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The Value of Additional Central Flyway Wetlands in Nebraska's Rainwater Basin Wetland Region

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Nebraska's Rainwater Basin wetland region is recognized internationally as a significant wetland complex for migratory waterfowl habitat. A contingent valuation study was undertaken to determine Nebraskan's willingness-to-pay for government acquisition/management programs for this resource. The study consisted of a double bounded referendum format. A censored regression model was utilized for data analysis.

Introduction

Nebraska's Rainwater Basin (RWB) wetland region is recognized internationally as a significant wetland complex, providing annual habitat to North America's central flyway migratory waterfowl. At the turn of the century this region encompassed some 4,000 major wetland areas, totaling approximately 100,000 acres. By the early 1990's only approximately 34,000 acres of RWB wetlands remained (LaGrange, 1996). The North American Waterfowl Management Plan (NAWMP) of 1986, via the RWB Joint Venture, maintains the objective of protecting, restoring and creating an additional 25,000 wetland acres, plus 25,000 acres of adjacent uplands (Gersib, et. Al., 1992). Within the NAWMP no quantitative analysis regarding the economic value of these wetlands was undertaken.

The non-existence of a market to directly measure the value of wetland habitat for migratory waterfowl, makes the valuation of this natural resource conducive to the contingent valuation method (CVM), (Hammack and Brown, 1974; Hanemann et. al., 1991; and Whitehead and Blomquist, 1991). The CVM is a survey method whereby resource values revealed by respondents are contingent upon the constructed or simulated market presented in the survey (Portney, 1994). Survey respondents are essentially asked what they would be willing-to-pay (WTP) for hypothetically specified improvements to the public good or natural resource (Mitchell and Carson, 1989). The objective of this study is to apply the CVM to estimate the value to the people of Nebraska, of government acquisition and/or management programs to increase the current amount of RWB wetlands.

Study Design and Methodology

Guidelines set forth by the National Oceanic and Atmospheric Administration (NOAA) Blue Ribbon panel chaired by Kenneth Arrow and Robert Solow were adhered to by this study with the exception of the personal interview recommendation. The basic components of the study were to use a closed-ended referendum format to elicit WTP responses, in a double bounded context. The hypothetical scenario and payment vehicle used for this study were a general increase in household taxes to finance a RWB wetland purchase/management program.

During the summer of 1996, a mail survey of Nebraska households was conducted, consistent with the Dillman approach (Salant and Dillman, 1994). An open-ended pre-survey was conducted to obtain estimates of WTP to be used in bid design, as well as to test response and questionnaire design elements. The closed-ended referendum questionnaire was then designed. The double bounded survey consists of two WTP questions. The initial question was stated "Would your household be WTP additional annual taxes of $B...", where $B represents the initial bid value. Depending on whether or not the respondent answered YES or NO to the initial question they were then asked whether or not they would be WTP either a higher (if initial answer YES) or a lower (if initial answer NO) amount. The bid structure used for the CVM survey is shown in Table 1.

Table 1: Double Bounded Bid Structure

	Follow-up Bid ($)	
Initial Bid ($)	**Lower**	**Upper**
1	.10	5
10	5.00	2
25	12.50	50
75	37.50	150

The questionnaire was mailed to a random sample of 2,400 Nebraska households. Reminder postcards and a second mailing were conducted as per Salant and Dillman (1994). After adjusting for non-deliverables and non-usable surveys, a response rate of 46% was obtained, yielding 1070 usable questionnaires. The 2,400 questionnaires were stratified such that 600 were sent for each of the four bid structures as noted in Table 1. In addition, the hypothetical scenario which depicts a government program to increase and maintain RWB wetlands varied among questionnaires, in terms of the quantity or acres of wetlands covered under the program. This change in the quantity of RWB wetlands varies in terms of increases from the current level of wetlands of approximately 34,000 acres to 50,000, 75,000 or 100,000 acres. Therefore, the 2,400 questionnaires distributed to a random sample of Nebraska households was stratified into 12 identical sets of 200 questionnaires in terms of the bid sets and the quantity change of wetlands (note variable QSTAR).

Econometric Model

A censored regression model as per Cameron (1988) was used to analyze the CVM data. The censored regression model does not restrict the analysis to a specific utility functional form of linear or log-linear as do the logit and probit models. When using this approach, because the utility functional form need not be specified, log-normal, log-logistic or Weibull models can be directly estimated using a maximum likelihood procedure (Cameron, 1988 and Hanemann and Kanninen, 1996). The censored regression approach uses the survey information to establish upper and lower bounds, thereby censoring the data such that the respondents true or maximum WTP is an unobserved continuous dependent variable with a specified distribution, conditional upon a vector of explanatory variables x_i. The double bounded data from the respondents allows

for an interval consisting of the upper and lower bounds around the maximum WTP to be established which is smaller interval than that of a single bounded CVM study in which no follow-up questions were asked. Table 2 summarizes the bounds given the variations in responses to initial bid offers.

Table 2: Bounds on Maximum WTP

	Lower and Upper Bounds for the Different Responses			
Initial Bid	**YES-YES**	**YES-NO**	**NO-YES**	**NO-NO**
1	5, ∞ (30.92)*	1,5 (34.73)	0.1,1 (4.96)	0,0.1 (29.39)
10	20, ∞ (16.42)	10,20 (23.13)	5,10 (12.32)	0,5 (48.13)
25	50, ∞ (8.86)	25,50 (18.45)	12.5,25 (13.28)	0,12.5 (59.41)
75	150, ∞ (3.35)	75,150 (8.18)	37.5,75 (26.39)	0,37.5 (62.08)

* Brackets indicate the % for each response category given the initial bid.

Let B be the initial bid value and let B^L and B^U be the corresponding follow-up bid values as per Table 1. The true or maximum unobservable WTP is such the $B^L \leq MaxWTP \leq B^U$, and can be described by the following valuation function:

$$MaxWTP_i = x_{i'} \beta + \_{i} \quad (1)$$

Where x_i is a vector of attributes for respondent *I*, as well as the change in quantity variable and ε_i is a random error term, such that $\varepsilon_i \sim N(0,\sigma^2)$. The probability of getting a Yes-Yes response (P^{YY}) to the initial bid B and the follow-up bid B^U is as follows:

$$P^{YY} \equiv Pr\_B_i \leq MaxWTP\_B_i^U \leq MaxWTP\_ \; Pr\_B_i^U \leq MaxWTP\_$$
$$\equiv Pr\_B_i^U \leq MaxWTP\_ = 1 - G_c(B_i^U)$$

(2)

Where $G_c(\cdot)$ is the underlying WTP distribution in the population. Similarly the probabilities of getting a NO-NO, YES-NO, and NO-YES responses to the initial and follow-up bid values are as follows:

(3)

$$P^{NN} = G_C(B^L)$$
$$P^{NY} = G_C(B) - G_C(B^L)$$
$$P^{YN} = G_C(B^U) - G_C(B)$$

Whether using a censored regression model where the upper and lower bounds are defined (Cameron, 1988) or the logit/probit model (Hanemann et. al, 1991) the log likelihood function is

$$lnL = \_{}_{i=1}^{N} [\, I_{YY}\, lnP_i^{YY} + I_{YN}\, lnP_i^{YN} + I_{NY}\, lnP_i^{NY} + I_{NN}\, lnP_i^{NN} \,]$$

formally identical and is as follows:

(4)

where the 'I^{xy}' is an indicator function equal to one when the two responses are 'xy' and zero otherwise (Hanemann and Kanninen, 1996). That is, the indicator variable tells us whether the bid value offered is less than or greater than the underlying WTP value (Cameron, 1988). Essentially

the WTP or demand function is estimated by maximizing the value of the joint likelihood function which is derived by multiplying together the probability of individual *I* making a particular response, over all individuals in the sample (Rubinfeld, 1987). The log likelihood function (4) can be estimated directly using a computer program designed for failure-time data with censoring (SAS LIFEREG procedure). For the censored regression model the WTP distribution $G_c(\cdot)$ can be assumed to be normal-based, logistic-based or Weibull. It was assumed that the true WTP is a non-negative random variable and thus the relationship shown in equation (1) is semi-log as shown in equation

(5).

$$lnWTP = x_{i'}\beta + \varepsilon_i \qquad i = 1 \ldots N$$

(5)

Thus, if $\ln WTP \sim N(\mu,\sigma^2)$, the intercept of the censored recession can be interpreted as the marginal conditional mean (μ) of the WTP distribution, given by exp(intercept). The dispersion parameter σ, is also directly computed as the 'scale' parameter via the maximum likelihood estimation procedure.

Censored Regression Results

A censored regression model was run specifying a log-normal distribution[2]. The results are shown in Table 3, variable descriptions are included as Appendix A.

The QSTAR variable was insignificant thus indicating that the WTP on the part of

[2]The model was also run using the Weibull and log-logistic distributions. The Weibull distribution yielded a squared value of the scale variable greater than 1.65, and thus the mean WTP measure blows up, due to lack of convergence (Hanemann and Kanninen, 1996). Also the final estimate of the maximized log likelihood was greater for the log-normal than the log-logistic indicating a preferred fit.

Nebraskan households for a RWB acquisition/management program is not related to the proposed acreage increase of the program. The signs of the significant variables were consistent with expectations. Whether or not the respondent had visited the RWB region was positively related to their WTP to increase RWB wetlands. The location of the respondent's household being in the RWB wetland region was negatively related to their WTP. RWB wetlands are considered to be in direct competition with agricultural land uses, thus the negative sign on the LOCATRWB variable is consistent with the negative sign on the AGINC, variable which is also significant. Whether or not the respondent and members of their household consider themselves bird watchers was also significant and positively related to WTP. Of the total respondents approximately 85% indicated that their households recycle trash. Although RECYC was a significant variable, the fact that respondents recycle trash does not appear to be a good indicator of environmental concern for waterfowl habitat as indicated by the negative sign. Whether or not the household had contributed to an environmental organization appears to be a better indicator of environmental awareness of waterfowl habitat as it was positively related to WTP. The level of the respondents education was positively related to their WTP to increase RWB wetlands and significant. The average age of respondents was approximately 53 years. Although income in general was not significant, the older the respondent the more likely they are retired and living on a fixed lower level of income. The significant age variable which is negatively related to WTP may be an indication that retired persons are not WTP higher taxes for an increase in RWB wetlands. The lack of significance of the hunting variables may have policy implications toward whether or not hunting fees should be used to support acquisition and/or management activities within Nebraska's RWB wetland region.

The estimates of the mean and median WTP are $126.79 and $3.36, respectively. The large variance (σ^2=7.2633) estimate used to calculate the mean of the log-normally distributed WTP random variable, contributes to the large difference in the mean and median measures. The small percentage change of respondents answering NO-NO as the bid increased suggests that a large proportion of respondents were not receptive to the higher initial bid values. The mean estimate given this sample data, does not appear to be a reliable estimate of WTP. The median estimate which is less susceptible to the distributional assumptions of the model appears to be a more appropriate estimate for WTP. As concluded by Hanemann and Kanninen (1996), although the mean may reflect the Kaldor-Hicks potential compensating criteria, the median may be a more realistic measure of WTP in a world where decisions are based on voting and the concern exists regarding the distribution of benefits and costs of a program.

Conclusions and Recommendations

Nebraska's RWB wetlands provide on an annual basis habitat to migratory waterfowl and are recognized to be of international importance. This study examined the non-use value of this resource to Nebraska households. The median willingness-to-pay in annual additional taxes was estimated to be $3.36 while the estimated mean was $126.79. The large divergence between these two WTP measures is due to the large variance in the WTP exhibited by the sample data. Table 2 shows how the survey respondents did not appear to be receptive to the higher initial bid offers, as illustrated by only a small change in the number of respondents answering either Yes-Yes or NO-No as the initial bid was increased from $25 to $75. Because the mean WTP measure is dependent upon the variance or scale parameter estimate, it appears to be the less robust WTP measure.

Variables which appear to significantly, positively influence a households WTP for a RWB wetland acquisition/management program: whether or not they've visited the RWB; whether or not they contribute to environmental organizations; and their level of education. Relevant variables that negatively influence a households WTP included: whether or not their household is located within the RWB region of the state; whether or no they earn income from agricultural activities; and their age. In addition, the QSTAR variable was insignificant, indicating that the respondents WTP for a RWB wetland acquisition/management program was independent of the proposed wetland acreage or quantity change.

This study could be used to provide valuable insight which policy makers should consider when developing Rainwater Basin wetland acquisition and/or management programs. It is important that policy makers not only understand and quantify estimates of Nebraskan's willingness-to-pay for such government programs, but also understand the attributes that significantly influence their willingness-to-pay. The significant positive relationship between a household's WTP for a RWB wetland acquisition/management program and whether or not they have visited the RWB region could be used by policy makers to increase support for such programs via increasing awareness among Nebraska's households regarding the uniqueness of this natural resource, thereby attracting more visitors. Thus a general awareness, education program directed toward the general public about Nebraska's RWB wetland region may assist policy makers in gaining greater support from the people of Nebraska. The variables that negatively influence a households WTP included whether or not their household was located in the RWB region and whether or not their household earns income from agricultural activities. This should indicate to policy makers the need to work closely with the residents of the RWB region so that

they feel more positive and supportive of RWB wetland acquisition/management programs. In addition, policy makers must work closely with competing agricultural interests in the RWB region such that more amicable programs can be designed and implemented. The empirical results which indicate none of the hunting variables had a significant influence on a household's WTP for RWB wetland acquisition/management programs may indicate to policy makers that funding such programs through hunting activity fees may not be the most favorable funding vehicle. Similar conclusions could be drawn with regard to camping and/or fishing fees.

The referendum survey results of this contingent valuation study indicate that if a general, annual household tax increase in Nebraska to fund a RWB wetland acquisition/management program were less than $3.36 per household, a majority of households would vote in favor of such a tax increase. The 1990 Census of Nebraska shows the total number of Nebraska households to be 602,363 (US Dept. Of Commerce, 1992), therefore such a proposed tax would yield approximately $2 million in annual funding for such programs. This dollar value appears reasonable given the State of Nebraska Tourism official estimate that the spring waterfowl migration through the RWB and the adjacent Platte River wetland regions bring as much as $6 million in direct tourist spending as well as an additional $10.2 million of indirect benefits to the local economy (Laukaitis, 1997).

Table 3: Censored Regression Results

Variable Name	Coefficient Estimate	Variable Means
INTERCEPT	1.21096* (0.7555)	
QSTAR	-0.0027 (0.0046)	42.0981

VISIT	0.7780 * (0.2053)	0.5033
LOCATRWB	-1.1274* (0.3459)	0.0920
RURAL	0.0366 (0.2311)	0.3449
HUNT1TO5	-0.2577 (0.3400)	0.2009
HUNT	0.1751 (0.3409)	0.3393
HUNTCL	0.1545 (0.4689)	0.0439
FISH1TO5	0.1134 (0.2806)	0.3093
FISHER	0.1293 (0.2960)	0.4972
CAMP1TO5	0.2219 (0.3805)	0.2626
CAMPER	0.3363 (0.3789)	0.3364
BW1TO5	-0.0618 (0.3570)	0.1467
BW	0.5939* (0.3037)	0.2664
BIRDCL	0.7059 (0.8710)	0.0159
RECYC	-0.6908* (0.2696)	0.8472
ENVCONT	1.0457* (0.2039)	0.3333
GENDER	0.0396 (0.2327)	0.5775
EDU	0.1533* (0.0478)	7.2433
INCOME	0.0696 (0.0781)	3.4748
AGINC	-0.5562* (0.1013)	0.5775
AGE	-0.0307* (0.0067)	52.8909

HHSIZE	-0.1215** (0.0687)	2.6875
SCALE	2.69504 (0.0875)	
PSEUDO R^2	0.2049	
The intercept and scale are reported for the restricted model which omitted the covariant.		
( )Indicate Standard Errors		
*, ** indicate significance at the .05 and .10 levels, respectively.		

Appendix A - Variable Descriptions

Variable Name	**Variable Description**
INITIAL	Indicates initial bid value of either $1, $10, $25 or $75.
RESPOND1	Response to initial bid. Yes=1, No=0.
SECONDUP	Second, higher bid value if responded Yes to initial. Equals $5, $20, $50 or $120, respectively.
SECONDDW	Second, lower bid value if responded No to initial. Equals $.10, $5, $12.50 or $37.50, respectively
RESPOND2	Response to initial and follow-up bids. Where YesYes=1, YesNo=2, No-no=3, NoYes=4.
LOWER	Lower bound on respondent's WTP.
UPPER	Upper bound on respondent's WTP.
QSTAR	Change in the quantity of RWB wetlands variable. 1=change from 34,000 to 50,000 acres, 2=change from 34,000 to 75,000 acres, and 3=change from 34,000 to 100,000 acres.
VISIT	Whether or not respondent has visited the RWB wetland region. Yes=1, No=0.
LOCATRWB	Is respondent's household located in the RWB wetland region. Yes=1, No=0.
RURAL	Whether or not the respondent considers themselves to be a rural resident. Yes=1, No=0.
HUNT1TO5	Whether or not members of the respondent's household are recreational hunter 1

Variable Name	Variable Description
	to 5 times per year. YES=1, No=0.
HUNT	Whether or not members of the respondent's household are recreational hunters (includes those who hunt more than 5 times per year as well as those who hunt 1 to 5 times per year). YES=1, NO=0.
HUNTCL	Whether or not members of the respondent's household belong to a hunting club. Yes=1, No=0.
FISH1TO5	Whether or not members of the respondent's household go recreational fishing 1 to 5 times per year. YES=1, No=0.
FISHER	Whether or not members of the respondent's household are recreational fishermen (includes those who fish more than 5 times per year as well as those who fish 1 to 5 times per year). YES=1, NO=0.
CAMP1TO5	Whether or not members of the respondent's household go wilderness camping or hiking 1 to 5 times per year. YES=1, No=0.
CAMPER	Whether or not members of the respondent's household are wilderness camp or hike (includes those who camp or hike more than 5 times per year as well as those who camp or hike 1 to 5 times per year). YES=1, NO=0.
BW1TO5	Whether or not members of the respondent's household bird watcher/photographer 1 to 5 times per year. YES=1, No=0.
BW	Whether or not members of the respondent's household consider themselves bird watchers/photographers (includes those who bird watch/photograph more than 5 times per year as well as those who bird watch/photograph 1 to 5 times per year). YES=1, NO=0.
BIRDCL	Whether or not members of the respondent's household belong to an associated bird watching/photography club. Yes=1, No=0.
RECYC	Whether or not the respondent's household recycles trash. Yes=1, No=0.
ENVCONT	Whether or not the respondent's household contributes to environmental organizations. Yes=1, No=0.
GENDER	Male=1, Female=2
EDU	Highest level of education. 1=no formal education, 2=some grade school, 3=completed grade school, 4=some high school, 5=completed high school, 6=some technical college, 7=completed technical college, 8=some university, 9=completed university, 10=some graduate work or 11=completed graduate work.
INCOME	Total household income in 1995 before taxes. 1=under $10,000, 2=$10,000 to $24,999, 3=$25,000 to $34,999, 4=$35,000 to $49,999, 5=$50,000 to $74,999

Variable Name	Variable Description
	or 6=$75,000 and over.
AGINC	Whether or not any household income was derived from farming activities. Yes: less than 25%=1, Yes: 25% to 50%=2, Yes: 51% to 75%=3, Yes: 76% to 100%=4 or No=0.
AGE	Respondent's age in years.
HHSIZE	Household size.

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1997 WAEA Selected Paper Submission Sheet

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Topic Codes: Indicate below the two-digit topic area code(s) that match the paper's contribution most closely. This will determine who reviews the paper.

01-Production economics and farm management
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06-Quantitative and research methods

_____Primary Area

12-Agricultural industry organization

_____Secondary Area (if any)