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A Link Between Behavior, Information, and Existence Value

JOHN C. WHITEHEAD

Department of Economics
East Carolina University
Greenville, NC 27858-4353

GLENN C. BLOMQUIST

Department of Economics
University of Kentucky
Lexington, KY 40506-0034

Abstract *The paucity of implicit markets and observable behavior that reveals existence value has raised questions about the validity and importance of existence value. A model of existence value with information is developed to show how past behavior leads to information that generates existence value. The authors find that information is acquired via observable behavior and willingness to pay depends on acquired information. This link between information acquisition through behavior and formation of existence values strengthens the notion that existence values are derived from observable behavior.*

Keywords Existence value, contingent valuation, dichotomous choice, wetlands preservation.

Introduction

In benefit cost analysis, total resource preservation value is the benefit measure that is compared to the costs of preservation. Total value is the sum of resource use and nonuse values. Resource use value (i.e., outdoor recreation) can be measured with both revealed behavior approaches and the contingent valuation method (Cummings, Brookshire, and Schulze 1986; Mitchell and Carson 1989).[1] Nonuse values include existence value, the value of utility gained from the knowledge of resource existence (Krutilla 1967), which can only be measured with the contingent valuation method (Bowker and Stoll 1988; Boyle and Bishop 1987; Brookshire, Eubanks, and Randall 1983).

The use of the contingent valuation method to measure existence values, with no comparison with revealed behavior approaches, generates concerns about the validity of existence values (Boyle 1989).[2] Studies that estimate existence value typically state that existence values are unrelated to any observable behavior.[3] The supposed lack of observ-

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able behavior associated with existence value contributes to validity questions raised with the use of contingent valuation.

In the initial definition of existence value, Krutilla (1967) argued that simply the knowledge that a resource exists is a sufficient condition for economic value to flow from resource preservation. This implies that a necessary condition for existence value is that information about a natural resource (knowledge of resource existence) has been acquired in some way. Without information about a natural resource, no existence values are plausible for that natural resource.

Information acquisition opens the possibility of finding a relationship between observable behavior and existence value. Information is acquired through observable behavior such as on- and off-site use of natural resources.[4] When pursuing on- and off-site activities, households purchase market goods related to resources and obtain information about natural resources. Once information about natural resources is acquired, households are able to gain utility from the knowledge of resource existence.[5]

The purpose of this article is to explore the link between observable behavior, information about natural resources, and existence values for resources by adapting the Randall and Stoll (1983) household production model to include information and testing implications of the model using behavior, information, and value data obtained from a contingent valuation survey. The behavior-information-value link suggests that existence values result from observable behavior, or trade-offs among economic goods based on individual benefits and costs, which strengthens the idea that existence values are economic values. An important implication of this link is that information involving natural resources is necessary for a household to gain utility from the knowledge of resource existence.

A Model of Information Acquisition and Existence Value

In a Randall and Stoll (1983) household production model, households gain utility

$$U = U(Z_Q, Z_X) \tag{1}$$

from the consumption of activities that are produced according to household production functions

$$Z_Q = f(V_Q, X_Q, Q, T) \tag{2}$$

$$Z_X = f(\mathbf{X}, T) \tag{3}$$

where $U(\cdot)$ = utility function
Z_Q, Z_X = activities that generate utility
V_Q, X_Q = purchased goods
Q = natural resource
T = time input, and
$\mathbf{X}$ = vector of all other market goods.

The first type of activity (Z_Q) is one that requires use of the natural resource (Q) and visits to the resource (V_Q) or the purchase of market goods related to the resource (X_Q). The second type of activity that generates utility (Z_X) requires only use of market goods ($\mathbf{X}$) that are unrelated to the natural resource.

Households are also able to gain utility directly, instead of indirectly through Eq. (2), from the natural resource if information about the resource has been acquired. For instance, suppose a household gains utility by pursuing on- or off-site use of the natural resource. This requires purchase of visits to the resource or related market goods (e.g., magazines). The interaction of market behavior and the existence of the natural resource generates information about the resource, I_Q. Behavior related to the natural resource could be experienced in past time periods or the present so that

$$\begin{aligned} I_Q &= 1 \quad \text{if } V_{Qt} > 0 \text{ or } X_{Qt} > 0 \\ &= 0 \quad \text{otherwise} \end{aligned}$$

where I_Q = 1 indicates information about resource has been acquired
I_Q = 0 indicates no information has been acquired, and
t = time period in which the activity occurred.

The t subscript on visits and market goods indicates that either behavior could have occurred in past time periods.

If information about the natural resource leads to appreciation of the resource for its own sake, utility may be increased by simply knowing that the resource exists in its natural state. The utility function that includes knowledge of resource existence is

$$U = U(Z_Q, Z_X, Q | I_Q = 1) \tag{4}$$

where the marginal utility of the natural resource, without use, is positive ($MU_Q > 0$).[6] A necessary condition for the household to gain utility from the knowledge of resource existence is that information about the natural resource has been acquired. If $I_Q = 0$, then $MU_Q = 0$.

Households are constrained by both time and money income. A combination of these constraints may be expressed as

$$Y = P_Q X_Q + C_Q V_Q + \mathbf{PX} + wT \tag{5}$$

where Y = full income including time resources
P_Q = market price
C_Q = travel costs to resource site
$\mathbf{P}$ = vector of market prices, and
w = wage rate.

Assuming labor time is not a choice variable, households with information about the resource minimize expenditures (Eq. (5)) to obtain a fixed level of utility (Eq. (4)) and find

$$e = e(P_Q, C_Q, \mathbf{P}, Q, U | I_Q = 1) \tag{6}$$

where $e(\cdot)$ is the expenditure function. The expenditure function measures the minimum amount of money necessary to achieve a fixed level of utility. The natural resource appears in the expenditure function as an unpriced good if information about the resource has been acquired in past or current time periods.

For households that have never pursued activities related to the natural resource (and do not intend to in the current time period), the relevant utility function is

$$U = U(Z_X|I_Q = 0) \quad (7)$$

where on- and off-site use are not observed, so that $Z_Q = 0$ and does not appear in Eq. (7). Households with no information about the natural resource minimize expenditures

$$Y = \mathbf{PX} + wT \quad (8)$$

subject to the constraint that utility is fixed. The resulting expenditure function is

$$e = e(\mathbf{P},U|I_Q = 0) \quad (9)$$

where the expenditure necessary to maintain the fixed utility level does not depend on the natural resource.

Consider an environmental policy that would allow development of the natural resource. The total value of resource preservation is

$$WTP^T = e(P_Q,C_Q,\mathbf{P},Q = 0,U|I_Q = 1) - e(P_Q,C_Q,\mathbf{P},Q = 1,U|I_Q = 1) \quad (10)$$

where WTP^T = change in expenditure necessary to maintain utility level after development of resource (total willingness to pay)
$(Q = 0)$ = resource after development, and
$(Q = 1)$ = preserved resource.

Equation (10) allows household value to be decomposed into use and existence value (Madariaga and McConnell 1987; Smith 1987).[7] Existence value is willingness to pay for natural resource preservation when no use takes place

$$WTP^E = e(P_Q,C_Q^*,\mathbf{P},Q = 0,U|I_Q = 1) - e(P_Q,C_Q^*,\mathbf{P}, Q = 1,U|I_Q = 1) \quad (11)$$

where WTP^E is the change in expenditure necessary to maintain the utility level after development of the resource without use and C_Q^* is the reservation (choke) price for on-site use of the natural resource.[8]

The paramount implication of this model is that only those households that have acquired information about the natural resource can possess existence values for resource preservation. Substitution of Eq. (9) into (11) would show that $WTP^E = 0$ for households that have never acquired information about the resource. Households that do not have information do not feel a utility loss and therefore will not be willing to give up anything of value to prevent development of the natural resource. The economic value of the loss is zero.[9]

Testing the Behavior, Information, and Value Link

The competition between surface coal mining and wetland preservation in Kentucky provides a case study for the behavior-information-value link test. The western portion of Kentucky along the lower Ohio River and within the western Kentucky coalfield contains wetlands dominated by bottomland hardwood forests. Preserved wetlands provide wildlife habitat, water purification, and flood control, among other benefits. Surface coal mining is an alternative use of these wetland areas. The Clear Creek wetland is the largest bottomland hardwood forest wetland in the western Kentucky coalfield.

Clear Creek wetland is not a nationally unique natural resource (such as the Grand Canyon or bald eagles), but it may be a regionally unique resource because of its size.[10] The Clear Creek wetland was chosen as a valuation case study because it is not known statewide for its recreational uses. Total values generated by a contingent market for preservation of Clear Creek wetland may be dominated by existence values.

The link between observable behavior (such as past resource-related activities) and information, and between information and existence values provides an indirect test of the relationship between observable behavior and existence values for the Clear Creek wetland. The test is performed by first identifying the determinants of participation in wetland resource-related activities. This will indicate if observable behavior is dependent on individual benefits and costs. Next, we identify the determinants of household information about the wetland resource (such as resource use). Finally, we measure existence value (WTP^E) for the Clear Creek wetland across groups of survey respondents who have acquired information about the resource and those who have not. According to the theory developed in the preceding section, households that have no information will not have existence values, and households that have information may have positive existence values.

A survey was designed to collect wetland activity participation, wetland information, and socioeconomic variables and measure willingness to pay for preservation of the Clear Creek wetland. Survey respondents were asked about their previous knowledge of all wetlands in western Kentucky and how it was acquired. For instance, watching television and reading newspapers or magazines about western Kentucky wetlands constitutes past off-site use. Hunting, fishing, observing, or photographing nature in western Kentucky wetlands constitutes past on-site use.

Participation in activities and on- and off-site use of western Kentucky wetlands depends on benefits and costs of participation. Benefits are the utility gains received from participation and are unobserved. Participation equations are specified as

$$\pi(V_Q) = f(S,D_Q) \tag{12}$$

$$\pi(X_Q) = f(S,D_Q) \tag{13}$$

where π = probability of activity being observed behavior
V_Q, X_Q = 1 if activity is observed and 0 otherwise, and
S = socioeconomic characteristics
D_Q = distance to resource site.

Socioeconomic characteristics control for the type of household that would receive benefits from activity participation. Costs of on-site use are the travel costs of trips to the resource site. These costs are captured by distance to the Clear Creek wetland. Costs of off-site use are the prices of market goods and time costs of searching for and using them. Increasing distance from the resource site is assumed to lead to higher search costs for information about the resource (Sutherland and Walsh 1985).

Information is acquired by participating in natural resource-related activities. The probability of information being acquired depends on revealed behavior and socioeconomic characteristics that determine household production technology. Information acquisition equations are specified as

$$\pi(I_Q) = f(S, V_Q, X_Q) \tag{14}$$

where $\pi(I_Q)$ is the probability of information about Q. On- and off-site use of wetlands is expected to increase the probability of information.

The contingent valuation (CV) portion of the survey instrument describes the functions and benefits of wetlands, alternative uses of wetlands, the current level of provision of wetlands in Kentucky, and the potential development of wetlands for surface coal mining. Survey respondents are informed that Clear Creek has been proposed for public acquisition, financed through a voluntary Wetland Preservation Fund, and the preservation cost is $\$A$ for each Kentucky household. A dichotomous choice valuation question is then presented: "Would you be willing to contribute $\$A$ each year, out of your own household budget, to the Wetland Preservation Fund to preserve the Clear Creek wetland? $\$A$ is a randomly assigned policy price that, if paid by all households, would finance the acquisition and management of the resource and avoid development.[11]

The dichotomous choice contingent market creates the following choice problem for the household:

$$A \lesseqgtr WTP^T \qquad (15)$$

where WTP^T is obtained from Eq. (10). If the policy price is greater than willingness to pay the household will respond NO. If the policy price is less than willingness to pay, the household will respond YES.

Estimation of willingness to pay with dichotomous choice CV data is accomplished using the Cameron (1988) censored logistic regression technique. The probability of a YES response in the dichotomous choice market is

$$\pi(\text{YES}) = \pi(WTP^T + \epsilon \geq A) = \pi(WTP^T - A \geq \epsilon) \qquad (16)$$

where WTP^T is unobserved (but is indicated by a YES or NO response) and ϵ is a mean zero error term. Assuming ϵ is distributed logistically, empirical implementation of Eq. (16) results in a logistic regression model

$$\pi(YES) = \{1 + \exp(-(\alpha + \beta A + \gamma S))\}^{-1} \qquad (17)$$

where α, β, and γ are estimated coefficients. Cameron (1988) showed that an estimate of WTP for each observation in the data set can be uncovered from Eq. (17) by a transformation of the estimated coefficients

$$W\hat{T}P^T = \alpha/\beta + (\gamma/\beta)S \qquad (18)$$

where $W\hat{T}P^T$ is predicted willingness to pay. The resulting predicted willingness-to-pay data set can be used for testing the link between information and existence value (Loomis 1990; Milon 1989).[12]

Empirical Results

A systematic random cluster sample was drawn from telephone directories according to the technique described in Sudman (1976). The Dillman (1978) mail survey procedure was followed during the summer of 1989. A response rate of 31% was achieved after a postcard follow-up and a follow-up mailing of the survey instrument. After deleting observations with nonresponses, a sample size of 219 households remained for the empirical analysis. This sample size is 4 or 5 less for some of the regressions because of nonresponse. In Table 1, means and standard deviations of variables are presented. Socioeconomic characteristics included in the analysis are number of children, gender, age or respondent, years of education, hourly wage, and respondent membership in environmental and conservation organizations. Comparison of characteristics of respondents and a sample of nonrespondents suggests no obvious differences.[13]

Table 2 shows results of activity participation Eq. (12) and (13), which are estimated using a maximum likelihood logistic regression procedure (Amemiya 1981). Measures of goodness-of-fit presented are the chi-square and McFadden's R^2 statistics (Amemiya 1981).[14] The dependent variables are the log odds of each type of use.[15] Education increases the probability of both on- and off-site use of wetlands. Increases in household distance from Clear Creek (costs of a recreational trip) decreases the probability of on-site use of wetlands. Environmental group membership increases the probability of off-site use of wetlands. This is consistent with the finding that one of the major benefits of group membership is the literature about natural resources that accompanies it (Dennis and Zube 1988). In this case the literature the environmental group provides may include information about wetlands. These results support the theory that households engage in observable behavior based on individual benefits and costs when pursuing activities that may lead to wetlands information acquisition.

Logistic regression results of the information acquisition Eq. (14) is presented in Table 3. The major finding is that activity participation (observed behavior) increases the probability that information about wetlands has been obtained. On- and off-site use are the most important determinants of wetlands information acquisition. In addition to use, the number of children decreases and years of education increases the probability of information acquisition. The indirect effect of certain variables on the probability of information acquisition can be inferred if these results are combined with the results of Table 2. Higher education leads to greater probability that information about wetlands has been acquired, greater distances from Clear Creek decreases the probability, and membership in environmental organizations increases the probability.

The last step in testing the hypothesis of the behavior-information-value link is to split the sample according to information acquisition, measure the willingness-to-pay values for each subsample, and compare values to determine if observable behavior and characteristics that influence information acquisition lead to larger existence values. Table 4 presents logistic regression results of determinants of the log odds of a YES response to the dichotomous choice valuation question, Eq. (17). As expected, increases in the natural log of the policy price (costs of wetland preservation) decrease the probability of a YES response for both the information and no-information subsamples.[16] For both subsamples, environmental group membership increases the probability of a YES response. Older respondents were less likely to answer YES in the information subsample.

Households who had participated in on-site use of the Clear Creek wetland are deleted to calculate existence values for the Clear Creek wetland.[17] Existence values (WTP^E) for households with prior information about wetlands is \$17.48 ($n = 118$); for households with no information, existence values are \$5.56 ($n = 96$). These values are statistically different from zero at the 5% level using a Wilcoxon rank sum test ($t = 2.15$).[18] Combined with the results of Tables 2 and 3, households who live near Clear Creek (a greater chance of on-site use) and who are members of environmental groups (a greater chance of off-site use) are more likely to have existence values for preservation of Clear Creek wetland.[19]

Table 1
Summary of Survey Data

Variable	Mean[a]	Standard Deviation
Number of children	0.69	0.96
Gender (male = 1)	66.0%	—
Age	47.42	15.84
Education	13.62	3.36
Hourly wage[b]	$16.08	10.83
Environmental group member	24.7%	—
On-site use[c]	15.3%	—
Off-site use[d]	35.8%	—
Miles from Clear Creek	139.89	68.05

[a]Sample size = 219.
[b]Assuming 2000 annual work hours.
[c]Equal to 1 if respondent had visited a wetland area in western Kentucky.
[d]Equal to 1 if respondent had watched television or read a magazine or newspaper about a wetland area in western Kentucky.

Table 2
Determinants of Activity Participation

Variable	On-Site Use	Off-Site Use
Constant	−2.330***	−1.438
	(1.89)[a]	(1.56)
Number of children	0.239	−0.102
	(1.06)	(0.58)
Gender (male = 1)	−0.170	0.110
	(0.35)	(0.31)
Age	−0.011	−0.016
	(0.68)	(1.50)
Education	0.171**	0.109**
	(2.41)	(2.16)
Hourly wage	0.0009	0.008
	(0.04)	(0.52)
Environmental group member	0.489	1.024*
	(1.08)	(3.02)
Miles from Clear Creek	−0.012*	−0.002
	(3.67)	(0.95)
Sample Size[b]	214	214
Chi-squared	23.88* (7 df)	23.19* (7 df)
McFadden's R^2	.130	.083

[a]Asymptotic t-ratio in parentheses.
[b]Less than 219 due to nonresponse.
*, **, and *** indicate significance at the .01, .05, and .10 levels.

Table 3
Determinants of Information Acquisition

Variable	Information
Constant	−2.631**
	(2.26)[a]
Number of children	−0.535**
	(2.11)
Gender (male = 1)	0.508
	(1.18)
Age	−0.0005
	(0.03)
Education	0.108***
	(1.66)
Hourly wage	0.011
	(0.53)
Environmental group member	0.234
	(0.49)
On-site use	2.84*
	(3.44)
Off-site use	3.93*
	(5.97)
Sample Size[b]	215
Chi-squared	126.28* (8 df)
McFadden's R^2	.427

[a]Asymptotic *t*-ratio in parentheses.
[b]Less than 219 due to nonresponse.
*, **, and *** indicate significance at the .01, .05, and .10 levels.

Implications for Contingent Valuation Research

Participation in on- and off-site use of wetlands is determined by individual benefits and costs. On and off-site use of wetlands, membership in environmental groups, education, and proximity are characteristics that indicate the type of household with information about wetlands in western Kentucky. These characteristics profile the type of household that may possess a positive existence value. An empirical test of this hypothesis shows that households with information do have higher WTP^E values for preservation of the Clear Creek wetland in western Kentucky ($17.48) than households that do not have information ($5.56). These results suggest that existence values result from observable behavior. Households become environmental group members and travel to wetlands and obtain information about them. Households trade off something of value for knowledge of the existence of wetland resources.

Contrary to the definition of existence value developed in this article, households with no information about wetlands do express positive WTP^E values ($5.56)—not zero. There are at least two reasons for this result. Both reasons are based on common practice in contingent valuation research. The first reason is the natural log functional form chosen for the policy price variable in this, and many, dichotomous choice CV studies.

Table 4
Determinants of a YES Response to Valuation Question

Variable	Information	No Information
Constant	2.078	1.232
	(1.58)[a]	(0.66)
ln policy price	−0.523**	−1.019*
	(2.33)	(3.31)
Number of children	−0.178	0.187
	(0.70)	(0.64)
Gender (male = 1)	−0.320	0.690
	(0.68)	(1.21)
Age	−0.038*	−0.012
	(2.63)	(0.61)
Education	0.069	0.059
	(1.02)	(0.63)
Hourly wage	−0.028	−0.002
	(1.12)	(0.07)
Environmental group member	1.174*	1.528**
	(2.67)	(2.21)
Miles from Clear Creek	0.0005	−0.005
	(0.20)	(1.35)
Sample Size	123	96
Percent YES	42.3%	31.5%
Chi-squared	23.14* (8 df)	26.18* (8 df)
McFadden's R^2	.138	.220
WTP^{Eb}	$17.48 (118)	$5.56 (96)

[a]The asymptotic *t*-ratio is in parentheses.
[b]Calculated from Cameron (1988), sample size in parentheses.
* and ** indicates significance at the .01 and .05 levels.

This form constrains predicted willingness to pay to be positive when using the Cameron (1988) technique. The functional form forces respondents to have positive statistical existence values.

The second reason is that contingent valuation questionnaires themselves contain information about the natural resource in the contingent market. Through the course of the valuation exercise, survey respondents with no prior information about the natural resource (and no existence values) acquire information. Enough information is provided that respondents may form positive existence values for the resource and express a willingness to pay for resource preservation.

Insofar as the assertion that households with no prior information have no existence values is believed, contingent markets elicit some existence values that are not economic values (but may be the result of an environmental ethic[20]).

Empirically, this article addresses this assertion in an indirect way. A direct approach would attempt to answer: Are existence values that are measured in contingent markets with no (or a minimal amount of) information about a natural resource equal to zero for households with no prior information about the resource? Until this question is answered, contingent valuation studies that measure existence value should investigate whether the existence values expressed are linked to some type of observable behavior.

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Notes

1. Contingent valuation comparisons with implicit market, revealed behavior approaches have shown that estimates are both internally and externally consistent. For example Smith, Desvousges, and Fisher (1986) compared water quality values using both travel cost and contingent valuation techniques. Blomquist (1988) compared the value of lake views using hedonic housing and contingent valuation techniques.

2. In this article validity is the concern of some researchers that existence values may be just random and uninformed values that more reflect attitudes or ethical norms than economic values. This view was articulated by Daniel Kahneman, who suggested that "the use of (the contingent valuation method) should be restricted to user values, rather than to ideological values" (Cummings, Brookshire, and Schulze 1986, 190–193).

3. There are, however, at least two exceptions. Walsh, Loomis, and Gillman (1984) found that existence values for wilderness preservation increase with each wilderness recreation trip. Sutherland and Walsh (1985) found that existence values decline with greater household distance from the site.

4. In this article *on-site use* is defined as any activity that requires travel to the site of the natural resource, such as hunting, fishing, or nature observation. *Off-site use* is any activity that involves the resource but does not require travel, such as reading a newspaper or magazine article about the resource.

5. Other studies have discussed or identified this link between behavior and existence value. Randall and Stoll (1983) and Stoll and Johnson (1984) defined existence value in a household production framework. Households have existence value when a utility gain is experienced from a natural resource even though it is not combined with market goods. Past behavior associated with the resource is a necessary condition to acquire the technology necessary to gain utility from the resource in current time periods, without use. Smith and Desvousges (1986) discussed indirect use, which they refer to as vicarious consumption, as empirically indistinguishable from existence value. Their discussion suggests that existence values are values which result from the purchase of resource-related market goods.

6. The presence of information about the natural resource does not ensure that marginal utility of Q is positive. This depends on individual preferences. However, we proceed with the assumption that if $I_Q = 1$, then $MU_Q > 0$.

7. Given our model, an important choice must be made when defining use and existence value—whether to include off-site use value independently or as a component of use or existence value. Our definition of existence value includes off-site use value, because it can be practically measured only with the contingent valuation method.

8. Use value is willingness to pay to avoid a price increase that would exclude on-site use of the resource $WTP^U = e(P_Q, C_Q^*, \mathbf{P}, Q = 1, U|I = 1) - e(P_Q, C_Q, \mathbf{P}, Q = 1, U|I = 1)$. It can be shown that $WTP^T = WTP^U + WTP^E$.

9. For resources with small use values, existence values can be included in the economic damage estimate of a natural-resource damage assessment (Carson and Navarro 1988). This model suggests that only households that had information about the natural resource before it was damaged could have had existence values before the damage occurred.

10. Uniqueness is an attribute of resources that generate existence value (Krutilla 1967).

11. Dollar values used in the contingent market were determined in a pretest of the survey instrument that elicited open-ended willingness-to-pay values. The distribution of the open-ended responses was used to estimate policy prices. In this procedure, willingness-to-pay values are ranked from highest to lowest. The probability of that value being elicited from the population is estimated by dividing the rank of willingness to pay by the number of observations. Policy prices are then obtained by multiplying open-ended values with the corresponding probability. This procedure generated six policy prices (after rounding) for use in the contingent market ($\$A = 2$, 7, 9, 17, 23, and 50).

12. The linear functional form is used here for ease of presentation. In the next section, the policy price variable is specified in log form (lnA), which statistically outperformed other functional forms, such as the linear, in preliminary models.

13. An abbreviated, nonvaluation follow-up survey to nonrespondents was prompted after the sample seemed to overrepresent males and high-income households. This survey elicited another 67 responses. For the sample of nonrespondents, average number of children is .68; 48% are male; average age is 50.26; average education level is 12.86 years; average hourly wage is $19.20; and 22% are environmental and conservation group members. Contrary to prior expectations, reported income of nonrespondents is higher than that of respondents. As pointed out by a reviewer, even with this comparison, we cannot be sure that the existence values for respondents and nonrespondents are the same. See Whitehead (1991) for a discussion of potential nonrespondent self-selection bias in existence values.

14. The chi-square statistic tests the hypothesis that all regression coefficients are equal to zero. McFadden's R^2 is a scalar measure similar to the R^2 of ordinary least squares regression.

15. The log odds is $ln(\pi/(1-\pi))$ where π is the probability of on- or off-site use.

16. The natural log is used because it statistically outperforms other functional forms. The distribution of the log of the policy price variables is similar in both subsamples. For the information (no-information) subsample the mean of lnA is 2.39 (2.33), and the standard deviation is 0.95 (0.98).

17. This delineation of existence and use values may underestimate existence values by not including those held by current resource users (Loomis 1988), but it avoids double counting that may lead to overestimation of total willingness to pay. Because a small percentage of the sample revealed on-site use of the Clear Creek wetland, this underestimation is considered small.

18. This nonparametric test is used because the willingness-to-pay data is distributed nonnormally. See Freund and Walpole (1981).

19. The indirect relationship between existence value and distance is a point of departure from the results of Sutherland and Walsh (1985), who found a direct relationship between existence value and distance. The two results are similar in that increased distance from the resource will lower existence value. However, this is not to say the distance-existence value relationship (whether indirect or direct) holds for nationally unique resources such as the Grand Canyon for which information is abundant and low cost.

20. Households may have an environmental ethic and feel that expressing an existence value is the right thing to do (Brookshire, Eubanks, and Sorg 1986).

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