. However, this total estimate does not identify location and quality values related to site usage.

Least-cost distribution of recreational activity

Location rent values are concerned only with proximity characteristics of the spatial relationships among sites and origins. Consequently, if a recreationist was concerned only with proximity in site selection, he would choose the least distant site. A spatial system of recreation sites and user origins, therefore, could be expected to seek an equilibrium that would minimize costs of travel or provide the least-cost distribution of levels of activity among all sites and origins. An estimate of the expected pattern of use activity among origins and sites associated with a least-cost situation can be made by redistributing the observed activity data (Figure 3). The classic transportation programming technique is as follows:

(1) Let subscript i indicate origins of recreationists from 1 . . . n;

(2) Let subscript j indicate sites of use from 1 . . . m;

(3) X_i = number of trips from origin i;

(4) X_j^d = capacity of site j;

(5) X_{ij} = number of trips from origin i to site j;

(6) P_{ij} = per unit use cost from origin i to site j; and

(7) C = total cost of transportation.

So, given

$$X_i, X_j^d, P_{ij}\,.$$

find X_{ij} for all i and j which minimize

$$C = \sum_{i=1}^{n} \sum_{j=1}^{m} X_{ij} P_{ij},$$

subject to these restrictions:

$$X_i = \sum_{j=1}^{m} X_{ij}$$

$$X_j^d = \sum_{i=1}^{n} X_{ij}$$

$$\sum_{i=1}^{n} X_i = \sum_{j=1}^{n} X_j^d$$

$$X_{ij} \geq 0.$$

The programming of the observed level of recreationist activity redistributes the amount of activity between the origins and sites in the relationship one would expect if use costs were minimized. The previously noted total usage of each individual site is maintained (an indication of site capacity) as is the total activity from each point of origin. But the distribution of activity among sites and origins now reflects the arrangement that would be obtained if only proximity or location were involved in the site selection decision. The resulting data matrix has the same general characteristics as shown in Figure 3, but the values of the X_{ij} have been reallocated and altered consistent with a least-cost distribution. This data matrix can be used to calculate the location value of individual sites.

The total location value associated with the least-cost distribution of site and origin activities is calculated in the same manner as for the observed activity table, but the data matrix associated with the least-cost distribution of activity is used. For the least-cost distribution, intermediate sites earn rents relative to a less distant, W_0W_n, than is the case with the observed activity matrix. The use-cost differentials, when multiplied by the "new" or least-cost level of activity, provide an estimate of the location value per point of origin. A summation of values associated with all origins provides the total site location rent

$$\sum_{i=1}^{n} L_i$$

Given the total rent value for the same site

$$\sum_{i=1}^{n} N_i$$

the economic rent value related to quality

$$\sum_{i=1}^{n} Q_i$$

can be calculated as a residual:

$$\sum_{i=1}^{n} N_i - \sum_{i=1}^{n} L_i = \sum_{i=1}^{n} Q_{ij} V_j$$

The rationale for this methodological procedure is that the total site value is composed of both location and quality components. Thus, the rent values based on observed activity contains both location and quality values. The redistribution of user activity in a least-cost manner defines the allocation of activity that would be expected if location were the only criterion used in selecting alternative recreation sites. Conceptually, recreationists motivated only by cost or distance considerations would follow a least-cost pattern of site usage without concern for quality. Therefore, the value generated by the least-cost distribution can logically be attributed to location. Since the values based on observed activity contain both quality and location values, the subtraction of the location value from the total value generates a residual value that can be attributed to site quality.

The methodology for identifying location and quality values is not restricted to only value estimates using the concept of economic rent. The methodology is equally applicable where consumer surplus estimates are made. The programming procedure redistributes the basic origin-site user data from which value estimates using either of these concepts can be made.

Data Collection and Procedures

Data for the study were collected by mail questionnaire from a sample of boaters in both Utah and Idaho during the 1973 boating season. The mailing list was randomly drawn from the total population of licensed boats in the two states for 1972. Utah boater registrations totaled 31,676 and Idaho about 30,190. Three mailings were made during the boating season which generally runs from June 1st to September 15th. Questionnaires were mailed on July 1, August 1, and September 15, and requested boater information for the previous month (except that the final mailing requested information for August and September). Each mailing approximated a 10 percent sample of the registered boats. In Utah, approximately 9,490 questionnaires were mailed, and for Idaho, about 10,245. Utah registrants returned 1,408 usable questionnaires or about 15 percent while Idaho received 1,351 questionnaires, or a 13 percent return. Out-of-state recreationists with boater registrations in Utah and Idaho were included in the sample. However, boat population lists were not readily available in all surrounding states from which boaters might use Utah and Idaho facilities. Consequently, no sampling was made of these boater populations. Television and radio news coverage was given to the study requesting boater's cooperation in returning the questionnaires.

The questionnaire solicited information on the boater's city of residence (origin), the various boating waters visited (site), the number of trips taken to each site, the number of people traveling, the size, type, age, and cost of their boat, and the variable costs for trips to each recreation site. Travel distances (round trip) for all combinations of origins and sites were calculated from current state road maps using the most direct routes. Variable travel costs were assigned at the rate of $.10 per mile. The estimates of travel cost contain no values for time costs of travel or the opportunity costs of using alternative boating sites. Note that since all distances would be multiplied by the same travel cost per mile, rents would be expected to work proportionally with changes in travel costs.

Additionally, data were collected from other sources relative to the physical characteristics of the various boating sites. Data were obtained on lake size, camping and overnight facilities, boat launching capacity, seasonal weather conditions, and fishing success. Sources for these data included the Utah Division of Natural Resources, Boating Section, the U.S. Bureau of Reclamation, the U.S. Corp of Engineers, the Idaho Department of Fish and Game, and the Idaho Water Resources Board. Such data are developed routinely by these agencies as part of their regular programs and were not generated especially for this study.

Procedures

Estimates of quality and location rent values were made for 42 boating sites in Utah, and 69 sites in Idaho. The analysis was accomplished for each state independently. The estimating procedures utilized the data obtained from the mail questionnaire and all calculations followed the steps detailed in the Methodology Section of this report. A total of 19 boating sites in Utah and 28 sites in Idaho were eliminated from the overall analysis due to a lack of sufficient boater use data. Generally, these are small bodies of water which are not extensively used.

Value estimates for the states were obtained from the sample estimates expanded to state totals. The expansion factor (F) for activity at each site for both states was derived as follows:

$$F = \frac{B}{RS} \; RS_i$$

where:

B = total registered boaters (1973)
RS = study sample size (respondents)
RS_i = size of sample visiting site (i)

Note that this expansion factor differs from the expansion factor which is commonly used for consumer's surplus models (see page 18).

If simplified algebraically,

$$F = \frac{B}{RS}$$

Substituting numbers into the formula, the expansion factor for Utah was:

$$F = \frac{31,676}{1,408} = 22.497$$

Using the same formula, the expansion factor for the Idaho data was:

$$F = \frac{30,190}{1,351} = 22.346$$

The quality value estimates vary among boating sites depending on use preferences of boaters. Regression techniques were used to investigate the independent variables which are associated with variation in site quality. The independent variables were site characteristics, while the dependent variable was the estimated quality value for each site.

Hypothesis

The site characteristics which were postulated to influence site quality for boating recreation in the Utah-Idaho area were lake size, day and night use facilities, boat launching facilities, weather conditions, and fishing success.

Size of lake

The size of the lake is important to the quality of the boating site, especially if user congestion is reflective of site quality. Unlike many other forms of water based recreation activity, boating activities are most enjoyed in an environment in which size permits freedom of movement and reduced danger of accidents and injuries. Sites of greater size can accommodate larger numbers of boats and thus greater levels of boater visits. Furthermore, size may increase the attractiveness of the lake and thus encourage visitation from origins of greater distance since greater distances require higher levels of gross utility to justify the greater expenditures. The combination of higher levels of total activity and greater distances traveled to use sites of greater size enhance the probability of greater quality values. Lake size may also reflect the availability of beach areas to accommodate swimming and other supplemental water activities. However, size alone may not entirely reflect the issues of boater congestion. A more meaningful expression may be the day-to-day and even hour-by-hour relationships of size to use which reflect peak use periods during which congestion is a critical consideration. But in the absence of suspected congestion, lake size alone is likely a meaningful determinant of site quality. Consequently, it was hypothesized that the size of the lake is positively related to site quality.

Day and overnight use facilities

Boating activities are often combined with camping and picnicking activities. Many boaters own campers and other facilities which permit overnight stays. Still others require various types of overnight facilities to accommodate their demand for multi-day trips, i.e., motels, lodges, etc. In addition, day-use facilities enhance the quality aspects of the boating areas by providing needed services. Picnic tables, restrooms, concessionaires, and drinking water are some of the types of day-use facilities important to site quality. Boating sites with the greatest availability of day-use and night-use facilities should have higher quality values. This positive relationship was hypothesized to exist between such use facilities and site quality.

Boat staging facilities

Launch facilities. Facilities to complement boating at the water recreation site including ramps, parking areas, boat docking and storage and fuel influence the propensity of boaters to use a given site and thus could be expected to affect site quality values. Perhaps the most important of these facilities is the launching ramp at the site. The type and size of ramp greatly influences the effort, safety, and time required in lauching the boat. Although most boating sites in the Utah-Idaho area have hard surface ramps the size and capacity of the launching facilities vary greatly among sites. Capacity of the launching facilities is relevant to the issue of lake congestion.

Parking areas. Closely related to the importance of launching facilities is the availability of vehicle and trailer parking. Day users are especially sensitive to this variable, since automobiles and boat trailers, which have significant space requirements, are often left during the day and require a parking location. The parking facilities at the site constitute a third potential source of congestion which has relevance to site quality.

Services. Service facilities for boat operation and "storage" are also important to site usage and quality. Marina facilities, which offer repair assistance and gasoline availability, enhance the desirability of the site. Docking facilities for overnight or weekly storage eliminate the need for continual transport of the boat between the boaters origin and the recreation site. Buildings for permanent storage may also be relevant, and their use by a boater can be very influential in determining site usage. Given the importance of the various forms of boat facilities to the boat user, it was hypothesized that quality values of the boating site are positively related to the availability of boat facilities.

Weather conditions

Favorable weather conditions are a necessary condition to most forms of boating recreation and, consequently, important to site quality. Rain, wind, and temperature are all relevant to favorable site conditions and the levels of boater usage. Surface conditions are especially important to boaters since the dangers of accidents are increased when unfavorable surface conditions exist. Daily temperature is likely the most readily available measure of site weather conditions. Boating sites in Utah and Idaho are located at varying elevations ranging from waters in desert-like conditions of Southern Utah to those located in the higher mountain areas of Northern Utah and the Teton region of Idaho. It was, therefore, hypothesized that site quality is positively correlated with favorable weather conditions at the site.

Fishing success

Fishing is one of the important recreation activities associated with boat usage. The degree of fishing success can provide an important indicator of site quality. Sites with higher levels of success are given preference over those with low success rates, since the fisherman places considerable emphasis on the "catch." Higher probabilities of success are consistent with the fisherman's concept of improved recreation quality. The hypothesis was, therefore, advanced that fishing success is related to measures of site quality in a positive manner.

Results of the Study

Estimates of value

Utah. Quality and location value estimates were made for 42 boating sites in Utah. The statistical sampling did not record boating activity on 16 other sites capable of supporting such activity. Three other major sites, Lake Powell, Utah Lake, and the Great Salt Lake were excluded for other reasons. (See footnote to Table 2 for explanations.) The estimates reported in this section follow the analytical model presented previously, and are based on the concept of economic rent. Consumer surplus estimates are presented in a later section in which the estimating procedures of the two methodologies will be compared.

The estimating procedure for deriving quality and location values for one boating site is illustrated in Table 1. The values are sample estimates and have not been expanded to a state total for the site at this point.

The estimates in section A were generated from the mail questionnaire data. Total trips from each boater origin to the site are shown in column 4. The calculated round trip mileage is in column 2. Since Heber is the most distant origin visiting the site, it becomes the no-rent origin from which all intermediate origins extract their rent advantage. The advantage is obtained by subtracting the distance of each of the intermediate origins from that of Heber. This indicates the advantage in miles per unit of activity (trips) for each origin using Willard Bay relative to the most distant origin which reported use. Column 5 indicates the total rent value obtained by multiplying the origin advantage per trip by number of trips, and then by 10 cents per mile which is the travel cost. The summation of all origin rents yields the estimated total site value ($2,529).

The estimate of location value is shown in section B of Table 1. The observed trip activity for all origins and all boating sites in Utah was reallocated by a least-cost programming procedure such that the cost of travel for the total system was minimized. The origins which would visit Willard Bay, if travel cost (location values) were the only consideration and the numbers of trips they would take, can be determined from column 8. Quality factors are removed from this new distribution of origin-site usage. Site location values are computed in the same manner as were the total site values. For this particular site, the proportion of total site value attributed to location is $354. The number of origins visiting the site under conditions of minimum travel costs is less than the number actually observed using the site when quality factors were also included. This is because activity from all origins is relocated to that set of sites which results in minimum location costs. However, the total number of visits to a site remains the same and is assumed to represent the capacity constraint for that site.

The quality value is calculated as the residual of the difference between total site value and location value. Based on the unexpanded sample data, the quality value for Willard Bay is $2,175.

Aggregate value estimates. Estimates of rent value for all 42 sites in Utah were made consistent with the procedures just presented. The sample estimates for each site were expanded to state totals as described in the Procedures section of this report. The total annual value for the 42 sites was $1,113,577 for 1973 (Table 2). (This value excludes three major boating sites in Utah. See footnote to Table 2 for explanation.) Of the total estimated value, 82 percent was associated with site quality and 18 percent with site location.

The highest total values in Utah were recorded for Flaming Gorge, Bear Lake, Strawberry, Starvation, Rockport, Willard Bay, Pineview, and Scofield. Highest quality values were generally associated with these same sites. The exception was Pineview which had 90 percent of its total value attributed to location. Of the highest value sites, Flaming Gorge had about one-half and Scofield about one-fourth of their total value represented by

Table 1. Quality and location rents for pleasure boating, Willard Bay State Park, 1973.

	(A) Observed Activity				(B) Least-cost Activity			
Origin	Round trip (miles)	Location advantage (miles)	# of trips	Total rent/origin @$.10/mi.	Round trip (miles)	Location advantage (miles)	# of trips	Total rent/origin @$.10/mi.
Hill A.F.B.	16	182	4	$ 73	16	58	7	$ 41
Brigham	20	178	6	107				
Ogden	24	174	61	1061	24	50	28	140
Hooper	32	166	2	33	32	42	8	34
Roy	36	162	11	178				
Clearfield	40	158	5	79	40	34	9	31
Sunset	42	156	3	47				
Layton	46	152	4	61	46	28	33	92
Syracuse	54	144	1	14				
Farmington	60	138	1	14	60	14	8	11
Morgan	72	126	1	13				
Bountiful	74	124	19	236	74	0	85	0
Salt Lake City	94	104	47	489				
Kearns	108	90	1	9				
Sandy	108	90	5	45				
Magna	114	84	2	17				
West Jordan	120	78	1	8				
Riverton	132	66	2	13				
Tooele	162	36	1	4				
Heber	198	0	1	0				
Plain City					22	52	1	5
Wood Cross					74	0	2	0
Total			181	$ 2529			181	$ 354

Quality Rent (A-B) = $ 2175

Table. 2 Aggregate quality and location economic rent values for boating, Utah, 1973.

Boating Sites[a]	Estimated Location Rent	Percent Total	Estimated Quality Rent	Percent Total	Estimated Total Rent[b]
Bear Lake	$ 18,290	8	$ 211,427	92	$ 229,717
Big Sand Wash	0	0	5,107	100	5,107
Lower Bowus	0	0	450	100	450
Causey Creek	0	0	405	100	405
Cutler	0	0	787	100	787
Deer Creek	$ 3,059	24	9,629	76	12,688
East Canyon	0	0	9,629	100	9,629
Echo	832	32	1,800	68	2,632
Fish Lake	2,587	18	11,744	82	14,331
Flaming Gorge	223,868	51	212,889	49	436,757
Gooseberry	0	0	675	100	675
Green River	337	44	427	56	764
Gunnison Bend	450	91	45	9	495
Huntington Lake	2,295	54	1,957	46	4,252
Hyrum Dam	0	0	7,447	100	7,447
Joe's Valley	2,902	73	1,080	27	3,982
Johnson	180	7	2,565	93	2,745
Kolob	495	41	720	59	1,215
Koosharem	0	0	5,422	100	5,422
Lost Creek	0	0	472	100	472
Minersville	0	0	427	100	427
Mantua	0	0	1,147	100	1,147
Navajo	1,530	13	10,191	87	11,721
Newton	0	0	22	100	22
Otter Creek	23,307	100	0	0	23,307
Palisades Park	0	0	3,779	100	3,779
Panquitch	0	0	2,880	100	2,880
Paradise Park	0	0	112	100	112
Pineview	46,299	90	5,084	10	51,383
Porcupine	270	100	0	0	270
Red Creek	0	0	90	100	90
Rockport	0	0	81,417	100	81,417
Scofield	5,624	22	20,180	78	25,804
Smith-Morehouse	0	0	45	100	45
Starvation	0	0	90,438	100	90,438
Stienacker	135	1	19,190	99	19,325
Strawberry	472	0	104,769	100	105,241
Willard Bay	7,964	14	48,931	86	56,895
Yuba	292	4	7,357	96	7,649
Twin Lakes	405	20	1,597	80	2,002
Gunlock	0	0	11,743	100	11,743
Pelican	540	30	1,282	70	1,822
Total	$ 343,437	18	$ 770,140	82	$ 1,113,577

[a] Insufficient data precluded value estimates on 19 of the lakes or reservoirs in Utah. In general, these were minor water areas. However, three large areas were excluded. Lake Powell was not included since the sampling procedure proved insufficient to capture the usage at that site before May 15 and after September 15. Failure to include this extensive usage significantly understated the site value. The observed activity for Utah Lake was also distorted possibly due to prior publicity regarding high levels of pollution. While the reports have since been disproved, the data collected seemed to reflect a suspected bias which caused this site to be disregarded in the analysis. Finally, the Great Salt Lake was excluded since the salty nature of the water does not lend itself to widespread boating use of the type included in this study.

[b] Expansion factor used was 22.497.

location. Otter Creek also showed a significant value, all of which was attributed to location.

Statistical analysis of quality value. A major objective of the study was to determine those site characteristics which were significant in explaining differentials in quality values among sites. Since the quality values are devoid of location value, they reflect those values resulting from user-perceived quality influences at the recreation site. Variation in quality value among sites, therefore, can be logically attributed to variation in selected site characteristics. In an earlier section, we defined, in a general way, the relationships which were hypothesized between site quality values and site characteristics. A test of these relationships was made with a step-wise regression analysis using site value as the dependent variable and the various site characteristics as independent variables. The general form of the regression equation was:

$$Q_i = b_0 + \sum_{j=1}^{n} b_j Z_{ij}$$

where:

Q_i = quality rent value for the i^{th} site

Z_{ij} = characteristics for the i^{th} site

The independent variables were specified as follows:

Z_{i1} = surface area of the i^{th} site expressed in surface acres.

Z_{i2} = the number of camp sites with a tent or trailer space, garbage disposal facilities and fireplace at the i^{th} boating site.

Z_{i3} = the number of 12-foot lanes for boat launching of either concrete or asphalt at the i^{th} site.

Z_{i4} = the number of days with temperatures from 75°F to 95°F between May 15th and September 15, 1973, at the i^{th} site.

Z_{i5} = the average length of stay per trip measured in 24-hour days for the i^{th} site.

Z_{i6} = fishing success as measured by creel counts and indexed as poor = 0, fair = 1, good = 2, and excellent = 3. (Due to lack of sufficient data, this variable could not be included in the general analysis. It is reported separately, however, for the 21 boating sites for which data could be obtained.)

Note that $\sum_{i=1}^{n} Z_{ij} = Z_j$

A stepwise statistical analysis was used to determine the statistical significance of each of the independent variables. The results of this analysis are summarized for Utah in Table 3.[12]

Of the six independent variables included in the analysis, two were statistically significant and explained a large portion of the variability in quality values for the 42 Utah sites.

Surface area of the lake. The size of the lake was the single most important variable in the Utah regression analysis. Lake size explained approximately 66 percent of the variation in site quality value. The partial regression coefficient was highly significant at the .01 level of probability and its positive sign corroborated the hypothesis that greater site quality values are associated with large water areas.

The strong statistical relationship of the analysis supports the rather obvious argument that size is important to quality and boater usage. The use of the boat requires an adequate area for enjoyable participation which has minimal congestion and reduced potentials for boat related injury. The fact that this specification for the independent variable produced highly significant results suggests that overall congestion of Utah's boating waters is not a significant problem. However, the issues of congestion are best examined on the basis of boaters per unit of water and peak period usage. This study did not provide such detailed analysis of the congestion problem

Campsite facilities. Campsite facilities for day and night use were significantly related to variation in site quality. The partial regression coefficient was significant at the .01 level of probability. Its positive sign supported the hypothesis that the availability of these facilities enhanced site quality. This variable added 15 percent to the overall model R^2.

All other variables were statistically insignificant and contributed nominally to the explanatory capacity of the model (R^2). The signs of the regression coefficients for on-site temperature (Z_4) and length of stay (Z_5) were negative. This is contrary to the hypothesized relationship but the coefficients were not statistically significant. Signs

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[12] The model was examined on the basis of the statistical significance of the partial regression coefficients (an F-test), the sign of the partial regression coefficients, and the amount of variation explained by the total model (R^2). Independent variables were also examined for interrelationships. A simple correlation coefficient of .70 or greater between two independent variables was considered as a high intercorrelation.

Table 3. Summary of stepwise statistical analysis of Utah data.

Stepwise Model	b_0	b_1	b_2	b_3	b_4	b_5	R^2
	Partial Regression Coefficients[a]						
Step #1	49072	4.27[b]	91.7[b]	2176	-491	-3270	.8414
Step #2	41154	4.11[b]	89.8[b]	2224	-470		.8394
Step #3	35886	5.49[b]	112.7[b]		-385		.8259
Step #4	2994	5.61[b]	115.4[b]				.8143
Step #5	1740	6.82[b]					.6606

[a] b_0 = constant and b_1-b_5 = partial coefficients of independent variables Z_1 to Z_5.

[b] Significant at .01 level of probability by F-test.

for the other variables were consistent with the hypothesized relationship.

A degree of intercorrelation was found between campsite facilities (Z_2) and launching facilities (Z_3). The interrelationship is apparent with the change in the coefficient of Z_2 from 89.8 to 112.7 as Z_3 is deleted from the model. However, the simple correlation coefficient remains significant at the .01 level of probability and the signs of the coefficients remain consistently positive. The constancy and significance of the statistics support the basic hypothesis regarding the relationship of the two variables to the dependent variable. However, the interaction of the two variables means that the direct effect of Z_2 on site quality is influenced by the level of Z_3, and the coefficient expressing this value likely lies somewhere between 89.8 and 115.4. The correlation matrix is shown in Appendix Table 1.

The overall two-variable model was statistically significant at the .01 level of probability and explained approximately 81 percent of the variation in site quality.[13]

Idaho. Analysis of the Idaho data followed the identical conceptual model as used in Utah for the site evaluation estimates. Likewise, the same analytical format was used for the statistical analysis and the same independent variables were identified to explain the variation in site quality estimates. Whereas, fishing success was excluded from the Utah analysis due to an absence of data for all sites, this variable was included in the analysis of the Idaho data.

Aggregate value estimates. Value estimates were made for 71 boating sites in Idaho using the concept of economic rent. Expansion of the sample data to statewide total utilized the expansion factor discussed in the Procedures section. The total annual value for the 69 sites was $4,601,125 of which 74 percent was related to quality values and 26 percent to location (Table 4). The Pend Oreille and Coeur D'Alene Lakes generated the highest total values. Both were in excess of $1,000,000 annually, The Priest Lakes, Dworshak Reservoir, Lucky Peak Reservoir, Magin Reservoir, and Island Park Reservoir also had significant values. These sites also had the highest quality values, with the exception of Coeur D'Alene Lake. Only 35 percent of the total value for Coeur D'Alene Lake was associated with quality.

Statistical analysis of quality value. The stepwise regression analysis was repeated for the Idaho data in the same format as used for analyzing the Utah data. The same measures of the independent variables were used and the hypothesized relationships developed earlier were assumed for the Idaho analysis.

The step-wise regression analysis is summarized in Table 5. Only one of the six independent variables proved statistically significant, but it explained a large portion of the variability in quality among the 71 Idaho sites analyzed.

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[13] The fishing success variable (X_6) was not included in the analysis of 42 Utah sites due to the lack of data for all sites. A separate analysis was made for 21 sites which included fishing success as measured by creel count data of the Forest Service. However, the variable was statistically insignificant, had a negative simple correlation coefficient, and contributed about 1 percent to the model R^2.

Table 4. Aggregate quality and location economic rent values for boating, Idaho, 1973.

Site[a]	Estimated Location Value	Percent	Estimated Quality Value	Percent	Total Economic Rent[b]
Benewah Lake	0	0	579	100	579
Black Lake	0	0	4,199	100	4,199
Cocolalla Lake	1,192	100	0	0	1,192
Chatcolet Lake	0	0	1,339	100	1,339
Coeur D'Alene Lake	692,281	65	365,501	35	1,057,782
Fernan Lake	0	0	2,423	100	2,423
Hauser Lake	0	0	417	100	417
Hayden Lake	11,596	35	21,357	65	32,953
Kallarney Lake	0	0	824	100	824
McArthur Reservoir	137	25	412	75	549
Pend Oreille Lake	127,800	11	1,022,258	89	1,150,058
Perkins Lake	0	0	525	0	525
Priest Lakes	39.904	7	519,485	93	559,389
Robinson Lake	0	0	486	100	486
Rose Lake	300	100	0	0	300
Spirit Lake	0	0	31,153	100	31,153
Twin Lakes	858	100	0	0	858
Alturas Lake	1,477	81	353	19	1,830
Redfish Lake	0	0	1,648	100	1,648
Williams Lake	0	0	701	100	701
Anderson Ranch Reservoir	2,659	19	1,130	81	3,788
Arrowrock Reservoir	0	0	736	100	736
Black Canyon Reservoir	1,084	100	0	0	1,084
Brownlee Reservoir	549	17	2,722	83	3,272
Cascade Reservoir	0	0	139,239	100	139,239
Deadwood Reservoir	0	0	98	100	98
Deer Flat Reservoir	1,128	50	1,128	50	2,256
Hells Canyon Reservoir	0	0	392	100	392
Horsethief Reservoir	0	0	623	100	623
Lost Valley Reservoir	177	54	152	46	329
Lucky Peak Reservoir	0	0	280,847	100	280,847
Upper Payette Lake	15,873	25	47,360	75	63,233
Little Payette Lake	0	0	44	100	44
Spangler Reservoir	0	0	1,678	100	1,678
Warm Lake	0	0	3,375	100	3,375
Little Camas Reservoir	0	0	2,884	100	2,884
C. J. Strike Reservoir	329	9	3,286	91	3,615

Table 4. Continued.

Site[a]	Estimated Location Value	Percent	Estimated Quality Value	Percent	Total Economic Rent[b]
Fish Creek Reservoir	1,275	100	0	0	1,275
Little Wood Reservoir	235	8	2,801	92	3,036
MacKay Reservoir	3,532	100	0	0	3,532
Magic Reservoir	40,919	17	200,211	83	241,130
Mormon Reservoir	0	0	14,122	100	14,122
Murtaugh Reservoir	103	40	152	60	255
Roseworth Reservoir	88	100	0	0	88
Salmon Falls Reservoir	5,268	6	78,434	94	83,702
Sublett Reservoir	422	12	3,007	88	3,429
Walcott Reservoir	0	0	530	100	530
American Falls Reservoir	12,592	62	7,735	38	20,327
Ashton Reservoir	0	0	98	100	98
Bear Lake	1,063	4	25,497	96	26,561
Blackfoot Reservoir	1,182	11	10,031	89	11,213
Chesterfield Reservoir	0	0	319	100	319
Daniels Reservoir	1,589	100	0	0	1,589
Henry's Lake	0	0	58,470	100	58,470
Island Park Reservoir	16,894	7	212,763	93	229,657
Palisades Reservoir	39,369	100	23,731	0	63,100
Treasureton Reservoir	88	1	15,643	99	15,731
Twin Lakes Reservoir (Franklin)	12,327	100	0	0	12,327
Dworshak Reservoir	37,667	8	392,235	92	429,902
Jackson Lake (Wyoming)	0	0	402	100	402
Saint Joe River	1,692	47	1,913	53	3,605
Spokane River	1,079	100	0	0	1,079
South Fork of Snake	2,227	55	1,854	45	4,081
Snake-Heyburn	0	0	5,808	100	5,808
Snake-Hagerman	378	79	103	21	481
Condie Reservoir	0	0	746	100	746
Paddock Reservoir	39	4	971	96	1,010
Swan Falls	0	0	765	100	765
Salmon River	1,256	21	4,802	79	6,058
Total	$ 1,178,415	26	$ 3,422,710	74	$ 4,601,125

[a] Insufficient data precluded value estimates for 28 lakes or reservoirs in Idaho. In general, these were minor water areas.

[b] The expansion factor used was 22.347.

Table 5. **Summary of stepwise statistical analysis of Idaho area.**

				Partial Regression Coefficients[a]				
Stepwise Model	b_0	b_1	b_2	b_3	b_4	b_5	b_6	R^2
Step #1	9819	.138	-.796	4733.5[b]	-154.7	-1482.6	263.7	.7723
Step #2	9640	.138		4722.7[b]	-152.2	-1501.2	263.3	.7723
Step #3	11976			5022.8[b]	-173.4	-1715.3	254.1	.7700
Step #4	11300			5021.6[b]	-153.1	1517.0		.7676
Step #5	-2017			4995.4[b]		1146.6		.7651
Step #6	-4554			4966.4[b]				.7633

[a] b_0 = constant and b_1 - b_6 = partial coefficients of independent variables Z_1 to Z_6.

[b] Significant at .01 levels of probability of F-test.

Boat launching ramps. Boat launching ramps, measured as the number of 12-foot lanes at each site, was the only statistically significant variable identified in the Idaho data. Approximately 76 percent of the variation in site quality was explained by variation in the number of launching ramps. The partial regression coefficient was significant at the .01 level of probability and had the hypothesized positive sign. The partial coefficient showed reasonable stability as the other independent variables were deleted from the model suggesting only slight intercorrelations with the other independent variables. The most important were associated with lake size and number of degree days between 75°F and 95°F. However, the signs of the latter variable is negative and, in neither case, were the partial regression coefficients statistically significant.

All other variables were statistically nonsignificant although most had the correct signs. The exceptions were degree days and average length of stay at the site. The sign of the latter did become positive, however, during the last two steps of the analysis. None of the other independent variables added as much as 1 percent to the overall model R^2. Of particular interest is the fact that lake size and camping facilities, both which were significant in the Utah analysis, were not statistically significant in the analysis of the Idaho data. The correlation matrix is summarized in Appendix Table 2.

The overall model R^2 was .76 for Idaho and was statistically significant at the .01 level of probability.

Comparison of Consumer Surplus and Economic Rent Methodologies

Mathematical comparison

An objective of this study was to contrast the consumer surplus and economic rent methodologies to determine the comparability of these two measures of resource valuation. The analysis tested the hypothesis that consumer surplus and economic rent are equivalent valuation methodologies. To accomplish the test, a common model was developed that encompassed the notation and logic of both methodologies. The model and the notations used are illustrated in Figure 4.[14]

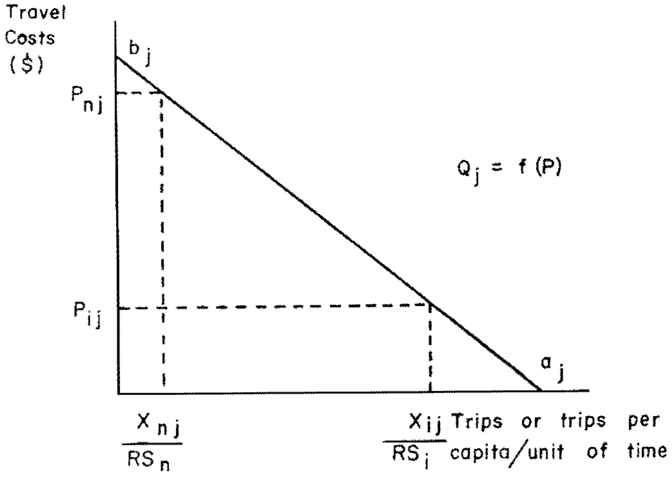

Figure 4. **Model illustration for comparison of economic rent and consumer surplus.**

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[14] The use of linear demand functions is not essential although it facilitates the comparison by simplifying the presentation and interpretation of the results.

where:

P_{ij} = the travel costs from origin i to site j

P_{nj} = the travel costs from the most distant origin (n) to site j

X_{ij} = the number of trips from origin i to site j

X_{nj} = the number of trips from the most distant origin (n) to site j

RS_i = the number of questionnaires returned from origin i

RS_n = the number of questionnaires returned from origin n

b_j = the travel costs (price) intercept of the demand function for site j

a_j = the trips per capita (quantity) intercept of the demand function for site j

B_i = the total number of registered boaters in origin i

i = the number of origins (1, . . ., n)

j = the number of sites (1, . . ., m)

Q_j = the demand function for site j.

Travel costs (P_{ij}) were assumed to determine the amount of recreation consumed at a site therefore the quantity of recreation (trips per capita) demanded was assumed to be a function of travel costs (price). Hence, the linear demand function for site j becomes;

$$Q_j = \frac{-a_j}{b_j} P + a_j$$

and the total consumer surplus (TCS) for site j has the following form:

$$TCS_j = \sum_{i=1}^{n} \left[\int_{P_{ij}}^{P_{nj}} \left(-\frac{a_j}{b_j} P + a_j\right) dp \right] B_i \quad \cdots (1)$$

$$\sum_{i=1}^{n} \left[\frac{(P_{nj} - P_{ij})}{2} \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) \right] B_i \quad \cdot\cdot (2)$$

The equation for calculating the total economic rent (TER) for site j can be written as:

$$TER_j = \sum_{i=1}^{n} (P_{nj} - P_{ij}) X_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \quad \ldots\ldots (3)$$

The following constraints were derived from the definitions and calculation procedures of the two methodologies.

$P_{ij} \geqslant 0$ for all i and j

$X_{ij} \geqslant 0$ for all i and j

$P_{ij} \leqslant P_{nj}$ for all i and j

$RS_i \geqslant 1$ for all i

$B_i \geqslant 1$ for all i

Comparison of the two methodologies was facilitated by first examining the mathematical formulation of surplus and rent for the i^{th} origin visiting a given site. The consumer surplus for the i^{th} origin visiting site j is given by the formula below:

$$\int_{P_{ij}}^{P_{nj}} \left(-\frac{a_j}{b_j} P + a_j\right) dp = \frac{(P_{nj} - P_{ij})}{2} \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) \quad \ldots\ldots\ldots\ldots\ldots (4)$$

The economic rent for the i^{th} origin traveling to site j is given by the equation:

$$(P_{nj} - P_{ij}) X_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Since $RS_i \geqslant 1$ for all i, then $X_{ij} \geqslant X_{ij}/RS_i$ for all i.

That is, the number of trips taken to site j from origin i will be greater than or equal to the trips per capita from origin i to site j for all origins visiting site j. This holds true for all the sites.

It can be shown that $X_{ij}/RS_i \geqslant X_{nj}/RS_n$ for all i traveling to j,[15] consequently, since $X_{ij} \geqslant X_{ij}/RS_i$ and $X_{ij}/RS_i \geqslant X_{nj}/RS_n$ for all i we have that:

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[15] For empirical data, the inequality may not hold but the calculation of consumer surplus is based upon the statistical demand function and the negative slope of the demand function dictates the relationship. In calculating the consumer surplus, the trips per capita are computed from the demand function and the corresponding travel costs.

$$2X_{ij} \geq 2\frac{X_{ij}}{RS_i} \quad \text{for all i and j} \; \ldots\ldots\ldots\ldots (6)$$

$$2X_{ij} \geq \frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n} \quad \text{for all i and j} \; \ldots\ldots (7)$$

$$X_{ij} \geq \tfrac{1}{2}\left(\frac{X_{ij}}{RS_i} + \frac{T_{nj}}{RS_n}\right) \quad \text{for all i and j} \; \ldots (8)$$

Also, since $P_{ij} \leqslant P_{nj}$, then $P_{nj} - P_{ij} \geqslant 0$ for all i and j, therefore:

$$(P_{nj} - P_{ij})\, X_{ij} \geq \frac{(P_{nj} - P_{ij})}{2}\left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) \; \ldots (9)$$

Therefore, the economic rent for origin i trips to site j is greater than or equal to the consumer surplus for the i^{th} origin visiting site j. The condition for equality is that:

$$X_{ij} = \tfrac{1}{2}\left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) \; \ldots\ldots\ldots\ldots (10)$$

or that the trips in the economic rent model from origin i be equal to the average trips per capita between origin i and trips from the highest cost origin (n) to site j in the consumer surplus model.

Since economic rent for origin i equals or exceeds the consumer surplus, the economic rent can be represented as a multiple, (K_{ij}), of the consumer surplus for origin i. That is,

$$(P_{nj} - P_{ij})\, X_{ij} = K_{ij} \left[\frac{(P_{nj} - P_{ij})}{2}\left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right)\right] \; \ldots\ldots\ldots\ldots (11)$$

The value of K_{ij} will depend upon the difference between the trips from origin i to site j, and the elasticity of the demand function. Consequently, the value of K_{ij} will vary among origins visiting site j as well as among sites 1, . . ., n. The value of K_{ij} based upon statistical demand functions would be calculated as follows:

$$K_{ij} = \frac{2X_{ij}RS_iRS_n}{X_{ij}RS_n + X_{nj}RS_i} \; \ldots\ldots\ldots (12)$$

In the situation where economic rent equals consumer surplus, the value of K_{ij} would be 1. As P_{nj} approaches b_i, then by definition of the demand function, X_{nj} approaches zero and K_{ij} would approach $2RS_i$. This means that if the highest cost origin coincides with the travel cost intercept of the demand function, then the economic rent value for origin i traveling to site j will exceed the consumer surplus value for origin i by twice the number of returned questionnaires. Thus, the value of K_{ij} will be between one and $2RS_i$ for origins visiting a site.

These conclusions can be represented graphically as shown in Figure 5. Economic rent is displayed in Figure 5 by area E and consumer surplus by area S.

The multiple K_{ij} is determined by dividing area E by area S.

$$K_{ij} = \frac{\text{Area E}}{\text{Area S}} \; \ldots\ldots\ldots\ldots\ldots\ldots (13)$$

After multiplying the economic rent and consumer surplus by their respective expansion factors, which adjust the values from sample size to total population, both methodologies are described in equivalent units. They are expressed in terms of a "price" times the total projected number of trips that would be taken from the i^{th} origin to site j.

The expansion factor for consumer surplus is the total number of registered boaters at the respective origin, B_i. Thus, the projected consumer surplus for trips from origin i to site j is given by the following formula:

$$\frac{P_{nj} - P_{ij}}{2}\left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) B_i \; \ldots\ldots\ldots (14)$$

The expansion factor for economic rent is the total number of registered boaters divided by the total number of questionnaires returned,

$$\sum_{i=1}^{n} B_i \Big/ \sum_{i=1}^{n} RS_i$$

or the weight that each questionnaire in the set of data represents. The expanded economic rent for trips from origin i to site j is shown below:

$$(P_{nj} - P_{ij})\, X_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \; \ldots\ldots\ldots\ldots (15)$$

The expansion factors used for the rent and surplus models, respectively, are:

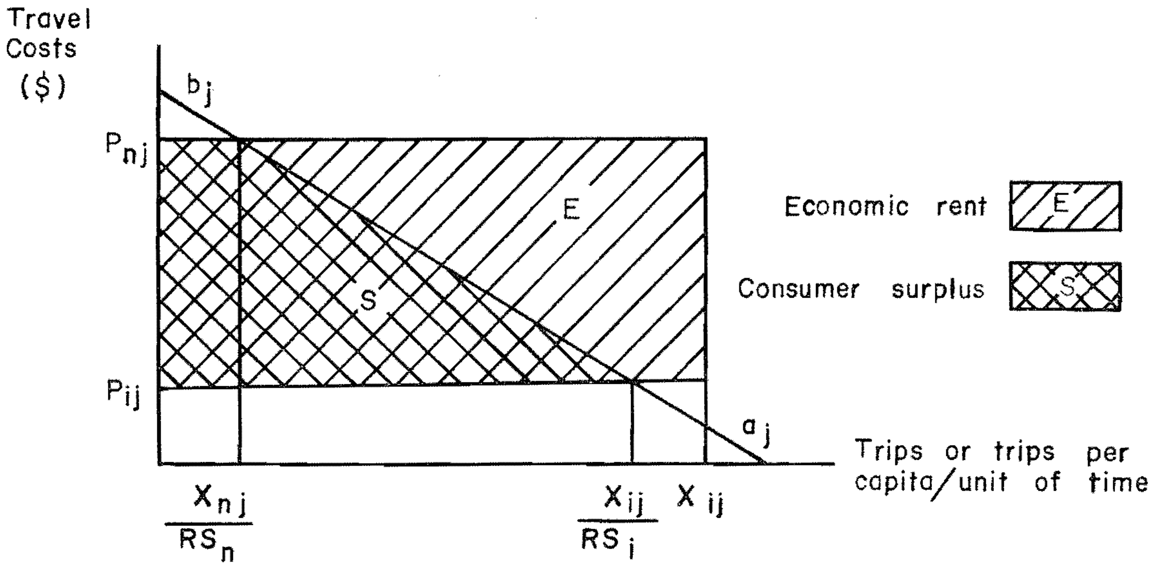

Figure 5. Graphic representation of consumer surplus and economic rent.

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \quad \ldots (16) \qquad \text{and} \qquad \frac{RS_i}{B_i} \quad \ldots\ldots\ldots (17)$$

The expanded number of trips taken from an origin siginificantly affects the relationship between the economic rent and consumer surplus value estimates. It can be shown that for trips from a particular origin to a site the total expanded number of trips taken from the origin in the economic rent and consumer surplus models will have the subsequent relationship; either

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} X_{ij} \le \frac{X_{ij}}{RS_i} B_i \longleftrightarrow \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \le \frac{B_i}{RS_i} \quad \ldots\ldots\ldots (18)$$

or

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} X_{ij} \ge \frac{X_{ij}}{RS_i} B_i \longleftrightarrow \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \ge \frac{B_i}{RS_i} \quad \ldots\ldots\ldots (19)$$

If the expanded number of trips in the rent model is less than the expanded number of trips in the surplus model,

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \le \frac{B_i}{RS_i} \quad \ldots\ldots\ldots\ldots\ldots (20)$$

then, the expanded economic rent value could be greater than, equal to, or less than the expanded consumer surplus value for trips from origin i to site j. Figure 6 represents this situation geometrically.

It has been shown theoretically that economic rent exceeds consumer surplus for each origin visiting each site. The amount that rent exceeds surplus may be sufficient to compensate for the empirical effect of the expansion factors upon their respective resource values. In Figure 6, if area A exceeds area B, then the expanded economic rent value will exceed the expanded consumer surplus value for origin i to site j. If area A equals B, then the two resource values for origin i will be equivalent. If area A is less than area B, then the expanded consumer surplus value will exceed the expanded economic rent for origin i. Mathematically, we have that given:

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} < \frac{B_i}{RS_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots (21)$$

then,

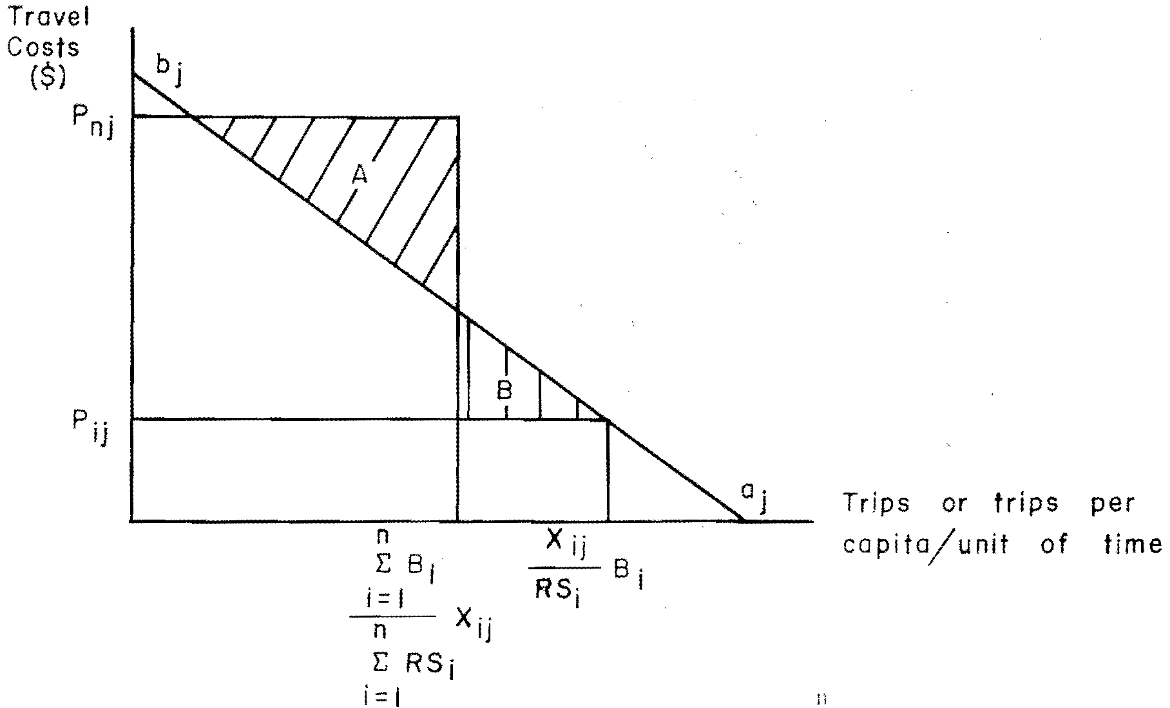

Figure 6. Comparison of economic rent and consumer surplus with $\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \geq \frac{B_i}{RS_i}$

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} X_{ij} < \frac{B_i}{RS_i} X_{ij} \quad \ldots\ldots(22)$$

and

$$X_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} < \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) B_i \quad ..(23)$$

$$(P_{nj} - P_{ij}) X_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} < (P_{nj} - P_{ij}) \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) B_i$$

$$\ldots\ldots\ldots\ldots(24)$$

But when the right side of Equation 24 is divided in half to obtain the equation for the expanded consumer surplus, there is no guarantee that the inequality will hold. The direction of the inequality in this situation will depend upon the empirical data. Consequently, no firm relationship exists in this situation between expanded economic rent and consumer surplus for all origins to a site.

On the other hand, if the total expanded number of trips in the economic rent model exceeds, or is equal to, the total expanded number of trips in the consumer surplus model for trips from origin i to site j,

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \geq \frac{B_i}{RS_i}, \quad \ldots\ldots\ldots(25)$$

then, the expanded economic rent value will exceed the expanded consumer surplus value. In this case, the expansiion factor magnifies the amount economic rent exceeds consumer surplus. This situation is shown in Figure 7.

Economic rent exceeds consumer surplus by a factor of K_{ij} and the rent expansion factor multiplies this into an excess of projected economic rent over expanded consumer surplus equal to area C in Figure 7. The amount by which expanded economic rent exceeds expanded consumer surplus

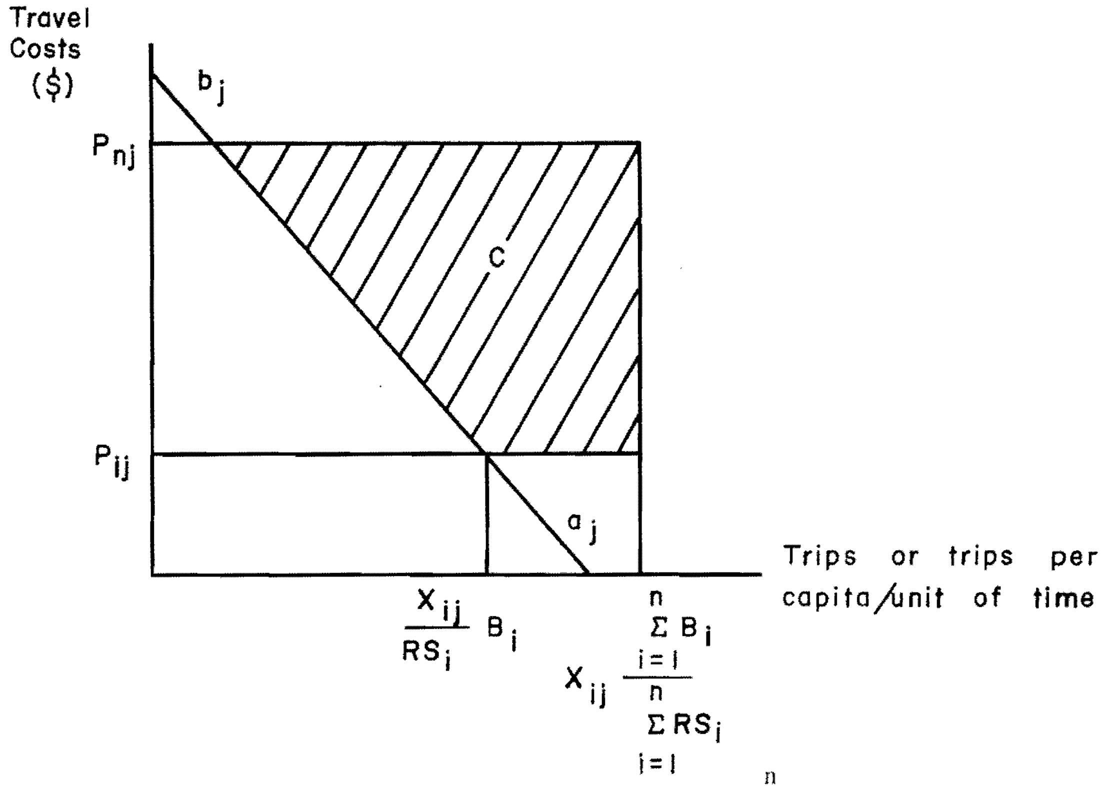

Figure 7. Comparison of economic rent and consumer surplus with $\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \geq \frac{B_i}{RS_i}$

in this situation will again depend upon the empirical data. Given:

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \geq \frac{B_i}{RS_i}\text{, then} \qquad \ldots\ldots\ldots\ldots(26)$$

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} X_{ij} \geq \frac{B_i}{RS_i} X_{ij} \qquad \ldots\ldots\ldots\ldots(27)$$

$$2\,\frac{\sum_{i=1}^{n}}{\sum_{i=1}^{n} RS_i} X_{ij} \geq \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) B_i \ldots(28)$$

$$(P_{nj} - P_{ij})\, X_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \geq \frac{P_{nj} - P_{ij}}{2} \left(\frac{X_{ij}}{RS_i} + \frac{X_{nj}}{RS_n}\right) B_i \qquad \ldots\ldots\ldots\ldots(29)$$

Since the effect of the expansion factors upon economic rent and consumer surplus is not unique, no specific relationship between the two valuation techniques can be ascertained. For activity from any particular origin i to site j, the expanded economic rent value can be greater than, equal to, or less than the expanded consumer surplus value for the origin. A specific relationship will depend upon the proportionality of the sampling technique; that is, the relationship between

$$\frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} RS_i} \text{ and } \frac{B_i}{RS_i} \qquad \ldots\ldots\ldots\ldots(30)$$

The factors most strongly influencing the comparability of the two measures are the use of trips as compared to trips per capita, the constant economic rent per trip compared to the declining marginal value for an additional trip per capita, and the repsective data projection factors of the two resource valuation methodologies.

Empirical comparison

The empirical comparison of economic rent and consumer surplus values follows the same line of reasoning as employed in the mathematical comparison. The analysis concentrates on a comparison between the economic rent and the consumer surplus based upon linear demand estimates. The curvilinear surplus values are presented to give an idea of the differences encountered where alternative demand estimates are used. To avoid redundancy, the empirical comparison will be illustrated by using a representative site to develop the concepts employed in the mathematical comparison. Boating site 19, Starvation Reservoir in Utah, will be used for this purpose. Only Utah data are used in this comparison.

Consumer surplus and economic rent values for the various origins from which visits are made to Starvation are summarized in Table 6.

These empirical results confirm the mathematical proof since all economic rent values exceed or equal the consumer surplus values. The economic rent value for Roosevelt was $62.00, while the consumer surplus value for linear demand estimates was $14.08. The economic rent and consumer surplus values for St. George (the highest cost user) are both zero. The largest difference between economic rent and consumer surplus was for Salt Lake City, with an economic rent value of $1,613.00, and a linear consumer surplus value of $9.74.

As expected from the mathematical comparison, the discrepancy in value estimates between the economic rent and consumer surplus methodologies is a result of rent being standardized on total trips and consumer surplus standardized on trips per capita. The fact that trips per capita will always be less than or equal to the total trips from an origin means that the consumer surplus estimate will likewise be equal to a less than the rent estimates.

Table 7 shows the number of trips and trips per capita that were taken from each origin to the site. As the number of trips from an origin increases, the discrepancy between economic rent and consumer surplus values increases. For example, 37 trips occurred from Salt Lake City to Starvation, but only 0.0833 trips per capita (Table 7, columns 3 and 4). The economic rent value for Salt Lake City is $1,613.00 (Table 6, column 2), but

Table 6. Economic rent and consumer surplus values for origins visiting Starvation, Utah, 1973.

Origin	Economic Rent/ Origin	Consumer Surplus/ Origin (Linear)[a]	Consumer Surplus/ Origin (Curvilinear)[b]
Roosevelt	$ 62.00	$ 14.08	$ 8.98
Park City	48.00	10.86	6.04
Pleasant Grove	97.00	10.86	6.04
Provo	144.00	10.77	5.97
American Fork	48.00	10.72	5.93
Mapleton	46.00	10.30	5.63
Salt Lake City	1,613.00	9.74	5.25
Sandy	87.00	9.70	5.21
Midvale	129.00	9.60	5.15
Mt. Pleasant	43.00	9.51	5.09
Murray	253.00	9.42	5.03
Magna	16.00	9.28	4.94
Woods Cross	41.00	9.10	4.82
Farmington	40.00	9.00	4.76
Layton	39.00	8.77	4.61
Riverton	38.00	8.50	4.44
Clearfield	38.00	8.45	4.41
Roy	38.00	8.36	4.35
Ogden	73.00	8.13	4.21
West Jordan	72.00	8.04	4.16
Monroe	30.00	6.67	3.36
Logan	28.00	6.08	3.03
Kanosh	23.00	5.09	2.49
Cedar City	10.00	2.17	1.02
St. George	0.00	0.00	0.00

[a] $Q_{19} = 0.2422 - .0004P$.

[b] $Q_{19} = e^{-0.3547P - 0.4654}$.

the consumer surplus value was only $9.74 (Table 6, column 3). Usually, trips per capita decline as distance from the site increases, but the observed number of trips may increase when large population centers (as the case of Salt Lake City) are involved. Such an increase in trips increases the economic rent value of the origin relative to other origins. The data necessary for calculating the total expanded number of trips from the various origins to Starvation in the consumer surplus model are presented in Table 8.

Table 7. Number of trips and trips per capita for the origin visiting Starvation, Utah, 1973.

Origin	Mileage (Round Trip)	Number of Trips	Trips per Questionnaire Returned
Roosevelt	66	1	0.3333
Park City	202	1	0.5000
Pleasant Grove	202	2	0.1538
Provo	206	3	0.0612
American Fork	208	1	0.0833
Mapleton	226	1	0.2500
Salt Lake City	250	37	0.0833
Sandy	252	2	0.0714
Midvale	256	3	0.2000
Mt. Pleasant	260	1	0.5000
Murray	264	6	0.1875
Magna	270	4	0.2667
Woods Cross	278	1	0.2500
Farmington	282	1	0.2000
Layton	292	1	0.0370
Riverton	304	1	0.3333
Clearfield	306	1	0.0435
Roy	310	1	0.0385
Ogden	320	2	0.0126
West Jordan	324	2	0.3333
Monroe	384	1	0.2500
Logan	410	1	0.0323
Kanosh	454	1	1.0000
Cedar City	586	1	0.0833
St. George	686	1	0.0714

The total expanded number of trips for the economic rent model was calculated by multiplying the projection factor (21.793) times the number of trips taken from an origin. In the case of Roosevelt, this was 21.793 trips (1 x 21.793). In the consumer surplus model, the total projected number of trips was computed by multiplying the trips per questionnaire returned by the total number of registered boaters. For Roosevelt, this was 38.667 (1 ÷ 3 x 116). By comparing the projection factor for economic rent (21.793) with the similar projection factors for the various origins in the consumer surplus model (Table 8, column 5), it was observed that the economic rent expansion factor may be less than, equal to, or greater than the expansion factor for origins in the consumer surplus as expected from the theoretical analysis.

The inconsistencies due to applying the respective expansion factors to the resource values can be seen in Table 9. For example, the expansion factor for economic rent was less than the expansion factor for consumer surplus for Park City, Provo, and West Jordan (Table 8, column 5). Yet, the expanded values for economic rent and consumer surplus have differing relationships. In the case of Park City, although the economic rent projection factor was less than the consumer surplus expansion (21.793 < 22), the expanded economic rent value exceeds both consumer surplus values (Table 9). The amount by which economic rent exceeded consumer surplus for Park City compensated for the increase in consumer surplus because of more total trips. The economic rent value for Provo was not sufficient to compensate for the effect of the expansion factor, and therefore the expanded economic rent value was less than consumer surplus value ($3138 < $12,202).

A comparative summary of the total economic rent and total consumer surplus values for 24 boating sites in Utah is presented in Table 10. These were the only sites with sufficient data to allow both types of calculations. Just as in the case of expanded economic rent and consumer surplus for an origin, there is no unique relationship between the total economic rent and total consumer surplus values for a site (Table 10). Since the expanded economic rent values per origin can be greater than, equal to, or less than the projected consumer surplus, summing the projected resource values per origin to obtain the total site value may also reflect an inconsistent relationship, depending upon which resource value dominates for the origins in question. For some sites such as Bear Lake, the total economic rent exceeded the total consumer surplus. For Pelican, the two values were almost equivalent. And for sites such as Big Sands

Table 8. Total number of registered boaters and questionnaires returned for the various origins visiting Starvation, Utah, 1973.

Origin	Number of Trips	Number of Questionnaires Returned	Total Registered Boaters	Boaters/ Returns
Roosevelt	1	3	116	38.667
Park City	1	2	44	22.0
Pleasant Grove	2	13	280	21.539
Provo	3	49	1,133	23.122
American Fork	1	12	349	29.083
Mapleton	1	4	41	10.25
Salt Lake City	37	144	9,032	20.342
Sandy	2	28	787	28.107
Midvale	3	15	405	27.0
Mt. Pleasant	1	2	42	21.0
Murray	6	32	817	25.531
Magna	4	15	232	15.467
Woods Cross	1	4	178	44.5
Farmington	1	5	114	22.8
Layton	1	27	551	20.407
Riverton	1	3	194	64.667
Clearfield	1	23	375	16.304
Roy	1	26	549	21.115
Ogden	2	159	3,128	19.673
West Jordan	2	6	214	35.667
Monroe	1	4	54	13.5
Logan	1	31	529	17.065
Kanosh	1	1	14	14.0
Cedar City	1	12	288	24.0
St. George	1	14	206	14.714

Wash, the total consumer surplus value exceeded the economic rent value.

Each step in the process of determining the total economic rent and consumer surplus values for a site suggests the absence of a unique relationship between the two methodologies. The economic rent exceeds the consumer surplus value for all origins of visits to our sample site, Starvation. But the amount by which rent exceeds surplus was not constant for all origins due to differences in the use of the data on trips and trips per capita, and whether constant economic rent per trip was considered. The expansion factors further complicated the comparison between the expanded economic rent and consumer surplus estimates. Finally, the total site values show no unique relationships because they are based upon a summation of the origin values, which suffer from the forementioned inconsistencies. Consequently, the only conclusions to be drawn with respect to consumer surplus and economic rent valuations is that the relationship is not consistent.[16]

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[16] An additional comparison of the two methodologies involved calculation of the quality and location values based on the consumer surplus estimates. Estimates could be made for only 11 of the 42 sites in Utah, since insufficient data were available to generate consumer surplus quality estimates. (This finding is considered significant, since it illustrates the greater data demands of the consumer surplus methodology.) Using these 11 sites for comparison of the two estimates, the consumer surplus model R^2 was .96, and the economic rent model R^2 was .94. Lake size was significant at the 1 percent level in both models. Campsite facilities were statistically significant in the consumer surplus model, but not in the economic rent model.

Table 9. Expanded economic rent and consumer surplus values for the origins of trips, Starvation, Utah, 1973.

Origin	Expanded Economic Rent	Expanded Surplus (Linear)	Expanded Surplus (Curvi-linear)
Roosevelt	$ 1,351	$ 1,633	$ 1,042
Park City	1,046	1,633	1,042
Park City	1,046	478	266
Pleasant Grove	2,114	3,041	1,691
Provo	3,138	12,202	6,764
American Fork	1,046	3,741	2,070
Mapleton	1,002	422	321
Salt Lake City	35,152	87,972	47,418
Sandy	1,896	7,634	4,100
Midvale	2.811	3,888	2,086
Mt. Pleasant	937	399	214
Murray	5,514	7,696	4,110
Magna	3,618	2,153	1,146
Woods Cross	894	1.620	858
Farmington	872	1,026	543
Layton	850	4,832	2,540
Riverton	828	1,649	861
Clearfield	828	3,169	1,654
Roy	828	4,590	2,388
Ogden	1,591	25,430	13,169
West Jordan	1,569	1,721	890
Monroe	654	360	181
Logan	610	3,216	1,603
Kanosh	501	71	35
Cedar City	218	625	294
St. George	0	0	0
Total	$ 69,868	$ 179,568	$ 96,154

Table 10. Total economic rent and total consumer's surplus values for 24 boating sites in Utah, 1973.

Boating Site	Projected Total Rent/ Origin	Total Surplus Value (Linear)	Total Surplus Value (Curvi-linear)
Bear Lake	$ 222,528	$ 133,781	$ 129,577
Big Sands Wash	4,947	65,275	12,196
East Canyon Lake	9,329	9,003	7,126
Fish Lake	13,883	28,567	16,238
Flaming Gorge	303,049	192,471	213,212
Huntington Lake	4,119	3,641	930
Hyrum State Park	6,865	3,436	2,269
Joe's Valley	3.858	4,137	2,233
Johnson	2,660	1,605	1,035
Koosharem	5,253	3,972	1,894
Mantua	1,111	1,447	466
Navajo	11,353	6,791	1,759
Otter Creek	22,578	16,495	8,533
Palisades State Park	3,661	3,230	1,016
Panquitch	2,528	1,782	1,556
Pineview	49,778	33,412	23,147
Rockport	78,869	92,726	38,716
Scofield	24,997	60,354	31,073
Starvation	69,868	179,568	96,154
Strawberry	101,947	151,166	69,677
Willard Bay	55,112	45,557	40,280
Yuba State Park	7,409	3,615	3,113
Twin Lakes, Ida.	1,940	1,963	631
Pelican	1,765	1,774	1,477
Total	$ 1,009,407	$ 1,045,768	$ 704,308

APPENDIX

Table A-1. Correlation matrix showing simple regression relationships, Utah boating study, 1973.

Independent Variable	Regression					Quality Values Q_i
	Z_1	Z_2	Z_3	Z_4	Z_5	
Surface Acres (Z_1)	1.0000	.3447	.8019	-.1702	.3593	.8128
Camps Units (Z_2)		1.0000	.5180	-.1386	.2175	.6481
Boat Ramps (Z_3)			1.0000	-.0658	.2725	.8245
Degree Days (Z_4)				1.0000	-.2020	-.2771
Length of Stay (Z_5)					1.0000	.2966

Table A-2. Correlation matrix showing simple regression relationships, Idaho boating study, 1973.

Independent Variable	Regression						Quality Values Q_i
	Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	
Surface Acres (Z_1)	1.0000	.7229	.3734	.0346	.0037	-.0322	.6717
Camp Units (X_2)		1.0000	.5534	-.2741	.3512	.0377	.4857
Boat Ramps (X_3)			1.0000	.0566	.1225	.0211	.8737
Degree Days (Z_4)				1.0000	-.2476	.1023	.0116
Length of Stay (Z_5)					1.0000	.1097	.0659
Fishing Success (Z_6)						1.0000	.0556