A Comparison of the Economic Rent and Consumer Surplus Methods of Valuing Recreation Boating Sites

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Allocating public monies among competing uses is among the most difficult problems facing government agencies concerned with natural resources. In the public sector, recreation is often provided at a nominal cost and therefore the price mechanism does not provide a meaningful guide to consumer preference and willingness to pay. Consequently, a satisfactory measure of benefits (and opportunity costs) is lacking. However, it is these benefits which are relevant to the investment decision in the public sector. To overcome this deficiency, indirect valuation methods have been proposed for imputing values to recreation resources to assist in the allocation of scarce public investment funds among alternative recreation sites.

Economists have devised various models designed to measure recreation benefits of values such as consumer surplus (Hotelling; Wennergren 1964), non-discriminating monopolist [Clawson; Brown], consumer survey [Davis], and economic rent [Trice; Wennergren 1972]. However, due to differences in assumptions, the models yield variations in value of a recreational site which creates the problem of which valuation estimate is most appropriate and under which circumstances are models comparable [Beardsley; Carey; Seckler]. Most of these models have been developed within the conceptual context of consumer demand theory. Economic rent has been less widely used as a measure of value, even though the conceptual equivalence of the economic rent measure and that of consumer surplus as indicators of changes in social well-being has been argued [Mishan]. The objective of this paper is to determine the comparability of consumer surplus and economic rent methodologies of recreation resource valuation.

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The concept of consumer surplus applies to the values that possessors of a commodity receive in excess of the pruchase price. With respect to recreation, individual site demand estimates are based on the concept that a recreationist is subject to costs and, consequently, to implicit prices incurred in the consumption of the recreational experience, which regulate his consumption and reflect the value of the experience to the consumer, thus, providing a useful approach to estimating recreational demand. The concept of economic rent defines economic rent as the difference between selling price and unit production costs expended in using the most productive resource. The application of economic rent to recreation valuation is based upon the concept that points of origin are spatially related to the site; those origins most closely located extract an economic rent relative to that origin most distant or disadvantageously located with respect to the site. The two models of recreation valuation incorporate the relationship existing between the variable use costs associated with various origins, sites, and units of activity.

Data were collected from a total 9,491 questionnaires mailed to a sample of Utah boaters drawn randomly from a master list of approximately 31,500 registered boats in 1973. A total of 1,408 questionnaires (14.8 percent) were returned and used in the study. Information was obtained from the questionnaires with respect to boater's origin, boating sites visited, number of trips taken to a site and trip expenses. Using this information, together with standardized distances and an assumed variable cost of travel, estimates of consumer surplus and economic rent were made for twenty-four boating sites in Utah.

To facilitate the comparison of the two methodologies, both estimates of resource value were based upon the same set of observed activity.

Consumer surplus estimates were made using linear demand functions and curvilinear demand functions. The consumer surplus was calculated relative to the highest cost user to alleviate the problem of high surplus values due to inelastic demand functions and to put economic rent and consumer surplus estimates on an equivalent basis. The calculations of economic rent are consistent with the methodology advanced by Wennergren and Fullerton [1972]. The consumer surplus estimates are consistent with the methodology developed by Hotelling.

The comparison and anlysis of economic rent and consumer surplus was developed through the use of a common mathematical model. The common mathematical model incorporated the logic and notation of both the economic rent and consumer surplus models. An empirical comparison was utilized to aid in the understanding of the conclusions arrived at in the mathematical model and to evaluate the conclusions through empirical observation. The mathematical definitions of consumer surplus and economic rent used in the study and the notation are presented below. The consumer surplus definition below is based upon the use of linear demand functions.[1]

$$TER_j = \sum_{i=1}^{n} (P_{nj} - P_{ij})\, T_{ij} \frac{\sum_{i=1}^{n} B_i}{\sum_{i=1}^{n} R_i}$$

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

$$= \sum_{i=1}^{n} \left[\frac{(P_{nj} - P_{ij})}{2} \left(\frac{T_{ij}}{R_i} + \frac{T_{nj}}{R_n} \right) \right] B_i$$

where:

TER_j = The total economic rent for site j.
TCS_j = The total consumer surplus for site j.
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.
T_{ij} = The number of trips from origin i to site j.
T_{nj} = The number of trips from the most distant origin (n) to site j.
R_i = The size of the sample of registered boaters from origin i.
B_i = The total number of registered boaters in origin i.
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.
i = A typical origin (1, . . . , n).
j = A typical site (1, . . . , m).

Three stages, or levels in the calculation procedure were considered in the comparison and analysis of the two methodologies. The first stage compared the basic economic rent and basic consumer surplus values per origin visiting a site. The second stage took into consideration the effects of the respective projection factors upon the basic resource values in calculating the projected economic rent and consumer surplus values for an origin traveling to a recreational site.[2] The third stage analyzed the relationship between the total economic rent and the total consumer surplus values for the site in light of the findings of stage one and two.

In stage one, it was found that the basic economic rent value will exceed the basic consumer surplus value for all origins visiting a recreation site. The reason for this relationship is the economic rent model utilizes the number of trips taken from an origin to the site, while the consumer surplus model uses the number of trips per capita in calculating the resource values. The number of trips will always equal or exceed the number of trips per capita. By using the number of trips from an origin to a site in the economic rent model, the rent values are influenced by large population centers, whereas in the consumer surplus model, this influence is reduced by using the number of trips per capita, thereby standardizing large and small population centers and reflecting a more accurate activity rate among origins visiting a site. A second reason for the difference in resource values is the assumption that the economic rent is constant for each trip taken,

[1] The use of linear demand functions is not essential to the analysis although it does facilitate the comparison by simplifying the presentation and interpretation of the results.

[2] The projection factors determine the total number of trips that would be expected from the total boating population of an origin visiting a boating recreation site based upon the size of the sample.

whereas the marginal value in the consumer surplus model declines as additional trips from an origin are consumed. Since the basic economic rent exceeds the basic consumer surplus, the rent can be expressed as a multiple of the surplus. The magnitude of the multiple will vary among origins visiting a site and among the sites visited by an origin because the number of trips and trips per capita varies among the origins visiting a site, and the elasticity of the demand function varies among the sites. The range of the multiple is from one to a factor of two times the sample size per origin.

In stage two, no consistant relationship was found between the projection factor for economic rent and the similar projection factor for consumer surplus. The projection factor for economic rent may be greater than, equal to, or less than the similar projection factor for consumer surplus depending upon the relevant data. Since the projection factors determine the total expected number of trips that would be taken from an origin, the inconsistent relationship between the projection factors creates an analogous relationship between the economic rent values and the consumer surplus values. Depending upon the relationship between the relevant projection factors, the projected economic rent value for an origin visiting a site could be greater than, equal to, or less than the projected consumer surplus value for the origin. The main reason for the difference between projection factors is that the economic rent projection factor is an aggregation of the population and sample size, whereas the consumer surplus projection factor is on a per-origin basis, thereby yield-relationshiping the greater than, equal to, or less than relationship.

In stage three, again no consistent relationship between the total economic rent and total consumer surplus values for a site was found. The total site value is the summation of the projected origin values for those origins visiting the site. In the process of determining the total resource values for a site, each stage in the process contributes to the lack of a unique relationship between the economic rent and consumer surplus valuation methodologies. The basic economic rent exceeds the basic consumer surplus for all origins visiting a site due to the difference in assumptions concerning the use of trips and trips per capita and the concept of constant economic rent per trip. The projection factors further complicate the relationship as discussed above. Since the relationship between the projected origin values is inconsistent, the summation of these values to arrive at total site values will also be inconsistent depending upon the net effect of stages one and two.

The empirical comparison of the total economic rent and total consumer surplus values for twenty-four boating sites in Utah is presented in table 1. The empirical comparison reflected the variations in the use of data, in the calculation procedure, and in the assumptions between the two methodologies. The use of regression analysis to determine the demand functions in the consumer surplus model did reflect a difference in the trips per capita from an origin than was actually observed thereby generating some bias in the empirical values for the consumer surplus model compared to the economic rent model, which utilized the actual data, but this did not affect the conclusions arrived at in the mathematical comparison. The conclusions of stages one, two, and three of the

Table 1. Total economic rent and total consumer surplus values for 24 boating sites in Utah, 1973

Boating Site	Total Economic Rent	Total Consumer Surplus (Linear)	Total Consumer Surplus (Curvi-linear)
	dollars		
Bear Lake	222528	113781	129577
Big Sands Wash	4947	65275	12196
East Canyon Lake	9329	9003	7126
Fish Lake	13883	28567	16238
Flaming Gorge	303049	192471	213212
Huntington Lake	4119	3641	930
Hyrum State Park	6865	3436	2269
Joe's Valley	3858	4137	2233
Johnson	2660	1605	1035
Koosharem	5253	3972	1894
Mantua	1111	1447	466
Navajo	11353	6791	1759
Otter Creek	22578	16495	8533
Palisades State Park	3661	3230	1016
Panquitch	2528	1782	1556
Pineview	49778	33412	23147
Rockport	78869	92726	38716
Scofield	24997	60354	31073
Starvation	69868	179568	96154
Strawberry	101947	151166	69677
Willard Bay	55112	45557	40280
Yuba State Park	7409	3615	3113
Twin Lakes, Idaho	1940	1963	631
Pelican	1765	1774	1477

mathematical comparison were substantiated through empirical observations.

An additional empirical comparison of the two methodologies involved the calculation of the quality and location values based on the consumer surplus estimates. Estimates could be made for only eleven of the twenty-four sites in Utah, since insufficient data were available to generate consumer surplus location estimates. This is considered significant, since it illustrates the greater data needs of the consumer surplus methology. Although the economic rent model has definite time and cost advantages in the collection and analysis of data, it does have shortcomings in that the differences, as pointed out in stages one, two, and three of the mathematical comparison, restrain its comparability to the consumer surplus methodology.

In conclusion, the identification of variations in the methodologies and their influence upon the resource values will assist in understanding the differences and problems of recreational resource valuation techniques. A broader understanding of these differences may lead to improved uniformity in the valuation procedures and to a better understanding of the interpretation of the results.

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