Contingent Valuation and Incentives

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ABSTRACT. *We empirically investigate the effect of the payment mechanism on contingent values by asking a willingness-to-pay question with one of three different payment mechanisms: individual contribution, contribution with provision point, and referendum. We find statistical evidence of more affirmative responses in the referendum treatment relative to the individual contribution treatment, some weak statistical evidence of more affirmative responses in the referendum treatment relative to the provision point treatment, and no statistical evidence of more affirmative responses in the provision point treatment relative to the individual contribution treatment. The relative credibility of the three payment mechanisms is also examined.* (JEL H41, Q26)

I. INTRODUCTION

Although the contingent valuation method is often criticized, it continues to be widely researched and frequently utilized to measure nonmarket values. The controversy has resulted in a discussion of *appropriate* methods for implementing a contingent valuation survey (Arrow et al. 1993). While we are still a long way from standardization, the NOAA panel recommendations are frequently cited as appropriate guidelines for implementing a contingent valuation study. One of the NOAA panel recommendations, based on the incentives for truthful demand revelation, is that the willingness-to-pay question be posed as a vote on a referendum.[1] The recommendation implicitly suggests that in the hypothetical decision-making framework of the contingent valuation method, individuals are sensitive to incentives for truthful demand revelation and will free-ride if the incentive structure allows for such behavior. Although there is evidence that incentives matter in actual payment situations, there has not been an empirical test of the effect on contingent values of departing from the referendum format. To bridge this knowledge gap, we investigate whether payment mechanisms with differing incentive structures give rise to different contingent values in a traditional field setting.[2]

In a recent paper, Carson, Groves, and Machina (1999) analyze the incentive properties of preference questions, and conclude that a hypothetical willingness to pay question is incentive compatible under the following five conditions: (1) the agency is able to coerce payments if the good is provided; (2) there are no other options for providing the good; (3) the posited payment is the real and only possible payment; (4) the posited amount of the good is the real and only quantity; and (5) the agency's decision potentially depends on the survey results. A further ob-

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[1] There has been some confusion in the literature about how ''referendum'' is used. Some have used the term referendum to refer to the dichotomous-choice format. We use the term to refer to the posing of the contingent valuation question as a vote on a referendum with a dichotomous-choice response format (e.g., vote in favor/vote against).

[2] In this article we use ''payment mechanism'' to refer to both the payment vehicle (e.g., taxes or donations) and the decision rule used to determine whether the good will be provided (e.g., majority vote or adequate number of contributions). Throughout this article the tax payment vehicle is always associated with a majority decision rule, the individual donations do not have a decision rule, and the provision point is associated with a decision rule of at least 30% of the respondents agreeing to pay. In all treatments the institution providing the good is Boulder County and the individuals paying for the good are Boulder County residents. However in the referendum payment mechanism all taxpayers in Boulder County would have to pay for the open space if the referendum passed while in the two contribution treatments the population paying for the good would be individuals who choose to donate.

vious condition is that (6) the money collected will be used only for the posited good. Based on the first condition, Carson, Groves, and Machina emphasize that only the referendum format can potentially elicit incentive compatible responses to a contingent valuation question. From a practical standpoint, however, it is difficult to know if a hypothetical referendum question is eliciting the desired Hicksian values. In light of the Carson, Groves, and Machina paper, this study provides an empirical comparison between a theoretically incentive compatible contingent valuation referendum and two elicitation formats that are known to be *not* fully incentive compatible. One reason for departing from the referendum format is that survey respondents may find other payment mechanisms, such as donations, to be more acceptable or credible mechanisms for providing the public good of interest. Therefore, there may be trade-offs in terms of the credibility of the mechanism and incentive compatibility.

This study involved a three-way split sample design to elicit willingness to pay for the purchase of a tract of land in Boulder County, Colorado, to be designated as open space. Open space designation was selected as the good to be valued because it is regularly provided through both taxes and contributions in Boulder County. In one treatment, the contingent valuation scenario described a land purchase to be made with donations to a trust fund managed by Boulder County. In a second treatment, the scenario described purchase of the land via donations to a trust fund managed by Boulder County with a guarantee that funds would be returned if not enough were collected, or rebated proportionately if more than enough were collected. In a third treatment, we described a referendum to implement a one-time tax on the residents of Boulder County to purchase the tract of land. In all three treatments, the willingness-to-pay question was posed using the dichotomous choice format.

Though the main focus of this research was to conduct an empirical test of the effects of the payment mechanism on contingent values, we also developed debriefing questions to investigate the credibility of various aspects of the three payment mechanisms. Our intent with these questions was to help us determine why, beyond possible strategic behavior, there might be differences among the treatments. For example, while a referendum format with a tax mechanism may be incentive compatible, in some cases respondents may not find the mechanism to be credible. One can envision a small-scale program involving just one National Park or National Forest where respondents to the contingent valuation survey reject the notion of a national referendum being held to determine whether the project will be funded. In such situations, a payment mechanism such as a donation to a trust fund may be more consistent with previous experiences. Even if a payment mechanism is deemed plausible by survey respondents, there may be specific aspects of the mechanism that respondents do not consider credible. For example, it may be plausible that a referendum would be held to fund an oil tanker escort service, but respondents may not believe that their household would actually be assessed a one-time tax of $500. By comparing responses among the three treatments to the debriefing questions, we explore the relative credibility of the three payment mechanisms.

II. PREVIOUS RESEARCH ON INCENTIVE STRUCTURES AND CONTINGENT VALUATION

Empirical research on public goods provision and incentive structures has largely been conducted in laboratory settings. The experiments have examined whether or not public goods can be efficiently provided by individual contributions. Results indicate that in early experimental rounds, subjects do not free-ride to the extent predicted by theory. However in later experimental rounds, free-riding becomes more prevalent (Andreoni 1988; Andreoni and McGuire 1993; Marwell and Ames 1981). Two additional features of experimental contribution scenarios, the provision point and the money back guarantee, have together shown some promise in averting the tendency to free-ride in later experimental rounds (Rose et al. 2002; Bagnoli and Lipman 1989; Rondeau, Schulze, and Poe 1999; Bagnoli and McKee 1991; Dawes et al.

1986; Isaac, Schmidtz, and Walker 1989; Bohara, McKee, and Berrens 1998).

The applicability of these results to contingent valuation studies conducted outside the control of a laboratory is unclear because of differences between the general conditions of the economic experiments and contingent valuation. The experimental-choice scenarios often involve continuous contribution levels rather than the binary choice format recommended for contingent valuation. Experimental-choice situations usually deal with actual money payments, rather than the hypothetical payments of contingent valuation. Finally, the choice experiments often involve repeated play, whereas contingent valuation is presented as a one-shot opportunity. In light of these differences, direct investigation of the effects of payment mechanisms on contingent values in a field setting is needed.

Only two contingent valuation studies have compared contingent values elicited under different payment mechanisms.[3] For protection of Leadbeater's possum, Jakobsson and Dragun (1996) compared responses from independent samples using a tax mechanism and donations to an independent conservation organization.[4] Both continuous or discrete choice responses suggested that the payment mechanism affected estimates of mean willingness to pay.[5] For the discrete choice data, mean willingness to pay from the donation sample was approximately 35% of mean willingness to pay from the tax sample. Jakobsson and Dragun explain this result by suggesting that the donation mechanism lacks credibility, where management of public land is the responsibility of the state in Australia. It is not common in Australia for private organizations to participate in such activities.

The other study was actually a pretest conducted by Bateman et al. (1995). In an effort to design a contingent valuation study with the most realistic payment mechanism, they pretested three mechanisms to fund flood defense work in a wetland area in the East Anglian area of England. The three payment mechanisms considered were an unspecified charitable donation (DONATE), payments to a specified charitable fund (FUND), and payments via a tax mechanism (TAX). For all three payment mechanisms, respondents were asked an open-ended contingent valuation question. The DONATE mechanism resulted in a disproportionate number of zero bids (46.5% compared to 23.1% for FUND and 11.8% for TAX). In response to a debriefing question about why respondents answered the contingent valuation question as they did, many of the DONATE and FUND respondents expressed doubt that the money would really be spent on flood defense work. Likewise, many of the TAX respondents said that although they did not like taxes, they thought the money would be spent as described. The authors noted that if the flood defense project were to actually be funded it would be with a tax mechanism, and concluded that as expected probabilities of the good being provided fall so do contingent values. Both Jakobsson and Dragun and Bateman et al. interpret their results in light of the credibility of the various payment mechanisms rather than incentive compatibility of the mechanisms.

III. HYPOTHESES

According to Samuelson (1954), the essential problem in public goods provision is that "any one person can hope to snatch some selfish benefit in a way not possible under the self-policing competitive pricing of private goods." Following this reasoning, the doctrine of self-interest dictates that provision by contribution should, at best, result in under contribution, the weak free-rider hypothesis, and, at worst, result in no contribu-

[3] There have been many contingent valuation studies comparing elicitation formats (e.g., open-ended, dichotomous-choice, payment card) but our focus is on payment mechanisms.

[4] The authors also valued conservation of all endangered flora and fauna in the state of Victoria, Australia. The flora and fauna portion of their study did not allow comparison by payment mechanism.

[5] The discrete choice comparison used a fairly small sample size of approximately 200 respondents in the respective treatments. Furthermore there were large proportions of protest bids. Once adjustments were made for protest zeros, the tax sample was reduced to 149 and the contribution sample was reduced to 138. Within each treatment respondents were assigned one of 20 bid values ranging from $1 to $150.

tion, the strong free-rider hypothesis. One way around this problem is through collective action with enforced payment. As noted by Carson et al. (1992), economic theory predicts that a binary, majority referendum is incentive compatible, even if the referendum is only advisory.[6] An intermediate position advanced by Brubaker (1975) suggests that if an individual receives an assurance that the remainder of the community would make appropriate matching offers along with a money back guarantee in the event sufficient contributions are not committed, then the public good may be efficiently provided. Under conditions of complete information, Bagnoli and Lipman (1989) showed that the core can be implemented through such a payment mechanism.[7] Public goods experiments also indicate that a provision point with money back guarantee reduces the tendency to under-contribute relative to individual contribution, even in later experimental rounds.[8]

These theoretical and empirical results lead to three hypotheses about payment mechanisms and contingent values: (1) that the contingent values inferred from the referendum treatment will not be less than the values inferred from the individual contribution; (2) that the contingent values inferred from the referendum treatment will not be less than the values inferred from the provision point treatment; and (3) that the contingent values inferred from the provision point treatment will not be less than the values inferred from the individual contribution. Our study was designed to test these hypotheses.

IV. STUDY DESIGN

The effects of payment mechanisms on contingent values were investigated using a three-way split sample design. The three independent samples were mailed contingent valuation surveys that were designed to be parallel in all aspects except the description of the payment mechanism for providing the good.

The Good

The study design required that the target good be (1) realistically provided by a public entity; (2) amenable to description in a mail survey; (3) of appropriate size to be funded by the study population; and (4) credibly provided through a tax mechanism and the donation mechanisms. Open space land purchases in Boulder County fit all these criteria. A tract of land was chosen for the study that was at risk of imminent commercial development if Boulder County did not purchase it and designate it as open space.[9] This tract was not included among the properties Boulder County had targeted for purchase with current funding.

The Survey[10]

The final contingent valuation scenario was developed with input from three focus groups and a pretest. We learned from focus groups that we needed to define open space, describe the current open space lands in Boulder County, and explain how Boulder County finances open space purchases. To communicate this information, we included maps of the designated open space properties in Boulder County, pie charts of open space expenditures in relation to total Boulder County expenditures, and written informa-

[6] The work of Carson et al. (1992) relies heavily on the work of Gibbard (1973) and and Satterthwaite (1975) who show that voting procedures with three or more alternatives can be manipulated and are therefore not incentive compatible.

[7] In this case the core refers to provision outcomes for which no coalition of agents could block the outcome. Given that the core exists, Pareto improving outcomes will reside in the core. Bagnoli and Lipman (1989) obtain their results using a particular refinement, undominated perfect equilibria.

[8] Rose et al. (2002) and Rondeau, Schulze, and Poe (1999) draw the distinction between demand revelation in the aggregate and demand revelation at the individual level regarding the provision point mechanism and individual contribution. Although this distinction is important when conducting induced value laboratory experiments, it is not directly applicable to our study. We focus on the propensity to agree to pay for the good under a provision point payment mechanism relative to both individual contribution and a referendum.

[9] We gratefully acknowledge the help of the late Carolyn Holmberg, Director of Boulder County Open Space until 1998, in helping us identify this tract of land.

[10] Hard copy of the survey instrument is available from the authors.

tion on financing and current holdings. After presenting this information, respondents were first asked about their use of and attitudes regarding open space in Boulder County. The survey then described the target property and showed its location on a map. Environmental characteristics of the property were described based on a recent biological assessment conducted on behalf of the local municipality. Survey participants were then told that the property was not on the list of properties to be purchased by Boulder County out of existing open space funds, and a proposal for purchasing the property was presented.

The three versions of the survey differed only in the description of the payment mechanism for purchasing the tract of land (see Appendix A for verbatim descriptions of each payment mechanism and the willingness to pay questions). The payment mechanisms were: (1) a voluntary individual contribution to a trust fund set up by Boulder County for the purpose of purchasing the property; (2) a provision point mechanism involving voluntary contributions to a trust fund set up by Boulder County for the purpose of purchasing the property which specified that at least 30% of Boulder County households had to agree to contribute or the property could not be purchased; and (3) a one-time tax increase for Boulder County residents based on the results of a referendum. The provision point mechanism also specified a money back guarantee if insufficient funds were collected, as well as a rebate if surplus contributions were collected. We chose a 30% provision point to be credible. In one of the focus groups we asked about an 80% provision point and were told by focus group participants that 80% seemed unreasonable.

All three versions posed the willingness to pay question using the dichotomous-choice format. Individuals were randomly assigned one of the following five offer amounts: $10, $20, $50, $80, $140. The bids were chosen with the goal of covering the range of the distribution as it is possible that treatment effects could be observed at some offer amounts but not others.[11] The offer amounts were selected based on the results of a pretest. In the pretest, four offer amounts were used ($10, $20, $50, and $80). Twenty-five percent of the pretest respondents receiving the $80 dollar offer amount said ''yes'' to the willingness-to-pay question, so we added the $140 offer amount in the final survey in anticipation that fewer respondents would say ''yes'' to this offer amount. Likewise we did not go above $140 as such an amount would not be credible given the likely cost of land in Boulder County and the relevant population who would pay. As discussed in the next section, approximately 28% of the respondents still chose ''yes'' at the $140 offer amount. This situation might call into question the estimated willingness to pay distributions but it should not affect the comparisons between the treatments.

The survey also included questions intended to measure the credibility and acceptability of aspects of the payment mechanisms. The first question asked respondents to rate on a ten-point scale (with the end points defined as 1 = very unlikely and 10 = very likely) how likely they thought ''enough money would be donated'' for the individual contribution treatment; ''30% of the households in Boulder County would agree to contribute'' for the provision point treatment; and ''a majority of Boulder County residents would vote yes on the referendum'' for the referendum treatment. A second question asked (yes or no) whether respondents were confident, if the referendum were actually held or the trust fund were actually set up, the money would be used as described (to purchase the property). A third question asked whether the offer amount was what respondents thought they would actually be assessed or asked to donate. Additional measures of the respondents' attitudes toward Boulder County and environmental protection were also elicited. The last section of the survey contained demographic questions.

The survey was administered through the

[11] The optimal bid designs usually focus on improving statistical efficiency by clustering the offer amounts around the median. Scarpa and Bateman (2000) investigate the trade-off in statistical efficiency gains from bid design versus follow-up bids to the dichotomous-choice contingent valuation question.

TABLE 1
PERCENTAGE ''YES'' RESPONSES TO THE WILLINGNESS-TO-PAY QUESTION BY OFFER AMOUNT AND TREATMENT

Offer Amount	Individual Contribution (n = 612)	Provision Point (n = 589)	Referendum (n = 626)
$10	62	63	64
$20	33	56	48
$50	37	36	39
$80	34	28	38
$140	28	28	30
Overall	39	42	44

mail to a sample of 4,200 Boulder County residents. We randomly assigned each sample point to one of the three treatments, so the initial survey mailing was sent to 1,400 people per treatment. The sample was purchased from a survey research firm and although it likely covered much of the Boulder County population, it was not intended to be representative. As our objective was to compare treatments, and not to generalize results to the population of Boulder County residents, a sample of this sort was adequate. Approximately ten days before the survey was mailed, a letter was sent on University of Colorado letterhead informing potential respondents that they would be receiving a survey. The survey packet included a survey booklet and a cover letter. Non-respondents to the first survey mailing received a postcard encouraging them to return the survey booklet. If they still did not respond, another survey packet was sent.

The response rates were very similar for the three treatments: 49% (n = 612) for the individual contribution, 47% (n = 589) for the provision point, and 50% (n = 626) for the referendum. Furthermore, contingency table analysis of the responses to both the open space use and attitude questions (asked at the beginning of the questionnaire) and the demographic questions found no statistical differences among the three treatments.

V. ANALYSIS OF THE EFFECT OF PAYMENT MECHANISM

We first report on the distribution of willingness-to-pay responses without regard to demographic characteristics, using both simple contingency table analysis and estimates from a univariate log-normal parametric model. We then consider a parametric valuation function approach that allows us to model differences in choices according to demographic and attitudinal characteristics.

Univariate Approach

The overall percentages of positive responses to the willingness-to-pay questions differ by treatment in the expected manner: 39% for the individual contribution, 42% for the provision point, and 44% for the referendum (Table 1). However, as seen in Figure 1, only the individual contribution and referendum treatments are consistently ordered in terms of percentage ''yes'' to the bid amounts. Under the provision point mechanism, acceptance of the bid amount is sometimes greater, and other times lower, than that of the other two mechanisms.

Pair-wise comparisons of the overall response to the willingness-to-pay question show that only the individual contribution and the referendum treatments are significantly different from each other ($\chi^2 = 4.083$; $p = .043$).[12] Looking at the individual offer amounts, we found that the hypothesized pattern of a higher percent yes in the referendum treatment relative to the individual contribution treatment was significant only for the $20 bid amount ($\chi^2 = 6.174$; $p = .013$).

Another test of our three hypotheses is to estimate parametric models of the willing-

[12] See Appendix B.

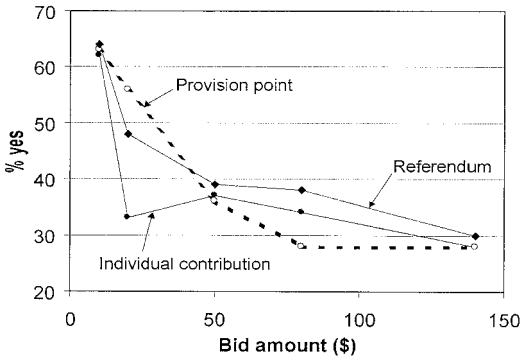

FIGURE 1
RESPONSE TO THE WILLINGNESS-TO-PAY QUESTION BY TREATMENT AND BID AMOUNT

ness-to-pay distributions. We use a pair-wise comparison by pooling the data into three separate data sets, each a combination of two of the treatments. We implement a lognormal specification using the likelihood criterion to test for treatment effects. Here the model is $\log(wtp) = \alpha_i + \varepsilon$ where i designates treatment and the error has a normal (Gaussian) distribution. We chose a log willingness to pay specification over a levels formulation that models willingness to pay as a constant plus an error because log formulations better handle right-tailed distributions.[13] Table 2 provides the estimation results for the univariate lognormal models.[14]

Given the log willingness to pay model, the treatment test is essentially a test for proportional differences in the median of the willingness-to-pay distributions. In addition to our log willingness to pay model being selected over a levels formulation, testing medians as opposed to means will be more robust to outliers. For the paired estimation results, we provide the predicted median willingness to pay for the main effect and then the predicted median for the other treatment. In addition to the prediction, we provide the proportional factor which is the subject of the hypothesis test (see the "Treatment" row in Table 2). Our likelihood ratio and t-statistic treatment tests directly translate into tests of whether the proportional change in the median willingness to pay due to treatment is different from one.[15] Due to our paired testing strategy, we have two estimates of median willingness-to-pay for each data subset.

The results of the univariate model analysis are qualitatively supportive of the three hypotheses in that the predicted median willingness to pay for the referendum data is greater than the median predicted for the provision point or individual contribution data. Similarly, the predicted median willingness to pay for the provision point data is relatively larger than the predicted median willingness to pay for the individual contribution data. However, as was the case for the contingency table analysis, the only statistically significant difference is between the referendum and individual contribution treatments. We consider a p-value of 0.076 to be statistical evidence, although weak, against the null hypothesis of no differences.

Valuation Function Approach

Our survey contained a number of demographic and attitudinal questions that are potentially useful in explaining responses to the willingness to pay questions. Using demographic and attitudinal questions in the modeling of choices has been referred to as the valuation function approach (Carson et al. 1992). This approach is used to control for confounding effects between treatments and individual characteristics, and allows for a more powerful test of the hypotheses. The valuation function includes eight attitudinal questions that we hypothesized would either positively or negatively influence responses to the willingness-to-pay question. We also included an income variable that was constructed from a categorical income question.[16] We did not have an expectation about

[13] This was the approach taken in the contingent valuation study of damages from the Exxon Valdez oil (Carson et al. 1992).

[14] In addition to treatment effects, we estimated models with different scale parameters. We found no statistical evidence against a common scale for the respective pairs.

[15] The exponential transformation is monotonic and so the rejection region for our hypothesis tests directly translates into proportional differences between median willingness to pay.

[16] We used the midpoint of each income category with the exception of the last category (above $150,000), where we used $160,000. We also estimated the model with income as a dummy variable (1 = in-

TABLE 2
UNIVARIATE LOGNORMAL MODELS FOR EACH OF THE THREE POOLED DATA SETS
(R = referendum, IC = individual contribution, PP = provision point)
(*p*-values in parentheses)

	R/IC Data	R/PP Data	IC/PP Data
Constant	3.1246[a]	3.2115[a]	2.8010[b]
	(0.0000)	(0.0000)	(0.0000)
Individual contribution	−0.4575	—	—
	(0.0870)		
Provision point	—	−0.0955	0.2891
		(0.6603)	(0.2105)
Sigma	3.5103	2.9002	2.4876
	(0.0000)	(0.0000)	(0.0000)
Likelihood ratio test	$\chi^2_1 = 3.1423$	$\chi^2_1 = 0.1807$	$\chi^2_1 = 1.6694$
	(0.0762)	(0.6708)	(0.2057)
Median WTP			
Referendum	$22.75	$24.81	
Individual contribution	$14.40		$16.46
Provision point		$22.55	$21.96
Treatment	WTP_R*.633	WTP_R*.909	WTP_{IC}*1.334

[a] Main effect equals referendum; treatment measures the difference from the main effect.
[b] Main effect equals individual contribution; treatment measures the difference from the main effect.

the sign on the income variable. Unlike many public goods, we did not necessarily expect willingness to pay to be positively related to income as open space is somewhat controversial, especially in Boulder County. There are many people who think that Boulder County has enough open space and loss of tax revenue from potential commercial development is a problem.

We estimated a log-normal parametric regression model with the variables listed in Table 3. The model is log-linear in the underlying variable, $\log(wtp) = X'\beta + \varepsilon$, where the error has a normal (Gaussian) distribution. Again we pooled the data pair-wise into three data sets. Table 4 presents the estimated models.

The valuation function analysis offers stronger evidence in favor of the first hypothesis ($WTP_{RR} \geq WTP_{IC}$); evidence, although not strong, in favor of the second hypothesis that $WTP_{RR} \geq WTP_{PP}$; and no statistical evidence that $WTP_{PP} \geq WTP_{IC}$.[17] The failure to find any significant difference between the provision point and the individual contribution treatments suggests that provision point mechanisms need to be more fully tested before any recommendations can be made about their use in contingent valuation studies.

VI. CREDIBILITY OF THE PAYMENT MECHANISMS

The main objective of this study was to empirically investigate the effects of three payment mechanisms on contingent values but our data also allow a preliminary investigation of the relative credibility of the mechanisms.[18] As mentioned above, open space lands in Boulder County are actually purchased with both tax revenue and donations. In focus groups we investigated respondents' perceptions of the plausibility of taxes and donations as mechanisms for raising funds

come greater than $90,000, 0 = income less than $90,000), but this coding scheme did not provide qualitatively different results from the model in Table 4.

[17] Similar results were obtained for linear models, $wtp = X'\beta + \varepsilon$. These models did not fit the data as well using the likelihood criterion.

[18] A reviewer aptly pointed out that credibility is just one dimension of the broader issue of whether survey respondents interpret information at face value. The reviewer suggested acceptability as another dimension. We cannot address this issue with our data but think it would be a useful topic for future studies.

TABLE 3
VALUATION FUNCTION VARIABLES

Variable	Description
Preserve	Preservation of natural areas; 1 = extremely important reason for acquiring open space, 0 = otherwise
Shape	Shaping or limiting urban growth; 1 = extremely important reason for acquiring open space, 0 = otherwise
Gooduse	Purchasing open space is a good use of Boulder County tax dollars; 1 = yes, 0 = no
Miles	Distance from home to property in miles.
Toomuch	Boulder County spends too much money on open space; 1 = strongly agree, 0 = otherwise
Enviro	Consider yourself . . . 1 = extremely interested in the environment, 0 = otherwise
Envprod	Buy products that are environmentally friendly even if they cost more; 1 = frequently, 0 = otherwise
Move	Do you anticipate moving out of Boulder County in the next five years? 1 = yes, 0 = no
Income	$7,500; $22,500; $37,500; $52,500; $67,500; $82,500; $97,500; $112,500; $135,000; $160,000
PP	1 = Provision point mechanism, 0 = otherwise
IC	1 = Individual contribution mechanism, 0 = otherwise

for open space and found both mechanisms to be credible in general. However, specific aspects of the payment mechanisms were found to have differing levels of credibility. Survey measures were designed to investigate two aspects of payment mechanism credibility: (1) whether respondents thought that the money would be used as described if the respective payment mechanism were actually enacted and (2) whether respondents thought that if the payment mechanism were enacted; they would pay the offer amount provided in the survey.

With regard to the first issue, the donation mechanisms were considered to be more credible than the referendum mechanism. As shown in Table 5, 62% of the respondents in the provision point treatment and 54% of those in the individual contribution treatment said they thought the donations would be used as described, compared with 47% in the referendum treatment. The percentages from the three payment mechanisms are statistically different from each other at the 0.05-level (see Appendix B). This result is surprising given that in all three treatments Boulder County would be managing the funds (either taxes or contributions).

In terms of the credibility of the offer amount, the referendum appears to be superior to both donation mechanisms (Table 5). Fifty-eight percent of the respondents in the referendum treatment thought that if the referendum were held and passed, their one-time tax assessment would be the offer amount listed in their survey.[19] Fifty-two percent of respondents in the provision point treatment, and only 37% of the respondents in the individual contribution treatment, thought that if a trust fund were set up, the amount they would be asked to donate would be the amount posited in their survey. In the referendum treatment, there is no statistical evidence that the response distribution for this question depends on the offer amount listed in the survey. This is not the case with the individual contribution and provision point treatments. The number of respondents who thought the offer amount listed was what they would actually be asked to donate is relatively constant across the various offer amounts, but the number of respondents who thought the amount they would actually pay would be less than the posited amount increases as the offer amount increases. This result could be an artifact of the somewhat unusual situation of soliciting contributions

[19] The possibilities were (1) no, donate/pay more; (2) no, donate/pay less; and (3) yes, the stated amount.

TABLE 4
ESTIMATED VALUATION FUNCTIONS FOR EACH OF THE THREE POOLED DATA SETS
(R = referendum, IC = individual contribution, PP = provision point)
(*p*-values in parentheses)

	R/IC Data	R/PP Data	IC/PP Data
Constant	1.2562[a]	1.0668[a]	0.0942[b]
	(0.1729)	(0.1156)	(0.9066)
IC	−0.8191	—	—
	(0.0071)		
PP	—	−0.3963	0.2427
		(.0689)	(0.2751)
Sigma	3.1669	2.3824	2.4876
	(0.0000)	(0.0000)	(0.0000)
Preserve	1.3176	1.4189	1.3861
	(0.0003)	(0.0000)	(0.0000)
Shape	1.1498	0.5050	0.3641
	(0.0009)	(0.0329)	(0.1372)
Gooduse	2.5540	2.3314	2.8141
	(0.0008)	(0.0000)	(0.0000)
Miles	−0.0368	−0.0228	−0.0341
	(0.0476)	(0.0966)	(0.0218)
Toomuch	−3.1074	−1.2239	−1.0868
	(0.0008)	(0.0393)	(0.0960)
Enviro	0.8496	0.7345	1.1459
	(0.0292)	(0.0120)	(0.0004)
Envprod	0.5659	0.0525	0.6632
	(0.0914)	(0.8307)	(0.0114)
Move	−1.0569	−0.5266	−0.7793
	(0.0104)	(0.0637)	(0.0151)
Income	0.0018	0.0010	0.0029
	(0.6004)	(0.7018)	(0.2925)
Likelihood ratio test[c]	$\chi^2_1 = 8.896$	$\chi^2_1 = 3.531$	$\chi^2_1 = 1.207$
	(0.0029)	(0.0602)	(0.2719)

[a] Main effect equals referendum and treatment measures the difference from the main effect.
[b] Main effect equals individual contribution and treatment measures the difference from main effect.
[c] At the request of an anonymous referee, we tested the null hypothesis that all parameters are equal across treatment pairs against a null of all parameters being different. Using likelihood ratio tests for the paired treatments used in Table 4, we found no statistical evidence against the null using the alternative that all parameters are the same. The respective Chi-squared tests were R/IC: $\chi^2_{11} = 9.19$, p = .604; R/PP: $\chi^2_{11} = 10.202$, p = .512; IC/PP: $\chi^2_{11} = 8.14$, p = .70.

in the dichotomous take-it-or-leave-it format. Respondents might think that when it comes to making a contribution, they will ultimately decide how much the contribution will be. Clearly this is not the case for taxes.

Respondents were also asked how likely they thought it was that ''enough'' people would donate for the contribution mechanisms or vote yes in the referendum treatment. ''Enough'' was defined as a majority of voters for the referendum treatment, as 30% of Boulder County households for the provision point treatment, and not defined for the individual contribution treatment. The distributions of responses to this question are significantly different between the individual contribution and the referendum treatments and likewise between the provision point and referendum treatments. More respondents in the contribution treatments thought it ''very unlikely'' that there would be enough donations (12% for individual contribution and 11% for the provision point) relative to the referendum treatment (6%).

VII. CONCLUSION

Our results, summarized in Table 6, support the NOAA panel's (Arrow et al. 1993) concern over potential differences that may

TABLE 5
PERCENTAGE OF RESPONSES TO CREDIBILITY QUESTIONS BY TREATMENT

	Individual Contribution	Provision Point	Referendum
Do you think the donations (tax revenue) would be used to purchase property as described?			
Yes	54	62	47
No	46	38	53
If a trust fund were actually set up (referendum held), do you think the amount you would be asked to donate (one-time tax assessment) would be $(offer amount)?			
No, more	50	40	38
No, less	13	8	4
Yes	37	52	58
How likely do you think it is that enough/at least 30%/a majority will agree to donate/vote yes?			
1 = very unlikely	12	11	6
2	8	6	8
3	14	12	16
4	12	11	12
5	13	13	14
6	14	15	18
7	9	12	16
8	11	13	6
9	2	3	1
10 = very likely	5	6	3

occur due to the incentive structures associated with various payment mechanisms. Relative to the referendum mechanism, we find statistical evidence that the individual contribution mechanism in a dichotomous choice question format results in a lower propensity to agree to pay for a public good, which is consistent with economic theory. The evidence is weaker that the provision point mechanism provides lower willingness to pay than the referendum treatment. And we find no statistical differences in willingness to pay between the provision point and the individual contribution (Table 6). While these two contribution mechanisms should be viewed as competitors when the referendum is not practical, our analysis offers no real insight into whether one should be chosen over the other. However, application of the provision point mechanism to contingent valuation probably merits further investigation.

Carson et al. (1999) proposed necessary conditions for an incentive compatible payment mechanism but, as a practical matter, even when the researcher designs the contingent valuation exercise to satisfy these conditions, one cannot assume that respondents will find all information provided in the contingent valuation scenario to be credible. Schwarz (1997) made this point when he argued ''The bottom line is simple: Respondents do not value the good as described, but the good as represented in their own mental construal of the scenario. . . . Understanding these construal processes may raise as well as solve problems that are crucial to CV research'' (p. 176). Focus groups, verbal protocols and other qualitative research methods are useful for developing credible scenarios. However, we also advocate development of survey questions to assess respondents' interpretation of information provided in the survey. Measuring issues such as credibility is a difficult task because including credibility questions may suggest to respondents that

TABLE 6
SUMMARY OF STATISTICAL EVIDENCE

Analysis	Hypotheses H_0: $WTP_{IC} = WTP_R$ H_1: $WTP_{IC} \leq WTP_R$	 H_0: $WTP_{IC} = WTP_{PP}$ H_1: $WTP_{IC} \leq WTP_{PP}$	 H_0: $WTP_{PP} = WTP_R$ H_1: $WTP_{PP} \leq WTP_R$
Contingency analysis	$p_{\chi^2} = .04$ Evidence Against H_0	$p_{\chi^2} = .23$ No Evidence Against H_0	$p_{\chi^2} = .44$ No Evidence Against H_0
Univariate	$p_{LRT} = 0.076$ Weak Evidence Against H_0	$p_{LRT} = 0.671$ No Evidence Against H_0	$p_{LRT} = 0.206$ No Evidence Against H_0
Covariate	$p_{LRT} = 0.002$ Strong Evidence Against H_0	$p_{LRT} = 0.272$ No Evidence Against H_0	$p_{LRT} = 0.060$ Weak Evidence Against H_0

credibility is an issue. Credibility is not likely to be a black-and-white issue; as we found in this study, it may be a matter of degree.

APPENDIX A
VERBATIM SURVEY DESCRIPTIONS OF THE THREE PAYMENT MECHANISMS AND THE WILLINGNESS-TO-PAY QUESTIONS

Individual Contribution

- Suppose Boulder County were to set up a trust fund to purchase the property and households in Boulder County would be asked to make a voluntary one-time payment of **$ offer amount** into this trust fund.
- The funds would only be used to purchase the property described above.

1. Would you be willing to contribute **$ offer amount** to this special trust fund to purchase the described property as open space? (CIRCLE ONE NUMBER)

   1 I would not contribute

   2 I would contribute

Provision Point

- Suppose Boulder County were to set up a trust fund to purchase the property and households in Boulder County would be asked to make a voluntary one-time payment of **$ offer amount** into this trust fund.
- The funds would only be used to purchase the property described above.
- Purchase of the property would only be feasible if 30 percent of the households in Boulder County paid into the trust fund.
- If not enough households agreed to pay, the payments would be returned to those households that had paid.
- If more than enough households paid, surplus funds would be divided among the households that had paid.

1. Would you be willing to contribute **$ offer amount** to this special trust fund to purchase the described property as open space? (CIRCLE ONE NUMBER)

   1 I would **not** contribute

   2 I **would** contribute

Referendum

- Suppose that Boulder County was to hold a special referendum that if passed would impose a one-time tax of $ offer amount per Boulder County household which would be used only to purchase the property described above.
- Purchase of the property would be feasible if a majority of the households in Boulder County voted in favor of the referendum.

1. How would you vote on a referendum which would impose a one-time tax of **$ offer amount** on every household in Boulder County for the purpose of purchasing the described property for open space? (***CIRCLE ONE NUMBER***)

   1 I would vote against the referendum

   2 I would vote in favor of the referendum

APPENDIX B

CROSS-TABULATION STATISTICS

Variable	Treatments	Pearson χ^2	*p*-value
Overall response to WTP question	IC v. PP	1.46	.23
	PP v. R	.61	.44
	IC v. R	4.08	.04
Response to WTP at $10 offer amount	IC v. PP	.04	.84
	PP v. R	.00	.97
	IC v. R	.07	.80
Response to WTP at $20 offer amount	IC v. PP	12.87	.00
	PP v. R	1.64	.20
	IC v. R	6.17	.01
Response to WTP at $50 offer amount	IC v. PP	.01	.91
	PP v. R	.21	.65
	IC v. R	.13	.72
Response to WTP at $80 offer amount	IC v. PP	.95	.33
	PP v. R	2.39	.12
	IC v. R	.34	.56
Response to WTP at $140 offer amount	IC v. PP	.01	.90
	PP v. R	.10	.75
	IC v. R	.20	.66
Do you think the donations (tax revenue) would be used to purchase property as described? Yes/No	IC v. PP	7.61	.01
	PP v. R	23.93	.00
	IC v. R	4.69	.03
If a trust fund were actually set up (referendum held), do you think the amount you would be asked to donate (one-time tax assessment) would be $(offer amount)? No, more/No, less/Yes	IC v. PP	23.41	.00
	PP v. R	10.11	.01
	IC v. R	59.32	.00
How likely do you think it is that enough/at least 30%/a majority will agree to donate/vote yes? 1 = very unlikely/10 = very likely	IC v. PP	9.21	.42
	PP v. R	44.37	.00
	IC v. R	39.76	.00

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