MEMORANDUM | January 25, 2016

TO Katherine Pease, NOAA

FROM Total Value Team

SUBJECT Appendix 1.13: A Behavioral Model of Voting in Contingent Markets (Revised Draft)

1. A BEHAVIORAL MODEL OF VOTING IN CONTINGENT MARKETS

The contingent valuation (CV) approach remains the only method that has the ability to obtain the total economic value of the good or service in question. Yet, there has been debate about whether a CV survey is able to provide reliable benefit estimates. A part of that debate considers two major conjectures: 1) an upward "hypothetical bias" permeates CV estimates and 2) respondents in a CV market are unduly influenced by 'yea-saying,' 'warm glow,' or some other expressive preference that they express during the voting decision.

The first claim is usually based on evidence from lab and field experiments with hypothetical bias typically defined as the difference between purely hypothetical and actual statements of value (see, e.g., Cummings, et al. [1995], [1997]; List [2001]; List and Gallet [2001]; Little and Berrens [2004]; Murphy, et al. [2005]; Harrison [2006]; Loomis [2011]; Carson et al. [2015]). The second claim involves behaviors in a CV market being influenced by yea-saying (defined various ways, including that "people have a tendency to answer yes rather than no" (see Schuman and Presser [1981]; Hurd [1999]) or by warm glow. While there are many alternative definitions of warm glow, one common variant is detailed in the National Oceanic and Atmospheric Administration (NOAA) report: "the value of a feeling of having done something praiseworthy."

This Appendix outlines a behavioral model of voting in contingent markets in an effort to understand how these criticisms affect the integrity of CV data. In so doing, the analysis explores how such effects would manifest themselves in CV responses. The model produces new predictions that allow one to assess how important these factors are in a typical application of CV.

1.1 BASE MODEL

Since a consequential dichotomous choice (DC) structure for CV survey has been shown to be incentive compatible (Carson, Groves and List [2015]) this analysis will focus on the single binary choice format. By asking respondents to vote for or against a program at a certain price (or tax), the DC format provides a relatively familiar and simple framework. The institution also shares similarities to the take-it-or-leave-it posted price offers that many consumers face.

The DC approach presents a simple choice environment:

Vote for the program to provide Q1 if:

$$V_{Q1} - V_{Q0} \geq tax\ (T), \qquad (1)$$

In this relationship Q1 designates an amount of a desirable object of choice which exceeds the amount available without the program. This amount is designated by Q0. V_{Q0} is the individual's value of the good or service in question in its current state (described here in monetary terms), and V_{Q1} is the individual's value of the good or service in question in its proposed state with the program implemented. T is the tax, or the proposed 'price' that the individual pays for the proposed change. Equation (1) says that the individual should vote for the program if the proposed change yields more economic value than the tax he must pay to provide the good.

In some CV surveys designed to use this format, each respondent is explicitly told before casting his vote, that if more than 50 percent of the people in the group vote in favor, then the good would be provided and he will pay T. If 50 percent or fewer of people in the group vote no, then the good would not be provided and no one would pay anything. The voting format requires an adjustment to equation (1) since each respondent should anticipate that others are casting their votes. As such, an individual may be uncertain how his vote maps into the eventual outcome and must consider the probability of being pivotal (p) when casting his vote:

$$p(V_{Q1} - V_{Q0} - T) \geq 0 \qquad (2)$$

Provided the voter believes that p > 0, then the computation is identical to that above: he should vote yes if the proposed change yields more value (in monetary terms) than what he has to pay (T). The incentive compatibility of the vote remains intact in this case: he should vote based on what is in his best interests when p > 0.[1] That is the framework is incentive compatible.

One can now begin to see the connection with the criticism in the literature that has been labeled denoted 'hypothetical bias.' If the voter believes that p = 0, or he believes that his vote has zero chance of being pivotal, then we are in a purely hypothetical setting. In that case, the model is not well understood since economic theory is driven by incentives, and in this simple model there are no incentives to vote truthfully. Votes should be generated randomly if the voter believes p = 0 under this model.

In CV surveys, a second consideration arises—the 'consequentiality' of the vote. That is, a CV survey question is consequential if the agent believes his response will potentially affect some outcome that he cares about. Consequentiality has been operationalized in many different ways in the literature, but it amounts to amending equation (2) as follows:

$$c * p\left(V_{Q1} - V_{Q0} - T\right) \geq 0, \qquad (3)$$

1 The position of being pivotal has been discussed at length in the voting literature. One recent example is Mitani and Flores (2012), who examined whether varying group sizes between one and 45 makes a difference in group voting behavior. They found that it did not.

where c is the probability of the vote being consequential. In this model, c represents the probability of the referendum being consequential.

The model predicts that for any positive c and p values, the agent will vote his true preferences. Indeed, it further predicts that provided c and p are positive, changes in either will not affect the voting distribution. Carson et al. [2015] provide proofs of the incentive compatibility of equation (3), and further predictions and the assumptions necessary to generate those predictions.

In particular, Carson et al. [2015] show that the incentive compatibility of a single binary choice question does not require agent preferences to conform to expected utility. In particular, they show that voters should vote their true preferences under the weaker assumption that lies behind cumulative prospect theory (Tversky and Kahneman [1992]) and rank dependent expected utility (Quiggin [1992]), two of expected utility's primary competitors. This result is important because the influence of a consequential survey question is through its probabilistic influence on an ultimate, potentially multi-stage decision of interest and it has been argued that utility functions that are not linearly additive in probabilities are potentially important in environmental policy analysis (Mason, et al. [2005]; Shaw and Woodward [2008]).[2]

To connect this idea to the empirical literature, consider that p is the probability of being the pivotal voter in the referendum and c is the probability that the vote will be executed with real stakes. For example, if a fair coin is flipped: in the c=50 percent case, a flip of heads means that the votes are counted and if 50 percent or more of the votes are "yes" then the good is provided and T is collected from each person. If the coin flip is tails then no money is collected and the good is not provided regardless of the vote distribution.

At this point it is important to step back and tie equation (3) to the CV literature. When critics discuss hypothetical bias and propose that it is implied by the existing literature, they are often relying on lab or field experimental evidence that has the "survey" treatments explicitly designed to be "purely hypothetical." That is the subjects are told, often repeatedly so, that their responses will not have an influence on the provision of the good or service. Such treatments are "inconsequential" in that similar to the case where p = 0, the model is not well understood. There are no incentives for individuals to vote truthfully when c=0. The researcher contrasts these inconsequential responses with responses from a 'consequential survey,' where c > 0. To operationalize c > 0, respondents are typically told that the survey is being done to help inform policy decisions and a government agency is the explicit sponsor of the survey in some cases.

A number of studies have started to examine various issues related to consequential survey questions (e.g., Polomé [2003]; Landry and List [2007]; Carson, Chilton, and Hutchinson [2009]; Nepal, Berrens, and Bohara [2009]; Vossler and Evans [2009]; Herriges, et al. [2010]; Vossler, Doyon and Rondeau [2012]; Vossler and Watson [2013]; Carson et al. [2015]; Mitani and Flores [forthcoming]) and have found substantial empirical support for predictions concerning economic behavior that follow from it.

2 Note that if expected utility does hold, equation (3) provides a setting that is isomorphic to the 'random lottery' approach used in experimental economics under which a subject makes several choices and of them, randomly chosen, is paid.

In addition, in a recent study Carson et al. [2015] find that in tests comparing consequential treatments ($c > 0$) to the inconsequential treatment ($c = 0$), a different response is obtained at $c = 0$, in terms of both the mean and variance of the response. This suggests that results obtained for the inconsequential purely hypothetical case should not be used to make inferences about how the standard consequential $c > 0$ case behaves. One way of summarizing their results and the insights gained from the broader literature is that people report truthfully when it is in their interest to do so. They do not report truthfully when it is in their interest not to. Finally respondents' reports, when there are no incentives, can diverge from situations where there are incentives for truthful preference revelation.

What can be done to test the model with CV market data? CV surveys typically generate data to examine if the CV market has a $c = 0$ or $p = 0$ problem. One first step to evaluating if the survey is affected by hypothetical bias (or has p = or c =0) should have the analyst test of scope and monotonicity.[3] From this simple model one can see how demanding it is for CV surveys to pass a scope test and not to violate monotonicity assumptions. If c*p (hereafter P) is small, then even large changes in $V_{Q1} - V_{Q0}$ (and T) might not be perceptible to the voter. If these integrity tests fail, one potential reason why is that the analyst did not provide the necessary incentives for truthful revelation.

1.2 ADDING EXPRESSIVE VOTING TO THE BASE MODEL

Recently critics have contended that this most basic model is lacking. They argue that the nature of voting is importantly influenced by yea-saying (defined various ways, including that "people have a tendency to answer yes rather than no" (see Schuman and Presser [1981]; Hurd [1999]), suggesting that some respondents will vote in favor regardless of whether $V_{Q1} - V_{Q0} - T$ is positive, social desirability bias (see Appendix 1.9) and warm glow effects (see Technical Memo TM-3 and Appendix 1.13).

Blamey et al [1999] view the yea-saying problem as follows:

> One possible explanation for the overestimation of values is the presence of yea-saying in CVM responses. Also known among psychologists and sociologists as response acquiescence, yea-saying is defined as the tendency to agree with questions regardless of content (Cronbach 1946, 1950; Couch and Keniston 1960; Ardt and Crane 1975; Moum, 1988). In the context of in-person CVM interviews, Mitchell and Carson (1989, 240- 41) defined it as "the tendency of some respondents to agree with an interviewer's request regardless of their true views."

One feature that is consistent in the various arguments in the literature on expressive utility is that most definitions of these motivations (yea-saying, warm glow, etc.) construct each as a *narrow* feature of preferences.

In the end, each consideration is the tendency to trade-off preferences over $V_{Q1} - V_{Q0} - T$ with some other characterization of expressive motivations when responding to CVM questions. These motivations may be social in nature or driven by internal considerations,

3 In Technical Memo TM-3 these are also referred to as being associated with the quantity and cost conditions.

where warm glow or self-signaling might be at work. Yet, in each case, the definitions in the literature largely suggest that this component, which we denote as expressive motivations, is *independent* of $P(V_{Q1} - V_{Q0} - T)$. This is a key assumption and will drive some of the predictions discussed below.

With expressive voting, the voting problem becomes:

$$P(V_{Q1} - V_{Q0} - T) + E \geq 0 \quad (4)$$

where E represents utility gained from the act of voting Yes and can be positive or negative. We model E to include all of the potential expressive preferences that the literature discusses. The voter is now comparing the left side of equation (4) to zero when deciding what to do.

Equation (4) represents the crux of the debate between critics who cite expressive preferences as a problem for CV. Critics contend that P is effectively zero and the component E is what drives voting decisions. CV proponents argue that well-done surveys have $P > 0$, and that E does not bias valuations upward.

This formulation also highlights that since P is plausibly small in many CV scenarios, if E is an important consideration it should dominate the decision. But, in such a case, what directly follows is that scope and monotonicity tests should be readily violated. If such tests are passed, then great pause should be taken in arguing that E is an important consideration in the voting decision.

If one selects T that sets the left side of equation (4) equal to zero and then solves, an interesting relationship emerges with willingness to pay (WTP):

$$WTP = T = V_{Q1} - V_{Q0} + E/P. \quad (5)$$

Equation (5) indicates that this model implies if E is zero, then the exercise of paying a tax via voting yields the marginal person to provide an exact WTP value, and infra-marginal people will provide lower bound WTP values. Further, if E is positive, WTP falls as P approaches one, and converges to exactly E above WTP. If E is negative, WTP rises as P approaches one, and converges to exactly E below WTP.[4]

This result is different than the standard model discussed in Section 1.1, which predicts that WTP is invariant to changes in P (provided P remains positive). We provide some illustrative figures to show the implications of this revised structure. These figures illustrate that if E is positive, the WTP implied by the model falls as P approaches one. If E is negative, WTP rises as P approaches one.

When one considers the empirical evidence thus far from incentive compatible lab and field experiments, there is little evidence to show that WTP follows such shapes in p. In particular, the bulk of evidence suggests that WTP is flat in p values. Moreover, when consequential CV surveys are consistent with weak monotonicity and display response to scope then under this model that evidence is consonant with the notion that there is no evidence to say that E is a large positive factor in respondents' votes.

4 We should highlight that this insight is heavily reliant on the manner in which we model the decision problem. In particular, whether E is independent of the other parts of the choice problem.

FIGURE 1. IMPLIED WTP WITH E = 5

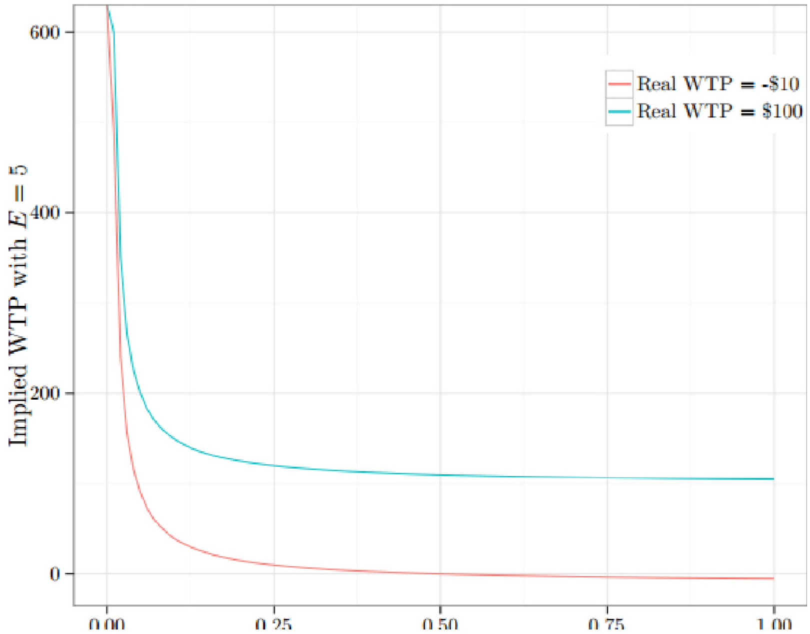
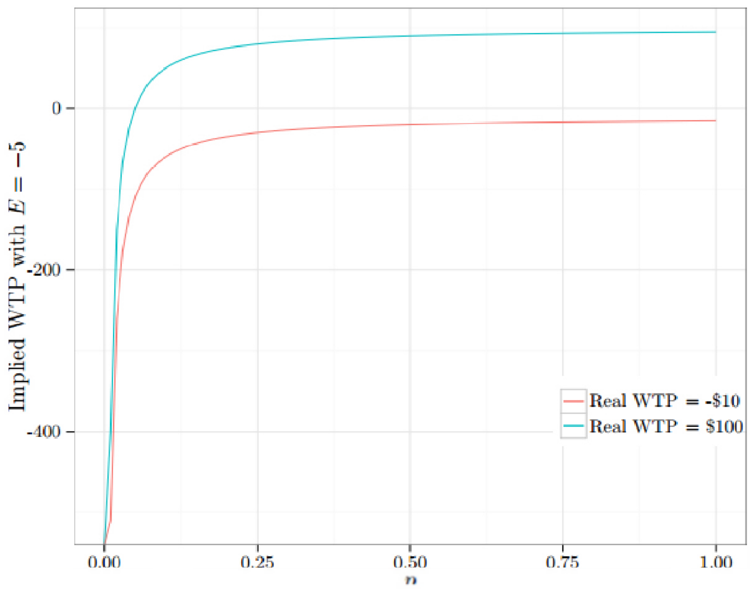


FIGURE 2. IMPLIED WTP WITH E = -5



REFERENCES

Arndt, Johan, and Edgar Crane. "Response bias, yea-saying, and the double negative." Journal of Marketing Research (1975): 218-220.

Arrow, Kenneth J., Robert M. Solow, Paul R. Portney, Edward E. Learner, Roy Radner and Howard Schuman. Report of the NOAA Panel on contingent valuation. Federal Register 58 (1993): 4601-4614.

Blamey, Russell K., Jeffrey William Bennett, and Mark D. Morrison. "Yea-saying in contingent valuation surveys." Land Economics (1999): 126-141.

Carson, Katherine S., Susan M. Chilton, and W. George Hutchinson. Necessary conditions for demand revelation in double referenda. Journal of Environmental Economics and Management 57 (2009): 219-225.

DeShazo, J. R., R. T. Carson, K. A. Schwabe, J. R. Vincent, A. Ismariah, S. K. Chong, and Y. T. Chang. "DESIGNING AND IMPLEMENTING SURVEYS TO VALUE TROPICAL FORESTS." Journal of Tropical Forest Science 27, no. 1 (2015).

Couch, Arthur, and Kenneth Keniston. "Yeasayers and naysayers: agreeing response set as a personality variable." The Journal of Abnormal and Social Psychology 60, no. 2 (1960): 151.

Cronbach, Lee J. "Response sets and test validity." Educational and psychological measurement 6, no. 4 (1946): 475-494.

Cronbach, Lee J. "Further evidence on response sets and test design." Educational and psychological measurement (1950).

Cummings, Ronald G., Glenn W. Harrison, and E. Elisabeth Rutström. Homegrown values and Hypothetical Surveys: Is the Dichotomous choice approach incentive-Compatible? American Economic Review 85: (1995) 260-266.

Cummings, Ronald G., Steven Elliot, and James Murphy. Are hypothetical referenda incentive compatible? Journal of Political Economy 105 (1997): 609-621.

Harrison, Glenn W. Experimental evidence on alternative environmental valuation techniques. Environmental and Resource Economics 34 (2006): 125-162.

Herriges, Joseph, Catherine Kling, Chih-Chen Liu, and Justin Tobias. What are the consequences of consequentiality. Journal of Environmental Economics and Management 59 (2010): 67-81.

Hurd, Michael D. "Anchoring and Acquiescence Bias in Measuring Assets in Household Surveys." Journal of Risk and Uncertainty 19, no. 1 (1999): 111-136.

Landry, Craig E. and John A. List. Using ex ante approaches to obtain credible signals for value in contingent markets: evidence from the field. American Journal of Agricultural Economics 89 (2007): 420-429.

List, John A. and Craig A. Gallet. What experimental protocol influence disparities between hypothetical and actual values. Environmental and Resource Economics 20 (2001): 241-254.

List, John A. Do explicit warnings eliminate the hypothetical bias in elicitation procedures? Evidence from field auctions for sportscards. American Economic Review 91 (2001): 1498-1507.

Little, Joseph M. and Robert P. Berrens. Explaining disparities between actual and hypothetical stated values: further investigations using meta-analysis. Economics Bulletin 3 (2004): 1-13.

Loomis, John B. What's to know about hypothetical bias in stated preference studies. Journal of Economic Surveys 25 (2011): 363-370.

Mason, Charles F., Jason F. Shogren, Chad Settle, and John A. List. Investigating risky choices over losses using experimental data. Journal of Risk and Uncertainty 31 (2005): 187-215.

Mitani, Yohei, and Nicholas E. Flores. Hypothetical bias reconsidered: payment and provision uncertainties in a threshold provision mechanism. Environmental and Resource Economics (Forthcoming).

Mitchell Robert M. and Richard T. Carson. Using surveys to value public goods: the contingent valuation method. Washington: DC: Resources for the Future (1989).

Moum, Torbjørn. "Yea-saying and mood-of-the-day effects in self-reported quality of life." Social Indicators Research 20, no. 2 (1988): 117-139.

Murphy, James J., P. Geoffrey Allen, Thomas H. Stevens, and Darryl Weatherhead. A meta-analysis of hypothetical bias in stated preference valuation. Environmental and Resource Economics 30 (2005): 313-325.

Nepal, Mani, Robert P. Berrens, and Alok K. Bohara. Assessing perceived consequentiality: evidence from a contingent valuation survey on global climate Change. International Journal of Ecological Economics and Statistics 14 (2009): 14-29.

Polomé, Philippe. Experimental evidence on deliberate misrepresentation in referendum contingent valuation. Journal of Economic Behavior and Organization 52 (2003): 387-401.

Quiggin, John. Generalized expected utility theory: The rank dependent model. Dordrecht, Netherlands: Kluwer (1992).

Howard Schuman, and Stanley Presser. Questions and answers in attitude surveys: Experiments on question form, wording, and context. Sage (1981).

Shaw, W. Douglass, and Richard T. Woodward. "Why environmental and resource economists should care about non-expected utility models." Resource and Energy Economics 30, no. 1 (2008): 66-89.

Tversky, Amos and Daniel Kahneman. Advances in prospect theory: cumulative representation of uncertainty. Journal of Risk and Uncertainty 5 (1992): 297-323.

Vossler, Christian A. and Mary Evans. Bridging the gap between the field and the Lab: environmental goods, policy maker input and consequentiality. Journal of Environmental Economics and Management 58 (2009): 338-345.

Vossler, Christian A. and Sharon B. Watson. Understanding the consequences of consequentiality: testing the validity of stated preferences in the field. Journal of Economic Behavior and Organization 86 (2013): 137-147.

Vossler, Christian A., Maurice Doyon, and Daniel Rondeau. Truth in consequentiality: theory and field evidence on discrete choice experiments. American Economic Journal: Microeconomics 4 (2012): 145-171.