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Contingent Valuation When Respondents Are Ambivalent*

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Respondents to contingent valuation surveys may have difficulty resolving ambivalence over trade-offs between money and changes in levels of environmental amenities. In two separate studies, respondents were given the opportunity to express intensity of preferences through polychotomous choice valuation questions. This elicitation method produced slightly higher rates of usable responses than dichotomous choice, but with wide ambivalence regions. Dichotomous choice responses appear to reflect a conservatism strategy, in that ambivalent respondents tend to reject any move away from the baseline. © 1995 Academic Press, Inc.

Since Bishop and Heberlein's [2] study on the value of a goose hunting permit, the dichotomous choice (DC) question format has gained wide popularity among contingent valuation (CV) practitioners. Application of the DC format includes both referendum approaches and the original "take it or leave it" hypothetical market approach of Bishop and Heberlein. In both forms, respondents are faced with a choice between two options. In the baseline option, the respondent's income remains the same, and the resource to be valued is set at some baseline level. In the alternative option, both the level of the resource and the respondent's disposable income are changed. In a willingness-to-pay (WTP) question, the resource is enhanced, while the respondent's income is decreased. The respondent is asked to compare utility under the baseline with utility under the alternative option. If utility is higher under the alternative option than under the baseline, the respondent so indicates, by stating that he or she either would vote "yes" in the hypothetical referendum, or would make the hypothetical transaction.

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With the DC format, the hypothetical decision situation in which the respondent is placed closely resembles an actual market transaction or an actual voting situation, and so it should be familiar to the respondent. For this reason, DC questions are believed to be easier to answer than open-ended questions [15]. The DC format does not suffer from starting point bias and does not provide incentives for strategic responses [8]. The DC format is easier to administer than iterative approaches and makes fewer demands on the respondent's time and patience [4]. The DC approach has the disadvantages, relative to open-ended questions or iterative bidding approaches, that less information is collected from each respondent, and that statistical analysis is more complicated and requires rather strong assumptions about the statistical distribution of values among respondents [5, 7].

An implicit assumption of the DC approach is that each respondent will be able to determine which option, the baseline or the alternative, is preferred. However, the hypothetical scenario presented will be deliberately constructed such that neither choice dominates the other in all respects. A "yes" response would gain the respondent an increase in the amenity, a desirable change, but a decrease in disposable income, an undesirable change, so that the respondent is guaranteed to have mixed feelings about the choice. For some scenarios, it may be difficult or impossible for the respondent to unambiguously determine which option is preferred. How will a respondent who is ambivalent over the choice between the two options answer a DC contingent valuation question?

RATIONAL BEHAVIOR UNDER AMBIVALENCE

This question is investigated using a model of decision making under ambivalence developed by Opaluch and Segerson [11]. According to Opaluch and Segerson, ambivalence occurs when an individual is forced to make difficult trade-offs between competing objectives. In the context of a DC contingent valuation survey, ambivalence can occur when a respondent must make a trade-off between money and environmental amenities.

Following Opaluch and Segerson, we can envision the baseline and alternative options as points in money/amenity space. In Fig. 1, point B represents the baseline option, with the amenity level Q^0 and income M^0. Points northeast of B represent situations that give the individual more amenity and more money. Points southwest of B represent outcomes with less money and less amenity. Clearly, respondents should have no difficulty making choices between B and points in either of these two quadrants. Difficulty arises when considering points southeast of northwest of B, where the respondent must make a trade-off between money and the amenity.

Contingent valuation questions will always involve points in these two quadrants. The quadrant northwest of B represents hypothetical WTP scenarios, where the individual must give up some money in order to receive extra amenity. If the decision involves a very lopsided trade-off, the choice may be easy for the respondent. The respondent will likely be willing to agree to alternatives that offer a great deal of extra amenity for very little money, such as alternative A_1. Likewise, the respondent should be able to easily dismiss alternatives that offer very little extra amenity but cost a great deal of money, such as alternative A_3. Based on this logic, we can envision boundaries that extend out from B. Alternatives that lie

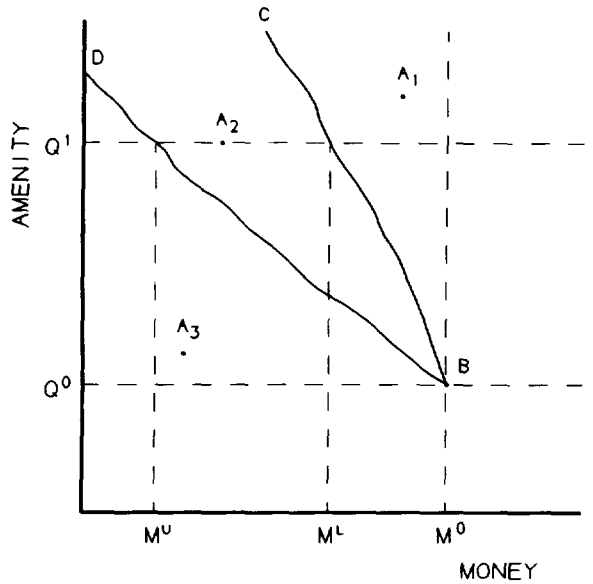

FIG. 1. Ambivalence region for trade-offs between money and an environmental amenity.

above and to the right of the right-hand boundary, $\overline{CB}$, are clearly preferred to the baseline, while alternatives that lie below and to the left of the left-hand boundary, $\overline{DB}$, are clearly inferior to the baseline. For an alternative option, such as A_2, that lies between these boundaries, however, the respondent has difficulty evaluating the trade-off between money and the amenity. The area between the two boundaries will be called here the respondent's ambivalence region.[1]

In a congingent valuation survey that values a specific improvement in the amenity, such as from Q^0 to Q^1, the ambivalence region translates into a range of bid values for which the respondent is ambivalent. The respondent with the ambivalence region shown in Fig. 1 will easily answer "yes" to any bid value smaller than $M^0 - M^L$, and will easily answer "no" to any bid value larger than $M^0 - M^U$. There remains a range of bid values, however, for which the respondent is ambivalent and has some difficulty answering the DC valuation question.

Ambivalence could be motivated by uncertainty over the location of the indifference curve. Absent such uncertainty, the respondent would have a complete utility ordering that generates an indifference map in amenity/money space, and could easily answer any DC contingent valuation question according to whether the alternative option lies above or below the indifference curve that passes through the baseline point B. The respondent may have little experience in making trade-offs between money and an environmental amenity, however, and could be unsure of the exact location of that indifference curve. The ambivalence region could then represent the range of possible indifference curves that pass through the baseline point B.

[1] A similar ambivalence region would likely exist southeast of B for WTA situations. Because our empirical studies did not include WTA questions, we will not consider the implications of ambivalence on WTA responses in this paper.

The question remains, how will the respondent answer contingent valuation questions involving alternative options located in the ambivalence region, such as alternative A_2? Most contingent valuation studies implicitly assume that the respondent resolves any uncertainty over the location of his or her indifference curve through introspection. When considering trade-offs involving environmental amenities, however, the respondent may not be able to completely eliminate the uncertainty. While introspection may narrow the ambivalence region, there may exist a core of persistent ambivalence that the respondent is unable to resolve. This core level of ambivalence may exist as a result of strong conflicting preferences [11]. The cost in terms of time and effort of completely eliminating such ambivalence may be prohibitively high or even infinite.

Such a respondent will be forced to make a choice over which he or she still feels some ambivalence. Faced with such a choice, a respondent may adopt simple decision rules. A lexicographic rule is one that gives dominance to one of the two goods. A respondent who follows a lexicographic rule that gives dominance to the amenity would accept any ambivalent scenario that increases the amenity, and would say "yes" to A_2. If such a respondent has a very wide ambivalence region, he or she would say "yes" to very large bid amounts in a WTP survey. A lexicographic rule that gives dominance to money would reject any ambivalent scenario that decreases money, resulting in a "no" response to A_2. A respondent with a wide ambivalence region who follows this decision rule would say "no" to very small bid amounts in a WTP survey, even though he or she may care about the amenity. A contingent valuation practitioner might identify such a respondent as a protest response, and delete him or her from the study.

Another simple decision rule is conservatism. This rule states that if the respondent is ambivalent, then he or she should avoid moves away from the baseline. Such a respondent would reject A_2 and would respond "no" to any scenario that lies below and to the left of the right-hand ambivalence boundary. $\overline{CB}$. Samuelson and Zeckhauser [14] have demonstrated a bias toward the status quo in a number of different contexts. They found that, when faced with a decision between change and the status quo, people tend to stick with the status quo. They provide a number of possible explanations, including the desire to avoid unknown risks. In a contingent valuation context, if the respondent is unable to rank the two options due to ambivalence, he or she may stick with the familiar baseline, rather than risk an unfamiliar alternative.

Conservatism in the face of ambivalence is similar to a model of respondent behavior proposed by Hoehn and Randall [8]. Among other effects, they modeled respondent behavior when there is uncertainty over the level of the amenity in the alternative option due to imperfect information in the survey instrument. In their model, a risk-averse respondent would have a smaller WTP for an uncertain increase in the amenity than for a certain increase with the same expected value. While their model gives a result similar to ours, the models differ in the assumed source of uncertainty. In their model, the respondent is uncertain over the level of the amenity. If additional information is provided, eliminating this uncertainty, WTP for the alternative option will increase to its true value. In our model, respondents are uncertain over their own preferences. There may exist a core of persistent ambivalence, due to strong conflicting preferences, that no amount of information or introspection will eliminate.

In contrast, Crocker and Shogren [6] presented a model that predicts WTP to be

higher in situations where preferences are uncertain. They considered a consumer facing a sequence of consumption decisions over a commodity for which preferences are uncertain, but where consumption of the commodity generates information about those preferences. Because that information would allow the consumer to make better decisions in later periods, the information itself has some value. Our model envisions only one decision, and that decision is hypothetical. While going through the exercise of making a contingent choice may provide the respondent with some information about preferences, the value of that information does not depend on the contingent choice made.

STUDY OBJECTIVES

In a pair of contingent valuation studies, one measuring WTP to prevent destruction of a wetland, the other measuring WTP to prevent the loss of horse farms to development, we estimated bounds for the ambivalence region and investigated how respondents answer DC contingent valuation questions when faced with ambivalence. This was done using a split-sample survey, in which the two subsamples were given survey instruments that differed only in how the valuation question was asked. In a typical DC contingent valuation survey, respondents are instructed to answer valuation questions either "no" (meaning they prefer the baseline) or "yes" (meaning they prefer the alternative). No opportunity is given to express ambivalence. In both studies, roughly half of the respondents (the DC subsample) were given such a typical survey.

The other half were given a survey that allowed the respondents to express ambivalence. Instead of from two possible responses ("yes" and "no"), the respondents chose from six responses. Such a valuation question might be termed polychotomous choice (PC). These six responses allowed preferences to be expressed along a range of intensity, from strongly preferring the baseline to strongly preferring the alternative. A respondent who felt ambivalence over the choice could express that ambivalence by choosing one of the middle responses.

Boundaries for the ambivalence region can then be estimated by examining the dollar values at which respondents switch from the extreme responses to the central responses, and the DC responses can then be compared to the location of these boundaries. If DC respondents are answering the contingent valuation question according to the usual model of respondent behavior, which assumes that respondents discover their indifference map through introspection, then each respondent should switch from a yes response to a no response somewhere inside the ambivalence region, depending on where the relevant indifference curve is located. Some respondents will discover that their true WTP threshold value lies close to the left-hand boundary of their ambivalence region (boundary $\overline{DB}$ in Fig. 1). Others will discover that their true WTP threshold lies closer to their right-hand boundary ($\overline{CB}$). On average, the dollar amount separating the yes responses from the no responses should fall somewhere in the middle of the ambivalence region. In contrast, if the DC respondents are following a conservatism decision rule in the face of persistent ambivalence, then each individual's WTP threshold value should lie closer to the right-hand boundary of his or her ambivalence region.

Another issue involving ambivalence that can be explored is usable response rate. An ambivalent respondent answering a DC valuation question may derive

disutility from being forced to give a confining response. Stevens *et al.* [16] found that the rate of protest zero responses in a DC study on WTP for wildlife protection was highest for bid levels between $50.00 and $75.00. They interpret this result as suggesting that respondents are ambivalent about the trade-off between money and wildlife for bids in that range, and react adversely to being forced to answer a DC question that generates such ambivalence. In contrast to the DC question format, the PC format allows the respondent to make less of a commitment, and may therefore be less distastefull to answer. If respondents find PC format questions less disagreeable to answer, we may see higher response rates for the PC subsample, lower item nonresponse rates, and/or lower protest rates, resulting in a larger usable sample size for the PC subsample than for the DC subsample.

Finally, the two question formats could differ in the incentives they provide to think hard about the question and answer carefully. Because the DC format forces a difficult, confining choice, respondents may take more care to answer it as correctly as possible. In contrast, a respondent to a PC format question that requires less of a commitment may feel less pressure to carefully consider the answer. This issue will be investigated by examining how sensitive DC and PC responses are to the description of the amenity improvement being valued.

SURVEY METHODS

Detailed accounts of the wetland and horse farm studies are available in reports by Blomquist and Whitehead [3] and Ready [13] and can be obtained by request from the authors. Sampling was done by the same method in both studies. First, households were contacted by phone using random-digit dialing in target counties. Adults answering the phone were asked to participate in a mail survey. Those people that gave the interviewer their names and addresses were sent questionnaires in the mail with one follow-up postcard. Nonrespondents in the horse farm survey were sent one additional copy of the questionnaire. Nonrespondents in the wetland study were sent two follow-up questionnaires.

In the wetland study, respondents were asked to imagine that a particular wetland in Western Kentucky is owned by a coal company and will be surface mined. Alternative versions of the questionnaire described four different wetlands named Flat Creek, Clear Creek with seasonal flooding, Clear Creek with temporary flooding, and Cypress Creek. For each wetland type, detailed information about the quality of each wetland was presented, including the acreage involved, the water regime (percentage of the year that flooding occurs), the specific plant, fish and wildlife species found in the wetland, and the wetland's flood control and water quality improvement functions. Included in each survey were a photo of the relevant wetland type and state and county maps showing the location of the particular wetland, along with information about other wetlands in Kentucky. Respondents were told that if nothing was done, the wetland would be mined, but that the wetland could be preserved if the respondent would donate a specified amount to a wetlands preservation fund. The survey therefore measured respondents' WTP to avoid the loss of the wetland. Based on a presurvey with an open-ended valuation question, five discrete dollar amounts were chosen ranging from $3 to $49. In DC questionnaires, respondent were asked whether they would

be willing to make the specified payment in order to preserve the wetland. Respondents were given only "yes" and "no" as possible responses. PC questionnaires were identical to the DC questionnaires, except that respondents were given six responses to choose from, "definitely yes," "probably yes," "maybe yes," "maybe no," "probably no," and "definitely no."

In the horse farm study, Kentucky residents were asked to suppose that the number of horse farms in Kentucky would decrease over time, due to a continuing decline in the profitability of horse farming in Kentucky relative to other states. Four different questionnaires described different levels of reduction, ranging from a 25% decrease in the number of horse farms to a complete loss of horse farms in Kentucky. These scenarios were credible to the respondents, at least for the lower decrease levels. Seventy-two percent of the respondents indicated that they believed that the number of horse farms in Kentucky is currently declining. Respondents were told that the decrease in horse farms could be avoided with a package of incentives to horse farm owners, but that the package would result in higher state and local taxes.[2] Dollar amounts of the tax increase were based on an open-ended valuation question in a presurvey. Eight discrete dollar amounts were used ranging from $5 to $500. In DC questionnaires, respondents were asked which they would prefer, implementation of such a program or the decrease in horse farming. Possible responses were limited to "prefer program" and "prefer no program." Again, PC questionnaires were identical to DC questionnaires, except that respondents were given six responses to choose from: "strongly prefer program," "prefer program," "slightly prefer program," "slightly prefer no program," "prefer no program," and "strongly prefer no program."

RESPONSE AND PROTEST RATES

A total of 601 wetland questionnaires and 563 horse farm questionnaires were mailed.[3] The response rates for both question formats are presented in Table I. Incomplete surveys are those that were returned but were unusable, typically due to item nonresponse for the valuation question. Protest responses were identified as those negative responses in which the respondent indicates, in a followup question, a belief that he or she should not have to pay for preservation of the amenity.

It was postulated that because the PC format allows respondents to express ambivalence, it might show higher return rates, lower item nonresponse rates, and lower protest rates than the DC format. These would combine to yield higher rates of usable surveys. The results of the two studies are suggestive, but not conclusive. In both studies, the PC format did result in a higher rate of usable responses than did the DC format (67.0% versus 60.0% for the wetland study, 58.0% versus 53.5% for the horse farm study). Logit estimation was used to analyze factors influencing

[2] An incentive package similar to the hypothetical package described in the survey was approved by the Kentucky legislature and signed into law in 1992, one year after the survey was completed.

[3] In both the wetland study and the horse farm study, a small number of PC questionnaires were mailed that included five response categories, rather than six. In these, the two middle response categories were combined to create a "maybe" category in the wetland study and a "no preference" category in the horse farm study. Too few of these surveys were sent to draw any definitive conclusions about that format, and they are not discussed in this paper.

TABLE I

Response Rates, Item Nonresponse Rates, Protest Rates, and Ultimate Sample Sizes for the Wetland and Horse Farm Studies

	Wetland study		Horse farm study	
	DC	PC	DC	PC
Surveys mailed	368	233	282	281
Surveys returned	294	172	202	205
(% of total returned)	(79.9)	(73.8)	(71.6)	(73.0)
Incomplete surveys	40	1	8	9
(% of total returned)	(13.6)	(0.6)	(4.0)	(4.4)
Protest responses	33	15	43	33
(% of completed surveys)	(13.0)	(8.8)	(22.2)	(16.8)
Final sample size	221	156	151	163
(% of total mailed)	(60.0)	(67.0)	(53.5)	(58.0)

the probability of a particular survey being returned and being usable, to determine whether these differences are statistically significant. For the wetland survey, the logit regression indicated that PC format surveys were significantly more likely to be returned and usable ($p < 0.05, t = 2.159$). For the horse farm study, the PC format surveys were again more likely to be returned and usable, but the difference was not significant at conventional levels ($t = 1.014$). These results suggest that question format did have a real effect on the proportion of usable responses in both studies, but that the effect is slight.

AMBIVALENCE BOUNDS

For each scenario presented to the respondents (each different wetland, each horse farm loss level) there will be a different range of dollar values for which the respondent will be ambivalent. Further, the ambivalence region will differ from individual to individual, due to differences in attitudes towards the amenities involved. We accommodate the first source of variability by presenting results for each of the scenarios used in the two studies. We accommodate the second by including socio-economic variables in logit analyses of the PC responses.[4]

Three logit analyses were performed on the PC data, modeling the probability that a respondent would give a "definite yes" (defined as either of the top two response categories), the probability that the respondent would give a "yes" (defined as any of the top three categories), and the probability that the respondent would give a "definite no" (defined as either of the bottom two categories).[5] The DC data was analyzed similarly, though only one logit regression was per-

[4] The width of the ambivalence region could also differ among individuals due to differences in information or experience. Some individuals may be more certain of their preferences, or may be better able to resolve any uncertainty over preferences, leading to a narrower ambivalence region. Estimation of individual ambivalence regions would require multiple valuation questions for each respondent.

[5] Alternatively, an ordered-response model could have been used to model all three probabilities. That approach restricts the regression coefficients to being equal for all three probabilities, except for an intercept term. With no reason to believe that the coefficients should be equal, we chose the more general approach of separate regressions.

formed, modeling the probability that the respondent would say "yes" (or symmetrically, the probability of a "no").

The variables used in these regressions are listed in Table II. These include socio-economic variables describing the household and variables that describe the scenario presented. The results of the four logit regressions are presented in Table III. Notice that a linear bid specification was used for the horse farm study while a log bid specification was used for the wetlands study. Focus groups conducted during the horse farm study revealed that a small number of respondents place a negative value on horse farm preservation. The linear bid specification allows negative maximum WTP. We did not have any evidence from the wetland focus group for negative values for wetlands preservation. With a log bid specification, all individuals are assumed to have nonnegative maximum WTP. For the horse farm study, different scenarios (different levels of horse farm loss) were modeled using three dummy variables, representing 25%, 50%, and 75% losses. Complete loss of the horse industry was the default. In the wetland study, dummy variables were included for Flat Creek, Clear Creek with seasonal flooding, and Cypress Creek. Clear Creek with temporary flooding was the default wetland type.

From these logit equations, upper and lower bounds on the ambivalence region were constructed. We defined the upper bound of the ambivalence region as the lowest dollar amount to which 50% of the respondents would give us a "definite no." The lower bound was defined as the highest dollar amount to which 50% of the respondents would give us a "definite yes" response. Defining the ambivalence region this way means that for any bid amount that lies outside of the region, more than half of the respondents would give definite answers to a PC valuation question. To calculate probabilities, socioeconomic variables were set at their mean

TABLE II
Variables Used in Logit Regressions

Wetland study	
LN(BID)	natural log of bid amount
FEMALE	= 1 if female
AGE	age of respondent in years
EDUC	education of respondent in years
CHILD	number of children in household
INCOME	household income
DONATE	= 1 if respondent is a member of, or has donated to, an environmental group
CRLSEA	= 1 for Clear Creek Seasonally Flooded Wetland
FLAT	= 1 for Flat Creek Wetland
CYPRESS	= 1 for Cypress Creek Wetland
Horse farm study	
BID	bid amount
25%LOSS	= 1 if horse industry would decline by 25%
50%LOSS	= 1 if horse industry would decline by 50%
75%LOSS	= 1 if horse industry would decline by 75%
FEMALE	= 1 if female
AGE	age of respondent in years
INCOME	household income; = 0 if question not answered
INCTELL	= 1 if income question not answered
FARMS	number of horse farms in county of residence

TABLE III

Logit Coefficients for Upper Ambivalence Bound, Lower Ambivalence Bound, PC Indifference, and DC Indifference

Wetland Study

	Upper bound $n = 156$		PC-indiff. $n = 156$		Lower bound $n = 156$		DC-indiff. $n = 221$	
Variable	Coeff. estimate	T stat.	Coeff. estimate	T stat.	Coeff. estimate	T stat.	Coeff. estimate	T stat.
CONSTANT	1.307	0.98	−1.122	−0.85	−3.447	−2.37	0.248	0.22
LN(BID)	−0.595	−2.83	−0.659	−3.13	−0.444	−2.03	−0.618	−3.66
FEMALE	−0.530	−1.31	−0.553	−1.41	−0.169	−0.41	0.036	0.11
AGE	−0.028	−2.18	−0.011	−0.93	0.004	0.28	−0.015	−1.46
EDUC	0.145	1.60	0.271	2.92	0.267	2.76	0.048	0.77
CHILD	0.022	0.10	0.273	1.27	0.251	1.33	0.005	0.03
INCOME	0.009	0.58	0.003	0.23	−0.006	−0.44	0.027	3.06
DONATE	1.648	2.36	1.315	2.14	0.631	1.23	0.995	2.46
CLRSEA	0.967	1.58	0.264	0.47	−0.193	−0.33	−0.838	−1.93
FLAT	−0.208	0.41	-0.541	−1.05	−0.741	−1.22	−0.680	−1.46
CYPRESS	0.489	0.91	0.250	0.47	−0.451	−0.81	0.894	2.07
MODEL X^2 (10 d.f.)	38.83		44.71		22.70		53.31	

Horse Farm Study

	Upper bound $n = 163$		PC-indiff. $n = 163$		Lower bound $n = 163$		DC-indiff. $n = 151$	
Variable	Coeff. estimate	T stat.	Coeff. estimate	T stat.	Coeff. estimate	T stat.	Coeff. estimate	T stat.
CONSTANT	2.096	2.27	0.521	0.67	−1.004	−1.34	−0.742	−0.95
BID	−0.004	−3.03	−0.004	−2.74	−0.003	−2.21	−0.004	−3.29
25%LOSS	0.147	0.21	−0.030	−0.05	0.274	0.53	−0.312	−0.64
50%LOSS	−0.197	−0.34	−0.065	−0.13	−0.355	−0.75	0.207	0.38
75%LOSS	−0.366	−0.63	0.014	0.52	−0.506	−1.02	0.904	1.84
FEMALE	−0.714	−1.57	−0.581	−1.52	−0.134	−0.37	−0.269	−0.74
AGE	0.003	0.27	0.008	0.76	0.011	1.07	0.007	0.66
INCOME	0.023	2.14	0.017	2.00	0.026	3.41	0.013	1.74
INCTELL	0.355	0.37	0.773	0.84	−0.074	−0.08	0.321	0.42
FARMS	−0.001	-0.55	0.000	0.23	−0.001	−0.34	0.002	1.45
MODEL X^2 (9 d.f.)	19.27		15.99		25.17		26.66	

values for the population [5]. An ambivalence region constructed in this way should be viewed as being appropriate for a "typical" respondent.

The ambivalence regions for each of the four horse farm loss scenarios are represented by vertical bars in Fig. 2. The upper bound of the ambivalence region varied from \$314 to \$401, depending on the amount of horse farm land that would be lost. The lower bound varied from −\$23 to \$142. Negative bounds are possible because of the linear bid specification used. Ambivalence regions for the four wetlands are shown in Fig. 3. The upper bound varies from \$21.91 to \$157.75. The lower bound varies from \$0.27 to \$1.71. Due to the log bid specification, negative bounds are not possible.

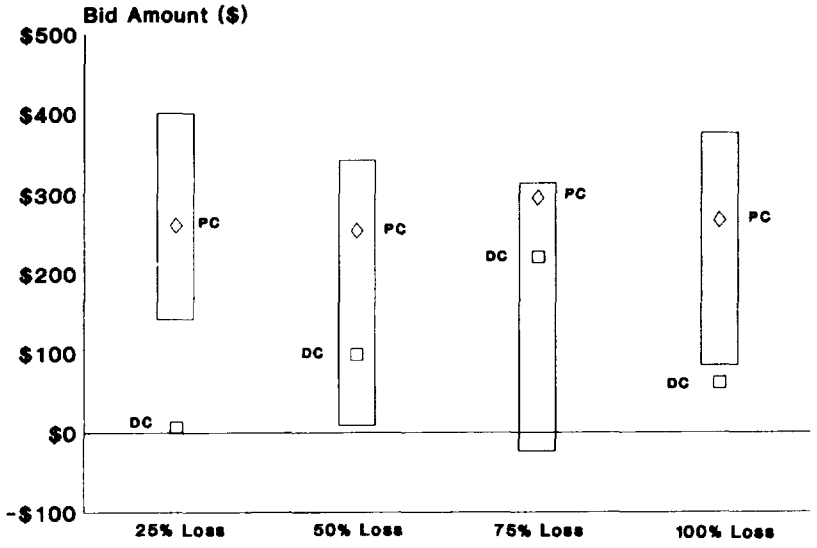

FIG. 2. Ambivalence range, PC-indifference bids, and DC-indifference bids for four horse farm loss scenarios.

For both studies, the ambivalence regions are rather wide. The lower bound is often close to $0, while the upper bounds are quite high. Respondents are reluctant to commit to preservation of wetlands or of horse farms if it costs any money, but they are also reluctant to abandon preservation altogether, even if it costs quite a bit.

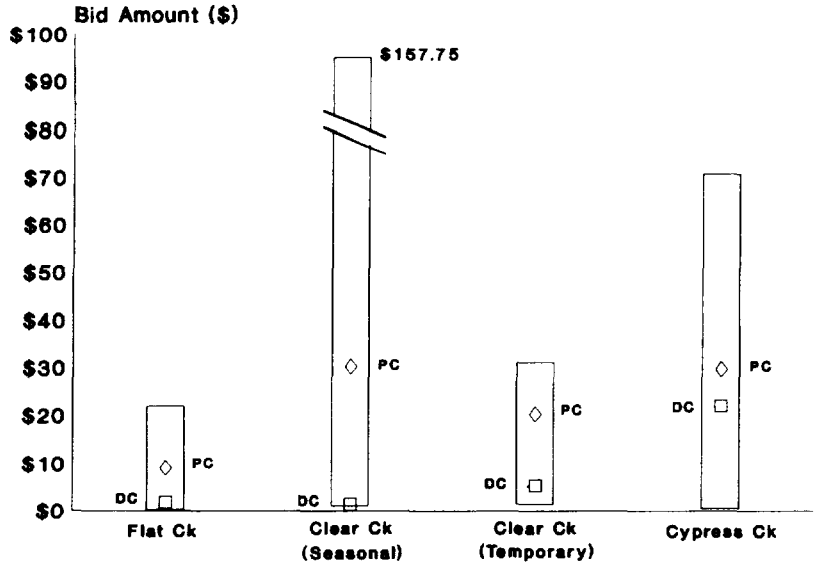

FIG. 3. Ambivalence range, PC-indifference bids, and DC-indifference bids for four wetland scenarios.

DC RESPONSES WHEN RESPONDENTS ARE AMBIVALENT

Given the wide range of bids over which respondents are ambivalent, how do respondents answer DC contingent valuation questions? Does the typical respondent switch from "no" to "yes" somewhere in the middle of the ambivalence region, in accordance with the usual assumptions, or does the switch occur closer to the lower bound of the region, consistent with conservatism?

We define the "middle" of the ambivalence region as the bid value at which half of the respondents to a PC valuation question would give one of the three "yes" responses, and half would give one of the three "no" responses. This amount is here called the PC-indifference bid, and is represented in Figs. 2 and 3 by a small diamond labeled "PC." The DC-indifference bid is similarly defined as the bid value at which half of the respondents to a DC valuation question would say "yes" and half would say "no," and is represented by a small square labeled "DC."

For both studies, for all scenarios, the DC-indifference bid is lower than the PC-indifference bid, indicating that respondents to the DC valuation questions did exhibit some degree of conservatism. These estimates of the PC- and DC-indifference bids are highly variable though, making direct statistical comparison difficult for individual scenarios. Table IV shows the PC- and DC-indifference bids estimated for each horse farm and wetland scenario, along with 95% confidence intervals estimated using the bootstrapping technique described by Park *et al.* [12].

Instead of conducting scenario-by-scenario comparisons, we statistically tested for conservatism by estimating an additional logit regression that combined the DC subsamples with the PC subsamples, with a dummy independent variable for question type (PC or DC). This analysis showed that the probability of a "yes"

TABLE IV

DC- and PC-Indifference Bids with 95% Confidence Intervals

Scenario	DC indifference	PC indifference
Wetland Study		
Clear Creek-temporarily flooded	\$5.15	\$20.27
	(1.49, 11.05)	(6.73, 64.88)
Clear Creek-seasonally flooded	1.33	30.23
	(0.09, 6.05)	(5.61, 257.51)
Flat Creek	1.71	8.92
	(0.17, 6.71)	(0.96, 33.38)
Cypress Creek	21.88	29.60
	(7.05, 118.56)	(5.92, 312.19)
Horse Farm Study		
25% loss	\$5.76	\$260.83
	(−253.35, 208.85)	(74.49, 886.79)
50% loss	97.10	253.98
	(−142.45, 401.00)	(118.37, 726.71)
75% loss	219.68	295.28
	(106.36, 635.64)	(103.14, 784.23)
100% loss	60.70	266.86
	(−136.94, 330.36)	(91.90, 854.05)

response is significantly higher for PC respondents than for DC respondents ($p < 0.01, t = 3.74$ for the wetland study, $p < 0.05, t = 2.51$ for the horse farm study), reinforcing the graphical evidence that respondents to DC contingent valuation questions show conservatism.

A strict conservatism rule would result in DC respondents answering "yes" only if the bid lies outside of the ambivalence region. Here, the DC-indifference bid lies above the lower bound of the ambivalence region for all wetlands scenarios, and for two of the four horse farm scenarios. It would appear that DC respondents are willing to answer "yes" to some bids lying within the ambivalence region. Our measure of the bounds of the ambivalence region are somewhat arbitrary, however. We could have placed the lower bound at the bid at which 40% of the PC respondents give a "definite yes" response. This would place the lower bound higher than shown in Figs. 2 and 3, and closer to the DC-indifference bids. Still, the PC- and DC-indifference bids are not arbitrarily defined. Regardless of how the upper and lower ambivalence bounds are measured, it is clear that some degree of conservatism is being demonstrated by DC respondents.[6]

DC VALUATION VERSUS PC VALUATION

What are the implications of conservatism for generating estimates of the value of horse farm and wetland preservation? One clear implication is that using a DC question format generates lower value estimates than using a PC question format. The DC- and PC-indifference bids presented in Table IV correspond to the medians of the estimated distributions of WTP across individuals and serve as one measure of the benefits of preserving horse farms or a wetland [7].[7] Based on the PC results, median WTP for horse farm preservation ranges from $254 to $295 per household per year, depending on the scenario. In contrast, the DC data yields median WTP values from $6 to $220. For the wetlands study, the PC data yielded median WTP values from $8.92 to $30.23, depending on wetland type, while the DC data gave values from $1.33 to $21.88. These differences, larger than an order of magnitude for some scenarios, could have dramatic policy implications.

A second implication is an apparent difference in the care taken by respondents in answering the questions. PC questions generate higher rates of "yes" responses because the respondent can give a "yes" response without making a strong commitment. An answer of "maybe yes" or "slightly prefer program" may do a better job of expressing respondents' mixed feelings than an answer of "yes." However, this greater ease in giving a "yes" response may also give the respondent less inducement to consider the question carefully before answering.

This lack of care shows up when investigating differences among scenarios. For the DC data from the wetlands study, the estimated median WTP for the Cypress Creek wetland, which was the wetland that had the most desirable characteristics

[6] While these results are consistent with conservatism, it should be noted that they are also consistent with lexicographic preferences that give dominance to money. For WTP questions, these two decision rules are indistinguishable.

[7] Another possible welfare measure is the mean WTP. For the horse farm survey, the linear bid specification implies that the median and mean are equivalent. For the wetland study, logit estimation resulted in a coefficient on LN(BID) greater than -1, implying that the mean WTP is infinite.

of the four,[8] was over four times as large as for the other three wetlands. The set of three wetland-type dummy variables is jointly significant ($p < 0.01$, X^2 with 3 d.f. = 12.14). For the PC regression, the Clear Creek seasonally flooded wetland generated the highest median WTP, though the Cypress Creek wetland value was a close second. However the dummy variables for wetland type are not significant at the usual levels (X^2 with 3 d.f. = 2.07). The relationship between wetland quality and the value of preserving the wetland is less clear for the PC data.

For the horse farm study, the relationship between level of loss and value of preservation is more complex. The DC data showed an increase in the value of preservation as the loss level increased from 25% to 75%, as would be expected. The value of preservation dropped, however, at the 100% loss level. These differences were significant at the 0.10 level (X^2 with 3 d.f. = 6.71). The unexpected drop at 100% may be due to a problem with the credibility of that scenario. Focus group participants indicated that they were willing to believe that the number of horse farms in Kentucky has been declining in recent years. However, many respondents were unwilling to believe that the horse industry might leave Kentucky completely. Some of the "no" responses for the 100% scenario may be due to rejection of that scenario by some respondents.[9] The PC data did not show a similar pattern. Differences in median WTP among scenarios were small, and insignificant at conventional levels (X^2 with 3 d.f. = 0.03). As in the wetland study, the PC respondents seem to pay less attention to the specifics of the scenario than do DC respondents.

Lack of care also may be responsible for greater variability in estimated WTP. In Table IV, the 95% confidence intervals around the PC-indifference bid estimates are uniformly larger than those for the DC-indifference bid estimates.

DISCUSSION

To summarize, we found four results that were consistent between the two studies. First, ambivalence regions, as defined here, are wide. Second, the PC format tends to result in slightly higher rates of usable responses, and therefore slightly higher sample sizes, than does the DC format. Third, the PC format results in much higher rates of "yes" responses, and therefore much higher estimated WTP's, than does the DC format. Fourth, respondents seem to be less influenced by the scenario being presented when answering a PC format valuation question than when answering a DC format question. These results were consistent between two WTP studies that investigated different amenities (wetlands and horse farms),

[8] Content analysis [17] was used to quantify the wetland quality information provided for each wetland type, generating a wetland quality scale that ranks the four wetlands based on the number of desirable characteristics each has [3]. Using this method, the Flat Creek wetland received a score of 7, the Clear Creek temporarily flooded wetland received a score of 12, the Clear Creek seasonally flooded wetland received a score of 13, and the Cypress Creek wetland received a score of 18.

[9] This pattern, increasing value from 25% to 75%, and a drop at 100%, was also seen in the open-ended valuation question used in the survey pretest. There, mean WTP to avoid a 25% loss was \$23.21 (n = 14), WTP to avoid a 50% loss was \$52.31 (n = 13), WTP to avoid a 75% loss was \$97.92 (n = 12), while WTP to avoid a 100% loss was only \$68.55 (n = 31).

used different payment vehicles (contributions and taxes), and motivated the six PC responses differently (by probability and by intensity of preference).[10]

All of these results are consistent with Opaluch and Segerson's model of ambivalence. Additional studies are needed, however, that compare CV responses using both PC and DC methods to actual behavior in simulated markets. If verified, ambivalence and conservatism in the face of ambivalence will have important implications for how contingent valuation is done, and how its results are interpreted.

The ideal in a contingent valuation survey is to get the respondent to make hypothetical choices between alternative bundles of money and amenities in the same way they would if faced with an actual decision situation. Conservatism is of concern because the potential errors introduced are not symmetric. If a respondent who follows a conservatism decision rule answers "yes" to a DC question, it is reasonable to assume that he or she would actually trade the money for the amenity. However, it is not clear that an ambivalent respondent who answers "no" will necessarily reject the trade in an actual decision situation. Such an individual might adopt the same conservatism decision rule in actual decision situations, in which case DC valuation questions would give accurate measures of actual WTP. However, an ambivalent individual might behave according to some other decision rule when faced with a nonhypothetical decision. Additionally, an actual choice situation may provide extra incentive for introspection, narrowing the ambivalence region further. To the extent that ambivalent individuals who answer "no" to a DC valuation question would adopt any other decision rule in an actual choice situation, DC contingent valuation will tend to underestimate actual WTP.

The data from our PC question format was not reliable enough for estimation of contingent values. We found that our PC questions did not provide enough incentive for the respondents to think long and hard when answering the questions. It was too easy for respondents to say "maybe yes" or "slightly prefer." It takes the discipline forced by a DC question to get the respondent to invest the time needed to fully consider the scenario being presented. This result calls into question the recommendation made by the NOAA Contingent Valuation Panel [10] that a "No-answer" option be offered as a response to a DC question. If the availability of such an option provides respondents with an easy way to avoid making a difficult contingent choice, the reliability and validity of the resulting WTP estimates will be reduced.

How could the DC format be improved? Clearly, anything that reduces the width of the ambivalence region would improve the quality of DC responses. If ambivalence is due in part to uncertainty over the amenity being investigated, more information could narrow the ambivalence region. Bergstrom *et al.* [1] observed that respondents who were given more information about the amenity being valued (wetlands in Louisiana) reported higher willingness to pay for preservation.[11] Their results are consistent with the hypothesis that additional information can narrow the ambivalence region. Practice at answering valuation questions may help re-

[10] Johannesson *et al.* [9] employed a format similar to our PC format in a study of health changes and obtained results consistent with ours. They did not offer ambivalence as a explanation or develop an alternative.

[11] Bergstrom *et al.* used an open-ended valuation question format, rather than the DC format considered here. Still, it is reasonable to expect that ambivalent respondents to an open-ended question would tend to report values near the lower bound of their ambivalence region.

spondents in their introspection process, resulting in narrower ambivalence regions. Likewise, inducements to take more time and care in answering valuation questions, such as in a simulated market in which real money is traded, could result in narrower ambivalence regions. Our results suggest that where ambivalence persists, however, its likely effect will be to decrease DC estimates of WTP. This potential source of bias must be considered along with other sources such as yea-saying when evaluating the validity of DC WTP estimates.

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