QUALITY AS A LATENT VARIABLE IN RECREATION ACCESS ANALYSIS

E. Jane Luzar, Christopher Gan, Barun Kanjilal, and Mark Messonnier

Abstract

Recreation trends indicating an increasing demand for quality recreation experiences suggest the need for special consideration of quality in analysis of fee access recreation. By viewing quality as a subjective latent variable, this paper uses a simultaneous equation framework to consider the use of subjective versus objective appraisals of quality in fee-based recreation access analysis.

Keywords: latent variable, quality, recreation

National and regional recreation trends indicate that increasingly sophisticated recreationists perceive and seek quality recreation experiences (Langner). Recreationists can be expected to become increasingly sensitive to recreation attributes such as quality as they develop experience and expertise through specialization (Schreyer et al.). As a result, efforts to develop and promote fee based recreation activities should address the quality issue to ensure competitiveness in providing the recreation experiences most in demand (Luzar and Gan).

Analyses of quality in recreation experiences can be based on either objective or subjective evaluations of quality which can in turn be described as *ex post* or *ex ante* measures. One means of analyzing quality in recreation decisions is to evaluate it as a latent variable. This paper evaluates recreation quality as a latent variable specified within a simultaneous equation framework that analyzes structurally the effect of quality on prices paid for a deer hunting lease.

In the following sections, the role of quality in recreation access analysis is discussed in terms of objective and subjective measurements, as well as in terms of aggregate versus individual measurement. The concept of quality as a latent variable is developed in the next section. With quality defined as a latent variable, a simultaneous framework analyzing determinants of recreation lease prices is then presented. Data collection procedures, estimation, and empirical results are presented in the next section. The paper concludes with a summary and some suggestions for further research exploring the importance of latent variables, perceptions, and quality in fee-based recreation access research.

QUALITY AND RECREATION EXPERIENCES

Attributes of consumer goods, including recreation-based experiences, have long been shown to influence both quantities demanded as well as prices paid by consumers (Griliches). For example, characteristic-based approaches such as the hedonic price framework have proven especially useful in determining the characteristics of recreation experiences that can influence consumption decisions (Livengood; Messonnier and Luzar; Pope and Stoll; Pope et al). Information developed from these kinds of analyses can provide valuable management guidelines for rural entrepreneurs seeking to establish competitive, fee-based recreation enterprises.

Attribute information employed in characteristic-based analyses typically addresses easily quantifiable, objective attributes related to the biological resource which forms the basis for the recreation experience, including for example deer herd size, acreage, location, or forest type. Additional characteristic information may focus on attributes of the consumer, including objective socio-economic characteristics such as income, age, or education. Information related to attitudes and preferences is often also incorporated into economic decision models (Tinsley and Tinsley).

Although recreation analyses can be improved by including what are often subjective measures of attitudes and preferences, questions have been raised regarding their interpretation and statistical validity (Norris and Koontz). Given the increasing importance recreationists assign to quality in their recreation experience, thorough analyses of recreation attributes should arguably include a more explicit consideration either of an objective or a subjective measurement of quality (Gunter).

E. Jane Luzar is an Associate Professor, Christopher Gan and Barun Kanjilal are Graduate Research Assistants, and Mark Messonnier is a Former Graduate Research Assistant in the Department of Agricultural Economics and Agribusiness at Louisiana State University Agricultural Center at Baton Rouge, Louisiana.

QUALITY IN RECREATION: OBJECTIVE OR SUBJECTIVE MEASUREMENT?

Quality as an attribute of a recreation or leisure experience may either appear as an objective measure or alternatively as a subjective perception of the recreationist. Objective measures of quality are often created by researchers who rely either on related attributes or on quantity characteristics of the resource or experience. For example, Messonnier and Luzar used an objective measure of quality in a hedonic analysis of deer lease prices that specified quality to be the ratio of hunter opportunities to shoot deer to total number of deer hunting trips to the lease. These constructed reflections of quality are often highly dependent upon the researcher's knowledge of the recreation experience and hence represent a subjective, *ex post* appraisal of quality. While objective measures can provide measurable information about quality, Witt and Ellis suggest that leisure behavior is often best explained in terms of the interplay between internal (subjective or psychological) factors and external/situational events (social group influences, etc.).

An alternative approach to including an objective measure of quality can be developed based on individually reported perceptions of quality (Mercer; Peterson). Subjective measures of quality, like other perceptions, are frequently obtained by asking survey respondents to identify quality through the use of scaled rankings or development of quality indices (Henderson et al). Respondents are, in these cases, providing their perceptions of quality, which may be contingent upon other attributes of the recreation experience. While this contingent perception of quality may be unobservable, the factors shaping it often are observable.

Perception-based measures of quality are inherently subjective and essentially unobservable, often giving rise to unique measurement problems. Norris and Koontz, for example, have identified two measurement concerns related to use of these scale data in statistical analysis, including interpretation problems arising from scale dependence and statistical problems related to the interval nature of these data. Interpretation problems arise within econometric frameworks when ordinal scales are used. Measurement and interpretation issues are also associated with scale dependence as most statistical methods require intervals within the variation of the data to have meaning. The measurement issue has been described as follows:

> A statement involving numbers is meaningful if and only if its interpretation is invariant under appropriate admissible transformations of the scale from which the numbers were taken. With ordinary survey data on attitude or belief rankings, statistical results are meaningful if they are invariant to increasing monotonic transformations of the data. However, statistical results will not, in general, be invariant to this type of transformation. (Norris and Koontz, p. 6).

Researchers grappling with appropriate, accurate reflections of quality may therefore face a trade-off presented by using observable measures or subjectively reported perceptions of quality. Objective measures of quality are often largely a function of the researcher's subjective appraisal of the properties of quality within a given recreation experience. Alternatively, although a survey-based reported subjective measure rating or ranking quality may be intrinsically correct, in its typical representation it does not reflect its contingent nature or the information content of the measure. The information content of either objective or subjective measures of quality may, however, be improved by evaluating quality in terms of a latent variable, an approach widely recognized in the psychometric literature (De Leeuw et al).

Many concepts in the social sciences, including economics, are widely used and understood although they are not readily observable. For example, in psychology, *verbal ability* is often discussed as it relates to *intelligence*, both unobservable concepts. Sociologists often refer to concepts of *prejudice*, *social status*, and *ambition* which are similarly unobservable variables. Economists often consider *price expectations* or *human capital.* These and similar variables are not directly observable but used in research constructs devised for the purpose of better understanding concepts for which there are no operational methods for direct measurement (Everitt). Although these latent variables are not directly observable, some of their effects on measurable or manifest variables are observable, and hence subject to analysis (Bentler and Weeks; Burt; Fornell and Larcker; Hula et al.; Kenny and Greenberg). Dijkstra notes that these latent variables are typically measured with error or that they do not directly correspond to anything observable. In this case, more than one observable variable is needed to capture the concept's "true" meaning.

Economists often describe quality in recreation experiences in terms of a single variable which at best represents a proxy for quality, which is itself a psychological construct reflecting characteristics, properties, or attributes. For example, degree of congestion has frequently been used as a quality indicator in recreation research (Miller et al.; Deyak and Smith; Walsh et al.). Quality, however, can be more

descriptively presented in terms of a latent variable that, although it is not directly observable, is reflected through a number of other manifest variables, including, for example, congestion, which can reflect social group influences as well as internal feelings.

QUALITY AS A LATENT VARIABLE: A CONCEPTUAL MODEL

Quality can be conceptualized as a latent variable which is unobservable but is reflected through other attributes, properties, or characteristics. In the context of fee-based recreation activities where a fee is paid for access, quality might, for example, influence the price recreationists are willing to pay. Alternatively, perceptions of quality may be influenced by access fees charged by landowners. Specifying quality as a latent variable within this framework provides the opportunity to further evaluate other contributors to quality. This framework is, however, complicated by the interdependency that potentially exists between quality and price.

An appropriate conceptual approach to hypothesized interdependence is to acknowledge it explicitly with feedback loops in the formulation, requiring estimation of simultaneous equation systems (Judge et al.). Conceptually, this simultaneous system can be represented as a two equation system where, for example, Y_1 and Y_2 represent dependent variables such as a recreation access fee and quality (respectively). When specified as a set of structural equations, this framework can characterize the economic theory underlying each endogenous variable by expressing it in terms both of endogenous and exogenous variables. Regarding this framework as a system will allow recognition of feedback loops (Studenmund and Cassidy).

Other exogenous variables hypothesized to influence the prices paid for recreation access might include travel time, landowner provided services, acreage provided through the lease, an index of game diversity on the lease, and wildlife density. Spatial factors, including location of the lease, could additionally influence prices paid for recreation access. The hypothetical relationship among these factors therefore characterizes factors influencing the prices paid for leasing recreation access while a second equation reflects quality, a latent variable, which is in turn influenced by access price and other variables.

AN EMPIRICAL MODEL

Based on this conceptual model, the following empirical model can be specified in order to evaluate fee access prices paid for a specific recreation activity such as deer hunting and the recreationist's perception of the quality of the activity.

$$(1)\ PRICE = \alpha_0 + \alpha_1 ACPERMEM + \alpha_2 TRAVTIME + \alpha_3 DIST4 + \alpha_4 DIST1 + \alpha_5 SERVICE + \alpha_6 QUALITY + \varepsilon$$

$$(2)\ QUALITY = \beta_0 + \beta_1 PRICE + \beta_2 SHOOTAT + \beta_3 GAME + \beta_4 DENSITY + \varepsilon$$

where:

PRICE (-)	= Total lease price paid by members
ACPERMEM (+)	= Acres of lease per club member
TRAVTIME (-)	= Travel time from member's home to lease (one way)
DIST4 (+)	= Lease location in LDWF District IV, measured as a 0-1 indicator
DIST1 (-)	= Lease location in LDWF District I, measured as a 0-1 indicator
SERVICE (+)	= Landowner provided services; measured as a 0-1 indicator
QUALITY (-)	= Lease quality; measured as members per acre, squared
SHOOTAT (-)	= Number of trips to lease with opportunities to shoot at a deer
GAME (-)	= Index of small game species diversity on lease
DENSITY (-)	= Big game density; deer population/lease acreage

In this specification, price is hypothesized to be influenced by spatial factors (DIST I, DIST IV), existence of owner provided services (SERVICE), the acreage available to club members (ACPERMEM), the time required to travel to the lease from a member's home (TRAVTIME), and an indicator of lease quality (QUALITY). Quality is at the same time hypothesized to be influenced by biological factors (GAME and DENSITY), a measure of skill and hunter effort (SHOOTAT), and the price paid for the lease (PRICE).

PRICE, the dependent variable in (1), is specified as total price paid by the hunting club for access rights. A greater acreage per hunter was hypothesized to positively influence prices paid by clubs, as was the location of these acres in a preferred location such as District IV. Travel time, an additional implicit cost to club members, was hypothesized to be inversely related to the price of lease, as was location in a less preferred location such as District I. District VI was omitted as the control dummy variable for

location. Additional owner-provided services, including for example, housing, road maintenance, posting, and liability insurance were hypothesized to increase the price of a lease. In this specification, the presence of owner provided services, represented as a 0-1 combination, was hypothesized to be positively related to price.

The specification of QUALITY as a latent variable in (2) in this model is based in part on the established role of congestion in recreation experiences. Hunting and many other related outdoor recreation activities are recognized as social endeavors. The very basis of a hunting club is the companionship shared as well as the ability to combine financial and other resources in order to obtain more or better recreation access. However, although the social component of hunting is acknowledged, companionship becomes congestion after a threshold number of companions is reached. As a result, quality is represented by a measure of congestion (squared to account for its nonlinearity) and evaluated as a latent variable related to other lease characteristics. Because quality is represented by a manifest variable, in this example, congestion, measurement error can be introduced, raising doubt about the consistency of model estimates. Including a measurement model which specifies

(3) CONGESTION = λ (QUALITY) + ζ

where ζ represents the measurement error is one approach to addressing this issue. If Var(ζ) is known, estimates can be disattenuated by subtracting Var(λ) from the Var(CONGESTION). Using this disattenuated covariance matrix of the dependent variable, one can obtain the set of disattenuated, i.e., measurement-error free, and consistent estimates. However, in most empirical applications, as here, the variance of the measurement error Var(ζ) is not known *a priori*. One approach is to estimate the error variance directly from the data, assuming that there are two or more indicators for the latent variable. In this illustration, with only one indicator of the latent variable, the conceptual issue is acknowledged but not empirically addressed.

In keeping with the simultaneous, latent variable framework, this measure of quality was hypothesized to be inversely related to lease price, as lower congestion levels on the lease would be expected at higher lease prices. Leases with higher levels of quality (lower levels of congestion) were hypothesized to be positively associated with biological indicators of better lease quality, including big game density (DENSITY) and GAME, indicating the diversity of small game species, including other prized game such as quail, on the lease. In addition, leases with higher quality should theoretically offer club members more opportunity to harvest game: therefore, SHOOTAT, a variable which includes opportunity but recognizes individual ability, was included in the simultaneous model specification.

DATA

Primary data were collected through a 1989 mail survey of hunting clubs which participated in the Louisiana Department of Wildlife and Fisheries (LDWF) administered Deer Management Assistance Program (DMAP) during the 1987-1988 deer hunting season. The mail questionnaire was designed to obtain information on the physical and biological characteristics of the leased land, services, facilities, and hunting activities associated with the lease, and the socio-economic attributes, attitudes, and perceptions of the respondents. LDWF, which has divided the state into eight game management districts, is responsible for management of Louisiana's wildlife. LDWF provided the addresses of contact persons in DMAP participating hunting clubs from Districts I, IV, and VI. District I in the northern region of the state is mostly pine woodland, while District VI is primarily wetland and agricultural land. District IV, which contains old growth bottom land hardwood and agricultural land is considered by LDWF to be the best deer hunting area in Louisiana. Prices paid per acre by clubs tend to reflect this perceived quality difference. These districts were chosen from among the eight because of their distinctly different wildlife habitats, geographic location, and proximity to population centers.

Dillman's Total Design Method (TDM) for mail surveys was employed in conducting the survey. Dillman developed the TDM as a cost-effective method for maximizing response rates for mail surveys, and Ballweg has more recently reviewed and updated the design method. The overall response rate for this survey was 67 percent. Complete, usable responses to the survey allowed for a sample size of 251 observations for this empirical analysis.

EMPIRICAL RESULTS

The theoretical model was empirically estimated using the Statistical Analysis System (SAS) via the two-stage least squares (2SLS) procedure. This procedure systematically creates instrumental variables to replace the endogenous variables where they appear as explanatory variables in simultaneous equations systems, thereby reducing simultaneity bias

Tabel 1. Descriptive Statistics of the Variables Used in the Analysis[a]

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
PRICE	6,179.1315	8,492.0975	100.0000	65,000.0000
TRAVTIME	0.77268	0.95325	0.25174	6.4286
DENSITY	0.10044	0.13364	0.01000	1.0000
GAME	4.1992	1.3150	1.0000	7.0000
ACPERMEM	126.6748	164.7355	6.1224	1,316.0000
QUALITY	0.00050	0.00232	0.00000	0.02668
SHOOTAT	8.4480	10.4272	0.0000	80.0000

[a]N = 251

(Judge et al.). Descriptive statistics of the model's variables are presented in Table 1, and results of the empirical estimation are presented in Table 2.

The empirical results presented in Table 2 suggest that the hypothesized interdependence between price and quality does exist. This model specification results in a statistically significant F-value of 6.454 and 6.69 for equations 1 and 2.

QUALITY displays the hypothesized sign and its estimated coefficient is statistically significant at the .05 level. As hypothesized, lower lease prices are paid for lower levels of quality. Lease prices in this model are also sensitive to location as represented by the two LDWF Game Management Districts. Higher lease prices are paid for leases in the superior habitat of District IV, while lower prices are paid for leases in District I, which is comprised of less desirable big game habitat. The estimated coefficients for both location explanatory variables display the hypothesized sign and are statistically significant.

TRAVTIME displays the hypothesized sign but its estimated coefficient is not statistically significant, suggesting that while club members are willing to pay higher lease prices for leases with lower travel time, this is not a significant contributor to the variation in lease prices. The variable reflecting owner provided services, SERVICE, was hypothesized to be positively related to lease prices. Although the estimated coefficient for SERVICE was not statistically significant, it displays the hypothesized relationship to lease prices. In the leasing market which currently exists in Louisiana, club members may value other lease attributes such as acreage or location more than optional owner provided services.

In the second equation, quality is dependent on lease price, which has the hypothesized sign and is significant at the .10 percent level. While both of the coefficients estimated for the explanatory variables describing lease attributes are statistically significant at the .05 percent level, DENSITY does not display the hypothesized sign. Quality does appear to be a function of game variety, which spreads recreational opportunity across other hunting seasons. SHOOTAT, the variable combining hunter skill level with opportunities to harvest game, demonstrates the hy-

Table 2. Two Stage Least Squares Model Coefficient Estimates of Simultaneous Relationship Between Lease Price and Quality Specified as a Latent Variable

Variable	Equation (1) Price	Equation (2) Quality
INTERCEPTS	6,664.7311 (3.462)	0.00264 (2.383)
ACPERMEM	8.5648 (2.243)	
TRAVTIME	-380.3497 (-0.490)	
DIST4	6,611.4045 (2.508)	
DIST1	-3,536.9713 (-1.981)	
SERVICE	1,398.93438 (0.435)	
QUALITY	-781,741.68 (-1.677)	
PRICE		-1.02848E-07 (-1.523)
SHOOTAT		-0.000015588 (-0.441)
GAME		-0.000492745 (-2.052)
DENSITY		0.01085644 (4.069)
R-SQUARE	0.27	0.20
ADJUSTED R-SQUARE	0.23	0.17
NO. OF OBSERVATION	251	251
F-VALUE	6.454	6.691

pothesized sign but its coefficient is not statistically significant.

SUMMARY AND CONCLUSIONS

Recreation trends indicating an increasing demand for quality recreation experiences suggest the need for special consideration of quality in analyses of fee access recreation. As private landowners and public resource managers compete in an increasingly sophisticated market for recreation access, quality may emerge as a prime determinant of consumer choice. Emerging recreation access markets based on ecotourism and other nature-based recreation are cases in point (Whelan). Consumer profiles of participants in these relatively new recreation and tourism markets consistently stress quality as a prime determinant of demand. As these markets mature with other, more traditional fee-based recreation access markets, it is reasonable to expect a consistent demand for quality.

Efforts to expand the usefulness of characteristic-based analyses of recreation choices that include quality as an explanatory factor can benefit from the theoretical and empirical framework presented here. For example, more explicit recognition of the objective and subjective characteristics of quality in the context of recreation experiences suggests that researchers must more thoughtfully define and measure quality in order to avoid model misspecification, including those of hypothesized interactions between observable and latent variables.

By viewing quality as a subjective latent variable, this paper has used a simultaneous equation framework to evaluate the relationships between quality and other lease attributes in a fee-based recreation access analysis. Empirical results from the hunting club example presented here indicate that lease price and quality appear to have interdependence captured by the simultaneous system. In addition, the latent variable quality, specified as a measure of lease congestion, is influenced by a number of lease characteristics, hunter skill, and lease price.

A simultaneous equation framework appears to offer the potential of capturing the interaction of quality and other observable variables, including price. Data permitting, the ability to estimate a measurement model will undoubtedly conceptually and empirically strengthen the results of this model. This framework is, in addition, adaptable to publicly provided recreation access through use of common proxies for price, including travel time. In conclusion, consideration of quality as a latent variable provides researchers the framework to address the growing importance of this explanatory variable in fee-based recreation.

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