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Resource quality information and validity of willingness to pay in contingent valuation

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Abstract

Elicitation of valid statements of contingent value requires survey participants who are familiar with the environmental resource change. A primary purpose of the contingent market must be to assure familiarity by providing information. Information about resource quality is important when incompletely informed respondents, say nonusers, perceive resource quality which diverges from true quality. Differences in perceived quality and true quality can be influenced as respondents learn from information in the contingent market. By presenting survey participants with information about four wetlands of varying qualities we test for information effects in a dichotomous choice contingent market for wetlands allocation. We find that information about quality is a determinant of willingness to pay for wetland preservation. Information about resource quality presented in contingent markets will result in more valid valuations of changes in allocations of environmental resources. © 1998 Elsevier Science B.V.

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1. Introduction

In order to elicit construct valid measures of willingness to pay (WTP) for preservation of a environmental resource using the contingent valuation (CV) method, contingent market participants must be familiar with environmental resource quality. Construct validity is the degree that the WTP measure is related to quality in ways predicted by theory (Carmines and Zeller, 1979). Tests for construct validity of WTP in CV research are of two types (Mitchell and Carson, 1989). Convergent validity tests are for correlation in WTP measured with the CV method and WTP measured with implicit market methods (see Loomis et al., 1991; Blomquist, 1988). Theoretical validity tests determine whether WTP is related to measures, such as environmental resource quality, which theoretically affect WTP.

Information presented in contingent markets can be used to test for theoretical validity. Randall et al. (1983) and Randall (1986) argue that information that changes survey respondents' true WTP for environmental resources should change stated WTP. Hoehn and Randall (1987) develop a theory which shows that information presented in contingent markets enhances communication about policy effects, reduces respondent uncertainty and the divergence between formulated WTP and true WTP. Additional information presented in contingent markets, if true, generates a desirable information effect. This theory is supported empirically in Bergstrom et al. (1989).

Some contingent market participants will have little prior information about environmental resource quality and can be expected to formulate WTP based on incomplete information. A primary purpose of the contingent market must be to provide information so that participants can make more valid WTP statements. Decisions about the amount and type of information contained in contingent markets is a major contingent market design issue. In this paper we view respondents as learning about resource quality through contingent markets similar to people learning about risk according to Viscusi (1989) prospective reference theory. We examine the effects of resource quality information on WTP in the context of a theoretical validity test. Our data are for different types of Kentucky wetlands which may be surface mined for coal. Better understanding of the validity of CV for nonuse values has taken on even greater importance with the recent controversy surrounding natural resource damage assessment; see Kopp and Smith (1993), Hausman (1993) and Arrow et al. (1993).

2. Background

For an empirical measure of a theoretical construct, such as WTP, to be theoretically validated by information effects a pattern of consistent results across

CV studies must be found. There are now several papers which have established an 'information effects' literature within the general CV literature. This literature grew from the older 'information bias' literature (Cummings et al., 1986). These papers can be grouped according to the type of information that is the focus of the research. To make these differences clear, consider a standard consumer problem:

$$\max u(q_1, q_2, x) \text{ subject to } y = p' x \tag{1}$$

where u is utility, q_1 is an environmental resource, q_2 is a related environmental resource, x is a vector of market goods, y is income, and p is a vector of prices. Willingness to pay for preservation of q_1 is typically elicited.

Research which has contributed to the information effects literature has considered the effects on willingness to pay of information about p, y, the quality [1] of q_1, and the quantity of q_2. Related research includes Bergstrom and Stoll (1990), who consider the effects of too much information, and Whitehead and Blomquist (1991a) and Whitehead et al. (1995), who consider the effects of no prior information, on the performance of the CV method.

2.1. Information about income and relative expenditures

Bergstrom et al. (1989) considered the effects of information about budget constraints (y in Eq. (1)) and relative expenditures (p in Eq. (1)) on willingness to pay. Information was presented in increments to subjects in experimental markets. Information was about the household budget share of willingness to pay and the magnitude of willingness to pay relative to other household expenditures. This information was designed to help respondents formulate willingness to pay. Also included was information that provides incentives for statement of true willingness to pay. The experimental subjects increase stated willingness to pay in response to the entire information package. Information effects are thought to be beneficial.

Boyle et al. (1990) present information about changes in prices of substitute hunting activities and, in general, find no information effects. They point out that it is very difficult to ascertain what survey respondents perceive to be adequate substitutes suggesting that the information may have been extraneous. Loomis et al. (1994) find that additional information about budget constraints has no effect on willingness to pay.

2.2. Information about the quality of the resource

Bergstrom et al. (1985) present information, which restricts the benefits that respondents perceive they receive from the environmental resource (q_1 in Eq. (1)).

[1] This research should be contrasted against CV studies that focus on information about the quantity, or scope, of the resource to be valued (Boyle et al., 1994; Carson and Mitchell, 1995).

Empirically, the information effect is in the theoretically predicted direction and WTP is overstated without the restricted benefit information. Samples et al. (1986) develop a theory concerning endangered species valuation. Two tests show that information about species characteristics changes WTP in theoretically predicted ways. Bergstrom et al. (1990) develop a theoretical model of the effects of information about services provided by a environmental resource on WTP. Additional information about services increases WTP which is beneficial because perceived resource quality must have been lower than true resource quality without the provided information.

Boyle (1989) argues that effects of information about different environmental resources, as in the Samples et al. (1986) study, is not a useful information effect. While agreeing that information about different environmental resources should lead to differences in WTP, Boyle finds no information effects for information changes in the description of a trout management program. A reinterpretation of these results, however, does not lead to the same conclusion. The group sampled (trout anglers) by Boyle was likely to have good information about the resource (Brown trout) and would be less likely to be influenced by information presented in the contingent market.

2.3. Information about related environmental resources

Whitehead and Blomquist (1991b) develop a model which suggests that information about related environmental resources (q_2 in Eq. (1)) affects WTP. Empirically, WTP changes with information about different related environmental resources which can then be interpreted as substitute or complement goods. A conclusion is that if related goods are not presented in the contingent market and are not perceived to be present, willingness to pay may be misstated by respondents who are unfamiliar with the environmental resource. Loomis et al. (1994) also test whether reminders of substitutes should be included in contingent markets. They find that the additional information has no effect on willingness to pay for a sample of respondents that is relatively familiar with the proposed resource change. We argue that for unfamiliar respondents, however, information about related environmental resources is needed to ensure validity of willingness to pay (Whitehead and Blomquist, 1997).

3. Resource quality information in contingent markets

The effects of information appear to be desirable in that WTP will change in theoretically predicted ways. Evidence supports use of information presented in contingent markets to increase the theoretical validity of WTP. In this paper, we address the effects of information about differences in the quality (characteristics and services) of environmental resources on WTP. In Whitehead and Blomquist (1991b) we show the effects of information about related environmental resources on willingness to pay for a constant quality wetland. In that paper, the smaller, 1989 pilot study sample is split into three groups, with each group being presented different sets of information about related environmental resources. Differences in information about substitutes and complement environmental resources is the source of differences in willingness to pay. In this paper, the larger 1990 sample is split into four groups with each group presented different information about the quality of a single wetland. Information about related environmental resources is presented, but, is the same for each respondent. Information about resource quality is important when incompletely-informed survey respondents, especially nonusers of the resource, perceive resource quality that diverges from true quality.

3.1. Information and willingness to pay

True willingness to pay is the difference between consumer expenditures with a resource quality decrement and expenditures with no decrement:

$$\mathrm{WTP} = e(\theta'',u) - e(\theta^{\circ},u) \tag{2}$$

where WTP is ex-ante willingness to pay (the value of avoiding the decrement in resource quality), $e(\cdot)$ is the planned expenditure function [2], θ'' is resource quality after the decrement, θ° is preserved resource quality, and u is expected utility.

Our model of information effects on willingness to pay utilizes prospective reference theory which emphasizes the divergence between subjective, perceived risk and true, objective risk (see Viscusi, 1989; Smith, 1992). Our adaptation of prospective reference theory focuses on the divergence between perceived and objective resource quality. Willingness to pay statements made in contingent markets depend on the resource quality perceived by the CV respondent. Perceived resource quality, q, is the perceived amount of characteristics and services the

[2] The planned expenditure function is found as the solution to the expenditure minimization problem: min $p'x$ subject to $u = \pi u(x,\theta^{\circ}) + (1-\pi)u(x,\theta'')$, where p and x is the price and quantity of a composite commodity, π is supply side uncertainty about the existence of the environmental resource, and $u(\cdot)$ is the utility function (see Smith, 1987). Price, related environmental goods, and the probability are suppressed in the theoretical model for simplicity.

resource provides. It depends on objective quality, θ, and information about resource quality, I. This relationship can be assumed linear and written as:

$$q[\theta,I] = \beta\theta + \delta I \tag{3}$$

where $\beta > 0$ and δ are learning parameters, β for prior information and δ for information contained in contingent markets. The assumption that β is positive insures that perceived quality and objective quality are positively correlated.

A respondent who possesses perfect information about the resource, $q = \theta$, would have $\beta = 1$. When $\beta = 1$, further information, $I > 0$, could be ignored, $\delta = 0$, so that $q = \theta$ or cause information overload so that $q \neq \theta$ (Bergstrom and Stoll, 1990). For the imperfectly informed respondent without contingent market information $(I = 0)$, perceived quality will be less than or greater than objective quality when $0 < \beta < 1$ or $\beta > 1$, respectively. For wetlands, if prior to entering the contingent market the respondent has heard little but that mosquitoes breed in wetlands, then $\beta < 1$. If the respondent has heard little but that no part of the fragile ecosystem can be disturbed without severe consequences, then $\beta > 1$.

Recognizing that CV survey respondents state willingness to pay for perceived quality changes Eq. (2) can be rewritten as:

$$\text{WTP} = e(q''[\theta,I],u) - e(q^{\circ}[\theta,I],u) \tag{4}$$

and since $u = v(q^{\circ},m)$:

$$\text{WTP} = e(q'',v(q^{\circ}[\theta,I],m)) - m \tag{4$'$}$$

where $v(\cdot)$ is the indirect expected utility function and m is income.[3] The degraded resource quality, q'', is assumed constant for each respondent. The comparative static effect of changes in information about resource quality on willingness to pay can be found through differentiation of Eq. (4′). The effect of resource quality on willingness to pay is calculated by the partial derivative:

$$\frac{\partial \text{WTP}}{\partial q^{o}[\theta,I]} = \frac{\partial e}{\partial v}\,\frac{\partial v}{\partial q^{o}[\theta,I]} > 0 \tag{5}$$

which is positive since the marginal cost of utility is positive and the marginal utility of perceived quality is positive. Willingness to pay will increase (decrease) with increases (decreases) in perceived resource quality since increasing quality increases the utility loss associated with degraded quality.

Information about resource quality presented in the contingent market can lead

[3] The indirect expected utility function is one solution to the utility maximization problem: $v(q,m) = \max\ u(\cdot)$ subject to $m = px$, where prices and probabilities are suppressed for simplicity.

to either increases or decreases in perceived resource quality depending on the relationship between objective and perceived resource quality:

$$\frac{\partial \mathrm{WTP}}{\partial I} = \frac{\partial \mathrm{WTP}}{\partial q^o[\theta,I]} \frac{\partial q^o[\theta,I]}{\partial I} \frac{>}{<} 0 \tag{6}$$

and by substituting from Eq. (3):

$$\frac{\partial \mathrm{WTP}}{\partial I} = \frac{\partial \mathrm{WTP}}{\partial q^o[\theta,I]} \delta \frac{>}{<} 0. \tag{6'}$$

If perceived resource quality is less than objective resource quality, $\beta < 1$, $q < \theta$, information about resource quality will increase perceived resource quality, $\delta > 0$, and increase stated WTP toward the true WTP. If perceived resource quality is greater than objective resource quality, $\beta > 1$, $q > \theta$, information about resource quality will decrease perceived resource quality, $\delta < 0$, and decrease stated WTP toward the true WTP. In either case, the information effect is desirable in that WTP with perceived quality is closer to WTP with objective quality with additional information provided in the contingent market. The sign of δ will depend on the information content of the contingent market. Descriptions or claims which have no credibility will be dismissed, $\delta = 0$.

3.2. The contingent market for wetlands allocation

We examine the resource quality information validity test by considering the tradeoff between wetlands preservation and surface coal mining. Consider a situation in which a coal company has proposed surface mining a wetland area. The public policy concerning the proposed mining is either to allow mining of the area by approving a permit and setting reclamation and wetland restoration conditions or disapproving the permit. Disapproving the permit will preserve wetland resource quality. Approving the permit will result in a decrement in wetland resource quality.

The contingent market contains ecologically correct information describing the current status of wetland preservation in the western Kentucky coal field, benefits of wetland preservation, alternative uses of wetlands, and a policy scenario. The policy scenario describes a surface coal mining company that owns a portion of a wetland area. If surface mining occurs at the wetland area the functions (characteristics and services) of the wetland will be reduced. With mining the mined wetland and off-site land (that is not now wetlands) will be restored, in time, to freshwater marsh wetlands.

The dichotomous choice form of contingent valuation, which elicits ‘yes’ or ‘no’ answers to close-ended valuation questions, is used. The WTP format assigns implicit property rights to the coal company. The payment rule is voluntary contributions to a Wetland Preservation Trust Fund which would be established in

Kentucky for the sole purpose of preserving natural wetland areas. The policy implementation rule is introduced in the value elicitation question. The implicit implementation rule is that if a (randomly assigned) dollar amount is not donated to the Trust Fund by Kentucky households the wetland can not be purchased and it will be mined. Implementation of the wetland preservation policy implicitly requires majority approval. Dollar amounts assigned to survey instruments were determined from a pretest of a related survey instrument used in a pilot study. [4]

There are four versions of the survey instrument of which each household gets only one version. Each version contains a description of one of four wetland quality types found in the western Kentucky coal field. The contingent market of instrument version A contains a description of a freshwater marsh, version B contains a description of a temporarily flooded bottomland hardwood forest, version C a seasonally flooded bottomland hardwood forest, and version D a bald cypress swamp. A photograph of the wetland type and map of the area provides characteristics information such as aesthetic qualities, location, and relative size of the wetland.

A general description of wetland resource quality with and without mining is presented for all versions. This information includes (1) the wetland services: flood control, water quality improvement, fish and wildlife habitat, outdoor recreation opportunities; and (2) the related environmental resources: restoration of mined areas and alternative wetland areas in Kentucky. For each instrument version more detailed information about the characteristics and services of each wetland quality type is then presented. This information includes the extent (acreage) of the specific wetland quality type in the coal field, water regime (percent of the year that flooding occurs), the specific plant, fish, and wildlife species found in the particular wetland area, flood control ability and water quality

[4] While not implemented in Kentucky this type of special fund is active in other states, such as Tennessee and has been advocated and proposed before the Kentucky legislature. For these reasons a voluntary fund may be familiar to survey respondents. The dichotomous choice valuation question reads: ‘Suppose a Wetland Preservation Trust Fund is established in Kentucky. Money contributed to the Trust Fund will be used to purchase and manage 500 acres of the Clear (Flat, Cypress) Creek wetland which would be open to the public (photograph 1). If the Clear (Flat Cypress) Creek wetland is not purchased, it will be mined (photograph 2) and reclaimed after 10 years (photograph 3) as described above. Another 500 acres of land will be restored to marsh and donated to the Trust Fund. About US$ A each year from each Kentucky household will be need to purchase and manage the Clear (Flat, Cypress) Creek wetland. Would you be willing to contribute US$ A each year to the Wetland Preservation Trust Fund in order to purchase and manage the Clear (Flat, Cypress) Creek Wetland? (yes or no). Photograph 1 depicted the natural wetland, photograph 2 a surface coal mine, and photograph 3 a marsh area. Dollar amounts chosen were US$ $A = 3, 7, 11, 22, 49$. See Blomquist and Whitehead (1991) for a discussion of the pretest and procedure used to choose dollar amounts as well as results from the related pilot study. The survey instrument is available upon request from the authors.

improvement ability (see the Appendix for these descriptions).[5] Characteristic information includes the existing wetland acreage, water regime, and number of species. Service information includes the flood control function and water quality improvement function.

3.3. Hypotheses about information effects

We employ content analysis, which can be used to quantify textual communications (Weber, 1985), on the resource quality information contained in the contingent market. Characteristics and services of the wetland comprise the content communicated to survey respondents (see Appendix A). The qualitative content of the contingent valuation information is converted into a quantitative scale by assigning numbers to the textual communication. The scale is used to specify testable hypotheses.

In the four instrument versions the amount of yearly flooding content is assigned a 1 for a temporarily flooded wetland, 2 for a seasonally flooded wetland, and 3 for a permanently flooded wetland. Flora species content is equal to the number of tree species mentioned in the description of the wetland type. Flood control content is assigned 0 if the wetland provides no flood control, 1 if it provides ‘some’ flood control, and 2 if it provides ‘much’ flood control. Water quality improvement content is assigned 1 if the wetland provides ‘some’ water quality and assigned 2 if it provides ‘much’ water quality. Fauna species is the number of fish and wildlife species mentioned in the description. The resource quality information scale is constructed by summing quantitative information for each wetland quality type. The wetland information scale variable for the freshwater marsh (version C) is 7, temporarily flooded wetland (B) is 12, for the seasonally flooded wetland (C) is 13, and for the bald cypress swamp is 18 (D). Other qualitative information presented in the contingent market, the photograph and map, is assumed to be captured by this scale. The resource quality information scale increases as the quality of the wetland increases.

We assume perceived resource quality is equal to objective resource quality for the wetland marsh, the wetland which has the fewest service flows. Further, we assume that perceived resource quality is less than objective quality and $\delta > 0$ for the three other types of wetlands. Information about them will increase WTP. Since WTP increases with perceived wetland quality, six hypotheses emerge. They are H1: $WTP^A < WTP^B$; H2: $WTP^A < WTP^C$; H3: $WTP^A < WTP^D$; H4: WTP^B

[5] Wetland resources are heterogeneous environmental resources. Much research has been conducted to identify various types of wetlands and the characteristics of the various types. The sources of the wetland quality descriptions are Cowardin et al. (1979) and Mitsch et al. (1983) and discussions with wetlands experts.

$< WTP^C$; H5: $WTP^B < WTP^D$; and H6: $WTP^C < WTP^D$. The null hypothesis in each case is that WTP in each information treatment group is equal. Without the additional resource quality information presented in the contingent market, WTP for each wetland area would be equal. The theoretical validity of WTP from resource quality information would be supported with empirical results that fail to accept the null hypotheses. Additional resource quality information enhances theoretical validity of WTP if higher quality wetlands are found to have higher WTP.

4. Empirical methods and results

4.1. Sample and data

The sampled population was stratified into three categories: (1) households in the western Kentucky coal field, (2) households in the rest of Kentucky outside the western Kentucky coal field, and (3) households in four cities outside of, but bordering, western Kentucky (Evansville, IN; Clarksville, TN; Carbondale, IL; and Cape Girardeau, MO). The sample was drawn by the University of Kentucky Survey Research Center using a random digit dialing procedure which gives any household with a phone an equal probability of being contacted. Calls were made until specified numbers of people from each sample gave names and addresses for the mail survey. The sample contains 730 households who completed the phone interview, 641 of whom (69%) gave their names and addresses for inclusion in the mail survey. Mail survey procedures followed the Dillman (1978) Total Design Method with two follow-up mailings of the survey instrument and a postcard follow-up. The response rate is 66.7% of the phone sample and 76% of the mail sample. [6] These rates are a substantial improvement over the 31% of our 1989 survey (Whitehead and Blomquist, 1991a).

[6] The sampling methodology produces a more representative sample than one drawn from telephone directories since unlisted phone numbers are included. Another advantage is that response rates should be higher since personal contact is made and households agree to participate in the survey before the questionnaire arrives in the mail. We oversampled households in the western Kentucky coal field for which we obtained 256 names and addresses. For Kentucky households not in the western Kentucky coal field, we obtained 304 names and addresses. For towns outside Kentucky and near the coal field we obtained 80 names and addresses. The sample of 730 households covers 79% of those reached through random digit dialing. Households who refused to participate in the phone survey were unaware of the topic of the survey. The resulting bias to willingness to pay from sample noncoverage is assumed small. In May 1990, mail survey instruments were sent to all 641 households who agreed to participate. In June, follow up post cards were sent to all people who received the questionnaire. In early July, a second mailing of the questionnaire was made to people who had not responded to the first mailing or the follow up post card. In late July a third mailing of the survey instrument was made to nonrespondents.

Table 1
Summary of data from contingent valuation survey ($n = 379$)

Variable	Mean	Standard deviation
Percent 'yes' (= 1)	45.6%	–
Gender (Male = 1)	0.478	0.50
Age (Years)	48.82	17.68
Education (Years)	12.66	2.77
Number of children (in Household)	0.68	1.08
Income (in thousands, 1990)	$24.66	18.68
Environmental organization (= 1)	0.19	0.395

Protest CV responses, which do not represent true 'no' responses to dichotomous choice questions (Mitchell and Carson, 1989), were deleted from the sample. [7] Observations with missing responses for the value elicitation question were deleted. Income nonresponses were replaced with values obtained from a regression imputation method which produces estimates of the mean of the distribution of the missing variable for each individual in the sample (Little and Rubin, 1989). A short description, means, and standard deviations of variables for the 379 observations that remain for the empirical analysis are presented in Table 1.

4.2. Information effects on willingness to pay

Survey respondents will answer 'yes' to the dichotomous choice value elicitation question if the WTP to avoid surface coal mining (individual benefit of the policy) is greater than the dollar amount variable (individual cost of the policy). Since true WTP is known by the respondent, but unobserved, the probability of a yes response is specified to depend on WTP with random error:

$$\Pi(\text{yes}) = \Pi[\text{WTP} + \varepsilon \geq A] = \Pi[\text{WTP} - A \geq \varepsilon] \tag{7}$$

where Π is the probability, ε is a mean zero error term, and A is the dollar amount variable. We estimate the probability of a yes response to the dichotomous

[7] Protest respondents are identified by a follow up survey question that asked respondents why they answered 'no'. If the respondent indicated the main reason for answering 'no' that 'my household should not have to pay for wetlands preservation,' the respondent was considered to be rejecting the contingent market. To determine if deleting protests from the sample results in bias an analysis of protest responses was conducted (Blomquist and Whitehead, 1991). We found that higher income households were more likely to protest the contingent market.

choice valuation question using the logistic regression procedure (Amemiya, 1981). This equation can be expressed as:

$$\Pi(\text{yes}) = \{1 + \exp[-(\alpha A + \boldsymbol{\gamma}'\boldsymbol{x})]\}^{-1} \tag{8}$$

where α is a maximum likelihood coefficient estimate, A is the dollar amount variable, $\boldsymbol{\gamma}'$ is a transposed vector of maximum likelihood coefficient estimates, and $\boldsymbol{x}$ is a vector of explanatory variables including a constant, dummy variables which indicate different resource quality information treatments, and socioeconomic characteristics. Survey instrument versions B, C, and D for different wetland types are included in the logistic regression as dummy variables equal to 1 for each version and zero otherwise. Version A is the base category and is omitted.

Logistic regression coefficients are transformed into a WTP equation using the Cameron (1988) technique. With this equation the effect of resource quality information on WTP can be directly determined. In this study the log transformation of the dollar amount variable (log A) is used to improve statistical fit of the equation, so that the functional form of the willingness to pay equation is:

$$\log \text{WTP} = \kappa(\boldsymbol{\gamma}'\boldsymbol{x}) \tag{9}$$

where $\kappa = -1/\alpha$ and $-\boldsymbol{\gamma}/\alpha$ is a vector of point estimates of the coefficients of the WTP equation. Cameron also shows how asymptotic standard errors of the coefficients can be found using Taylor series approximations.

4.3. Regression and WTP results

In Table 2 we present the estimated logit and Cameron WTP equation, which is the transformed logit Eq. (9), in log WTP form. The equations are specified to depend on instrument version dummy variables, socioeconomic characteristics, and contingent market format. [8] Results from the logistic regression show that responses to the contingent market valuation question are reliable according to several statistical criteria described in Amemiya (1981).

Contingent market responses are consistent with expectations concerning the relationship between education, income, and environmental group membership.

[8] A modification of the usual dichotomous choice question format was used where almost half of the questionnaires contained valuation questions with six possible responses. The six responses are ‘definitely yes,’ ‘probably yes,’ ‘maybe yes,’ ‘maybe no,’ ‘probably no,’ and ‘definitely no.’ The polychotomous probabilistic ‘yes’ and ‘no’ responses are treated as dichotomous ‘yes’ and ‘no’ responses in this study. The polychotomous choice format is controlled with a dummy variable equal to 1 for the polychotomous choice format and zero if the dichotomous choice format is used. See Ready et al. (1995) for a study which addresses people’s ambivalence and analyzes polychotomous choice CV results for these wetlands and for preservation of horse farms.

Table 2
Contingent market results ($n = 379$)

Variable	Logit[a]	log (WTP)
Constant	−1.44 (−1.62)	−2.39 (−1.45)
Log (A)	−0.60** (−4.68)	–
Version B[b]	0.58† (1.72)	0.95† (1.63)
Version C	0.23 (0.54)	0.38 (0.53)
Version D	1.16†† (2.84)	1.92†† (2.37)
Gender (Male = 1)	0.19 (0.79)	0.32 (0.79)
Age (Years)	−0.01 (−1.61)	−0.02 (−1.53)
Education (Years)	0.12* (2.32)	0.19* (2.01)
Number of children (in household)	0.15 (1.26)	0.26 (1.20)
Income (in thousands, 1990)	0.02** (2.84)	0.03* (2.37)
Environmental organization (=1)	1.11** (3.42)	1.84* (2.54)
Polychotomous choice (=1)	0.94** (3.78)	1.56** (2.73)
κ	–	1.66 (4.68)
Chi-square (df)	95.65 (11)	–
McFadden's R^2	0.18	
% correct predictions	70.4	

[a] Dependent variable: yes = 1, no = 0.
[b] Version A is the omitted category.
*, ** Indicates statistical significance at the $\alpha = 0.05$ and 0.01 levels for a two-sided test.
†, ††: indicates statistical significance at the $\alpha = 0.05$ and.01 level for a one-sided test.

Increases in education and income leads to increases in willingness to pay. The income result suggests that wetland preservation is a normal good in that income and the probability of a yes response are positively related. Membership in environmental organizations, which is a taste indicator variable, leads to increases in willingness to pay.

Results show that resource quality information is a determinant of WTP. A chi-square test rejects the null hypothesis that the coefficients on the versions B through D dummy variables are jointly zero at the 0.05 level ($\chi^2 = 9.47[3]$). Individual hypothesis tests are conducted with t-statistics from logistic regression coefficients and differences in logistic regression coefficients.[9] These results show that all but one test has the expected sign and four of the six null hypotheses can not be accepted at the 5% level using one-sided tests. The one wrong signed coefficient is not significant at normal levels for wetland types B and C. These two bottomland hardwood forest wetlands differ only in how much of the year they are flooded; they have only slight differences in characteristics.

We then compute the conditional median of each respondent's WTP. Median willingness to pay for the Flat Creek marsh is US$1.69, for the Clear Creek temporarily flooded wetland is US$4.69, for the Clear Creek seasonally flooded

[9] The results for differences in regression coefficients are available upon request.

Table 3
Tests for information effects on WTP

Alternative hypothesis	Difference in WTP (expected sign +)	Kruskal–Wallis Chi-square
H1: $WTP^A < WTP^B$	US$3.00[b]	23.00
H2: $WTP^A < WTP^C$	US$1.99[a]	5.78
H3: $WTP^A < WTP^D$	US$9.52[b]	38.78
H4: $WTP^B < WTP^C$	−US$1.01	0.98
H5: $WTP^B < WTP^D$	US$6.52[b]	14.87
H6: $WTP^C < WTP^D$	US$3.68[b]	11.20

[a, b] Indicates statistical significance at the $\alpha = 0.05$, 0.01 levels.

wetland is US$3.68, and for the Cypress Creek swamp is US$11.21. [10] Pairwise rank order tests of median WTP are consistent with quality information effects hypotheses. In Table 3, the six alternative hypotheses are presented with the difference in median willingness to pay, and chi-square statistic from the Kruskal–Wallis test. Only hypothesis 4, for wetland types B and C which have slight differences in characteristics, has insignificant results. [11] Overall, resource quality information has the expected effect on WTP.

5. Conclusions

In this paper we demonstrate the effect of changes in information about resource quality on WTP using an adaptation of prospective reference theory. Differences in perceived resource quality and true quality can be influenced as respondents learn from information provided in the contingent market. Using data collected from a contingent market explicitly designed to measure WTP for wetlands of differing qualities, we test whether resource quality information is a significant determinant of WTP. We find that information about wetland characteristics and services differentiates wetlands by quality for survey respondents with incomplete information. This study contributes to the existing evidence that information presented in contingent markets can be used to increase the theoretical validity of WTP.

[10] Several details of our WTP estimation approach must be noted. Since our estimate of κ is greater than 1, the mean WTP is undefined (see Patterson and Duffield, 1991). Accordingly, we estimate median WTP. We set the polychotomous choice dummy variable equal to zero so that the WTP estimates correspond to dichotomous choice CV. Also, sample sizes for versions A, C, and D were designed to be small relative to version B making comparisons of simulated WTP confidence intervals as in Cooper (1994) an unreliable test of information effects. Therefore, nonparametric tests and comparison of coefficient estimates for the information treatment dummy variables are most appropriate.

[11] These results are consistent with the t-tests from the logit coefficients.

One implication for CV research is that detailed characteristics and service information are important components of contingent market design. This is especially true for heterogeneous environmental resources such as wetlands which may generate WTP statements from resource nonusers who have little personal experience and prior information about the resource.

These results suggest two areas for future research. The growing size of the CV information package (service, characteristics, related goods, etc.) increases the burden placed on survey respondents and the potential for information overload (Bergstrom and Stoll, 1990). More research is needed to determine when the benefits of additional information exceed the costs. Also, environmental resources that are not well known and generate both use and nonuse value, such as wetlands, are the type about which information is most important. More research is needed to assess whether the effects of resource quality information is important for resources other than wetlands. Unique recreational areas, for example, may not need such detailed descriptions for a contingent market to generate valid statements of WTP.

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Appendix A. Quality information presented in survey instruments

A.1. Presented in all questionnaire versions

Wetland Preservation Benefits: Wetlands in the western Kentucky coal field include marshes, forested swamps, and other similar areas which are flooded for parts of the year. Benefits of wetland preservation include flood control by absorbing peak flows, water quality improvement by filtering pollutants, a natural habitat for birds, fish, wildlife, and plants, as well as outdoor recreation.

A.2. Version A: flat creek wetland

The Flat Creek wetland area is composed mostly of persistent emergent wetlands commonly called freshwater marshes (see map and photograph A).

Freshwater marshes are characterized by permanent flooding. Four percent (4%, 6 square miles/3968 acres) of the wetlands in the western Kentucky coal field are freshwater marshes. Plant species dominant in the Flat Creek marsh are grasses, reeds and rushes. The Flat Creek wetland provides some flood control for surrounding areas and much water quality improvement for Flat Creek and the Pond, Green, and Ohio Rivers. A small fish species is found in the marsh.

A.3. Version B: Clear Creek (temporarily flooded) wetland

The Clear Creek wetland is composed mostly of temporarily flooded (infrequent flooding during Spring and Summer) bottomland hardwood forests commonly called swamps (see map and photograph A). Sixty-two percent (62%, 110 square miles/70,080 acres) of the wetlands in the western Kentucky coal field are temporarily flooded forests. The forests of Clear Creek are dominated by maple, birch, and ash trees. The Clear Creek wetland provides much flood control for surrounding areas and some water quality improvement for Clear Creek, and the Tradewater and Ohio Rivers. Four small fish species and herons are found in the Clear Creek area.

A.4. Version C: Clear Creek (seasonally flooded) wetland

The Clear Creek wetland area is composed mostly of seasonally flooded (flooding during most of Spring and Summer) bottomland hardwood forests commonly called swamps (see map and photograph A). Twenty-two percent (22%, 39 square miles/25,216 acres) of the wetlands in the western Kentucky coal field are seasonally flooded forests. The forests of Clear Creek are dominated by four species of oak trees. The Clear Creek wetland provides some flood control for surrounding areas and some water quality improvement in Clear Creek, and the Tradewater and Ohio Rivers. Four small fish species and herons are found in the Clear Creek area.

A.5. Version D: Cypress Creek wetland

The Cypress Creek wetland is composed mostly of permanently flooded bottomland hardwood forests commonly called Cypress swamps (see map and photograph A). One percent (1%, 2 square miles/1408 acres) of the wetlands in the western Kentucky coal field are permanently flooded forests. The forests of Cypress Creek contain cypress, ash, and willow trees. The Cypress Creek wetland provides much water quality improvement for Cypress Creek and the Pond, Green and Ohio Rivers. Three small fish species are found in Cypress Creek. Wildlife species found in the area include herons, hawks, ducks, swamp rabbits, beavers, and deer.

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