EVALUATING NATIONAL POLICY BY CONTINGENT VALUATION

by

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(abstract)

The contingent valuation method is extended to policy valuation via two innovations: a model where the citizen evaluates the impact that policy has, and registers her willingness to pay by a voting procedure. Estimated annual national benefits from a proposed policy to reduce air and water pollution loads by 25% exceed $61 billion.

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INTRODUCTION

A recent development in natural resouce economics is the application of benefit-cost analysis (BCA) to national policy proposals concerning pollution control. These applications are an outcome of Executive Order 12991, under which no federal regulatory initiative can be undertaken unless the benefits outweigh the costs. Some of these national regulatory analyses are concerned with only impacts on market sectors of the economy. For example, Adams, Hamilton and McCarl (1984) estimated the national economic effects of ozone damages on a set of agricultural commodities. Schwartz, et al. (1985) estimated the benefits of a national policy to reduce gasoline lead content, for both market and nonmarket sectors of the economy. The research on which this paper is based (Randall, et al., 1985) estimated the nonmarket benefits to the household sector of a national policy which would reduce air and water pollution loads. We provided alternative benefit estimates derived from a specially adapted contingent method and a national multi-market hedonic analysis, respectively.

This extension of the contingent valuation method (CVM) into analyses of national scope is a substantial departure from the mainly localized studies to which the method was originally applied. This paper focuses on some innovations used in our research to adapt CVM for evaluating policies at the national level. In particular, this paper introduces the national policy evaluation referendum (NPER) model developed for that study, and discusses its advantages. Finally, a short summary of the study's benefit estimates is presented. The basic validity of CVM is not at issue here. Rather, the reader is refered to two recent 'State of the Art' books for detailed discussions of the general

validity issue: Cummings, Brookshire and Schulze (1986) and Mitchell and Carson (in press).

STANDARD CVM PRACTICE: THE PRIVATE MARKET ANALOGY

Following widely cited early studies by Davis (1963) and Randall, Ives and Eastman (1973), there has been rapid development in the theory and methods of contingent valuation. It has become standard practice to design and implement a contingent market to elicit Hicksian compensating measures of welfare change which, upon interpersonal aggregation, can be interpreted as benefits (or costs) in the potential Pareto improvement (PPI) framework. Contingent markets may be implemented in laboratory or survey settings, and surveys may be administered via face-to-face interview, by telephone, by mail questionnaire, or by various combinations of these. Nevertheless, any contingent market has certain features that have become standard. The status quo is described with respect to institutions and the provision level of the nonmarket good at issue; an alternative level is offered; and -- in the context of well-specified rules concerning the conditions under which the alternative level will be provided and individual payments will be collected -- the participant states a contingent valuation or a contingent choice in a form that permits the researcher to infer the participant's valuation. In the well--structured contingent market, the researcher will have ensured that the participant has been motivated to a) undertake a thorough valuation search, and b) truthfully report her valuation (Randall, Hoehn and Brookshire, 1983).

A hallmark of practiced CVM research has been an adherence to the private market ideal as a foundation for the contingent market. Public opinion polls, often designed to simulate referendum elections, had long been used to gather information about citizen attitudes to environmental policies and other public

actions to provide nonmarket goods (Anon.,1972). Early CVM researchers made a conscious departure from this tradition, for at least two reasons: 1) the alternative presented in public opinion polls were frequently poorly specified as to quantity, quality, and cost ("would you make an economic sacrifice for cleaner air? Yes__, No__, No opinion__"); and 2) there was, at that time, no conceptual basis for interpreting the results of such polls in terms of an acceptable economic theory of welfare change measurement.

Adherence to the private market ideal seems to explain certain features commonly found in CVM applications, e.g., iterative bidding and explicit payment vehicles. Cummings, Brookshire and Schulze (1986) emphasize that certain reference operating conditions (ROCs) should be followed in conducting CVM. Two of the four ROCs are derived directly from the private market principle: 1) the participant's familiarity with the good, and 2) her prior valuation and choice experience. They further state that adherence to the ROCs ensures that CVM results can be validated by methods that use market data, such as hedonic market analysis.

The private market ideal has fostered a focus on goods rather than policies in CVM. While economic theory permits markets in nonhomogeneous goods (consider, for example, hedonic price theory), analysis of homogeneous goods is more common. In CVM, this approach has led to contingent markets that seek to standardize goods and services (i.e. the impacts of policy) across individuals. Standardizing some reference points is required for statistical testing and interpretation of value data in PPI terms. However, the practice of standardizing impacts has some obvious disadvantages when individuals are differently exposed to the impacts of policy, and that, we argue, is typically the case. The problem is that any standard description of baseline and with-policy conditions, in terms of goods and sevices enjoyed by the

individual household, will be least a little inaccurate from any particular individual's point of view. Concerning policies of broad geographical scope, this problem is excerbated.

CVM practitioners must be aware that participants do not approach the exercize tabula rasa. They have prior beliefs about the status quo and about how policy will affect them. To the extent that these prior beliefs deviate from the researcher's impact-standardized scenario, the participant's posterior beliefs will deviate from the scenario. There are two consequences: first, impact-standardization is futile, and second, a credibility gap arises which may undermine the CVM effort. The obvious solution to this second problem is to instruct the participant to respond "as if" the standardized scenario fitted her case, but this would likely serve to notify the participant that the whole exercize is more hypothetical than real. These arguments serve to construct a strong general case against the standardized presentation of policy impacts.

THE NATIONAL POLICY EVALUATION REFERENDUM

We posit that the CVM participant is a citizen accustomed to forming opinions about policy alternatives, and to making choices as a voter, responding to surveys, and in some cases acting as a member of organizations and interest groups. Citizens receive information (from government, interest groups, the media, etc.) that describes national and regional effects of policy, in rather general terms. They then combine this information with their own stock of prior information, specialized local knowledge, and personal knowledge about their own suseptibility to damage from pollution and their ability to take evasive action. Finally, they arrive at a personal decision in favor of (or opposed to) the proposed policy, given its likely implementa-

tion cost.

To implement this national policy evaluation model, the CVM scenario presents the same policy alternatives to all participants, who then make their own inferences about how policy affects them. While the policy choices are standardized, the policy impacts are unique to each individual. Upon description of the national policy, each participant forms an indiviualized expectation of policy impact on her own welfare. As argued in the preceeding paragraph, we believe this process is familiar to citizens in a democracy. We argue, further, that PPI evaluation of a standardized policy is entirely consistent with relevant theory. There is no violation of any important theoretical requirement by departing from the private goods market, homogeneous goods ideal.

VALUE ELICITATION BY REFERENDUM

Two recent developments have revived the earlier-discarded referendum approach to collecting value information: 1) value elicitation by referendum has been shown to be an incentive-compatible demand revelation device, 2) the availability of appropriate statistical procedures for analyzing data in dichotomous choice form, to generate welfare change estimates in PPI terms.

Hoehn and Randall (forthcoming, hereafter refered to as H&R) define an optimal benefit-cost indicator as one that correctly identifies potential Pareto improvements (PPIs), and a satisfactory benefit-cost indicator as one that will never incorrectly identify non-PPIs as PPIs. If a satisfactory BC indicator is used as a filtering device, non-PPIs cannot be passed by a BC test and progress will always be in the direction of social efficiency.

With a satisfactory benefit cost indicator thus defined, H&R undertake a conceptual analysis of the incentive structure of various CVM formats.

The participant completes two processes: (a) value formulation, where the issue is the effect of a decision by the participant to restrict effort devoted to the introspection that is necessary to discover her "true" valuation; and (b) value reporting, where the issue is concern for whether there exist incentives for individuals to act strategically, misreporting their "true" valuations in order to benefit themselves by influencing the outcome of policy research.

H&R conceptualize a contingent policy evaluation referendum, in which a participant records a dichotomous vote (YES/NO) to a proposed policy change after having been presented information about: 1) the quantity and quality of goods or services the policy offers; 2) the public decision rule for implementing the proposed policy or not; and 3) the payment to be exacted from the individual in the event of implementation. Note that the H&R referendum is considerably more structured than the instruments commonly used in public opinion polls.

Within the policy referendum framework, the value formulation stage proceeds as follows. The individual is informed that she is a member of a sample of citizens participating in the exercize, and therefore she probably expects enhanced influence vis-a-vis that of a participant in a plebiscite. Furthermore, it can be assumed that she believes that the results of her valuation exercize will have some impact on policy implementation. Thus, the individual will devote some resources (i.e., an amount equal to or less than a private market decision that would have a comparable impact on her welfare) to formulating a response intended to influence policy in a direction favorable to herself. However, the value formulation process is time and resource consuming because information has to be acquired and assimilated. Formally, value formulation requires that the individual solve a constrained

expenditure minimization problem. H&R show that, in the case of Hicksian compensating measures of value, the incomplete solution to this problem gives unambiguous underestimation of willingness to pay.

The value reporting stage must be analyzed to identify any incentives for strategic behavior. The H&R analysis assumes that the participant gains positive utility from the amenity being valued, but that paying fees or taxes would reduce her disposable income. The key issues, then, are how her participation in the exercize is likely to influence the chances that the amenity-increasing policy will be implemented, and how her disposable income will be affected by implementation. For a referendum in which each participant is told (and believes) the amount of payment that will be extracted from her in the event of policy implementation, and that the policy will be implemented by plurality vote, the optimum stategy is truth-telling. The participant's welfare is maximized by voting YES if her formulated value exceeds that stated cost to herself and NO if it does not.

The analytical results for the H&R referendum can be summarized: it tends, if anything, to underestimate benefits and overestimate costs at the value formulation stage; and it is incentive-compatible at the value reporting stage. Therefore, while the policy referendum may not be an optimal BC indicator, since PPIs may be discarded, the approach fulfills the requirements of a satisfactory BC indicator.

The referendum reponses do not directly indicate the full value of each consumer's surplus, but previous research has successfully used the logit estimation technique to yield estimates of consumer surplus (Deacon and Shapiro, 1975; Bishop and Heberlein, 1979; Sellar, Chevas and Stoll, 1984). Furthermore, the referendum can be iterated to converge on the personal payment that leaves the participant indifferent (i.e. extracts full consumer surplus)

without adversely affecting its immunity to strategic behavior (H&R). Thus, two valuations can be obtained from a single referendum. A latter section reviews the estimation procedures.

The H&R referendum is a satisfactory BC indicator and its results can be analyzed to generate welfare change estimates consistent with economic theory. These properties eliminate economists' ancient and venerable objection to using referenda to generate BC data. With these concerns allayed, economists can now focus on the long-recognized advantage of referendum formats for evaluating public policies: they use a familiar and throughly plausible framework for citizens to communicate their preferences about policy, whereas the private market analogy long standard in CVM always suffers from a degree of implausibility where nonrival and nonexclusive goods are involved. Having argued for standardization of policy (as opposed to impact) and for the H&R referendum format for CVM data collection, we now introduce the NPER mode of CVM which combines these approaches.

THE POLICY EVALUATION INSTRUMENT

A primary consideration in developing the instrument was defining precisely what the resulting benefit estimate should represent. Considering that the estimate would have to be useful for policy purposes, we made four strategic decisions: 1) benefits should be valued at the national level, rather than as the sum of local benefits, 2) the objective is to estimate total value, rather than component values (i.e. option, existence values, etc.), 3) whole program valuation is more valid than summing component environmental services, and 4) the final estimate should be net of direct effects from other sectors.

In developing the instruments for use in the policy evaluation referendum

we attempted to account for the complexity of the national pollution control program. Our strategy was to make this complexity manageable and comprehensible to citizen-participants, rather than to pretend it does not exist. Furthermore, we posited that citizens value programs in terms of delivered levels of delivered services rather than, for example concentrations of particular chemicals. Therefore, we stressed the following dimensions of environmental quality affected by pollution control: the array of environmental services provided; the level of provision of each; for episodic phenomena, the frequency, severity and duration of events; and the relationships between environmental amenity levels, the production of human activities and the satisfaction gained.

For the national survey, a 'master' instrument was eventually developed, which communicated a base level of complexity, around which four variations were planned that would allow sub-tests on the effects of varying levels of complexity.

The general form of the final instrument is as follows: a set of environmental knowlege questions, a set of environmental attitude questions, a description of baseline and subsequent national environmental quality resulting from a policy that would reduce pollution loads by 25 percent, the CVM policy referendum, and a set of sociodemographic questions. Environmental quality was decribed verbally and by numerical indicators that used the most reliable information available, e.g. the excess human death rate per 100,000 was obtained from Lipfert (1984).

WTP ESTIMATION METHODS

Figure 1 is a reproduction of the CVM policy referendum. It contains the the individual's price (in terms of higher prices and taxes), the policy

Suppose a nationwide program to reduce pollution by 25 percent (Program A) could be adopted within the next year that would accomplish all of these improvements within five years. Adoption of Program A would increase the amount of money spent by households, government and industry on pollution control, and you, the end consumer, would eventually have to pay for it. As a result, you (or your household) would have $ 300 less per year to spend on other things, beginning next year.

Q-14 If the adoption of this national policy were put to a referendum, would you vote to accept this program? (Circle number)

1 YES
2 NO → Go to Q-16

Q-15 Of course, we cannot be certain, in advance, about the costs of this pollution control program. If it turned out that this program would result in you (or your household) having $1,000 less per year to spend on other things, would you vote to accept this program? (Circle number)

1 YES
2 NO → Go to Q-18

Q-16 Of course, we cannot be certain, in advance, about the costs of this pollution control program. If it turned out that this program would result in you (or your household) having $50 less per year to spend on other things, would you vote to accept this program? (Circle number)

1 YES
2 NO → Go to Q-18

Q-17 Now, think for a moment and write down the very highest amount this pollution reduction program could cost you (your household) and for which you would still vote to accept it. (In other words, if it would cost any more than this "highest amount", you would have to reject the program.)

The Highest Amount is $_____per year.

Go to next page

Q-18 Now think for a moment and write down the very highest amount this pollution reduction program could cost you (your household) and for which you would decide to accept it. (In other words, if it would cost any more than this "highest amount," you would have to reject the program.)

The Highest Amount Is $_____per year.

Figure 1. CVM Policy Referendum

implementation rule (implicitly, majority vote), and the payment rule (if the policy is approved, you pay the stated price). The policy was offered in Q14 at one of the following prices: $75, $150, $ 225, $300, $375, $450, $525, $600, $675, and $750. This payment institution is a neutral device (i.e. has no "vehicle bias") that accurately models the way that changes in policy extract a price in the real world. The yes-no responses are analyzed via the logit method. The iterative valuation part, Q17 or Q18, extracts a continuous valuation, analyzed via OLS.

The problem of deriving valid WTP estimates from voting data has been the subject of recent aricles by Hanneman (1984a, 1984b). His argument runs parallel to the H&R examination of strategic incentives, but focuses on the decision process as a utility difference. That is, if the individual votes to accept the program, then the indirect utility associated with accepting the program and giving up some income, $A, must be greater than the indirect utility of rejecting the program and keeping the money. Employing Hanneman's suggestions yielded the following expression for mean compensated WTP from the sample data: $E(WTP|s) = \int_0^{A_{max}} \{1 - G(A|s)\}\, da$, where $G(A|s)$ is the cumulative distribution function of WTP, conditional on the vector s, the average characteristics for the sample such as income, age, etc. By Hanneman's argument, the upper limit of integration should be infinity, but unfortunately our highest stated tax price was $750, where 60 percent of the participants still accepted the program. This implies that the upper tail of G(A) is 'fat', which would lead to a very high E(WTP). Therefore, integration was truncated to the 0-750 range, which yields an underestimate of WTP. The parameters of G(A) were estimated via logit analysis, and integration was calulated numerically using a composite four-point Gauss - Legendre rule (Conte and deBoor, 1980). For the continuous valuations from the iterated

referendum, mean WTP was calculated by simple average.

SUMMARY OF BENEFIT ESTIMATES

Since this was designed to be a pilot study, subtests of administration methods and the aforementioned instrument types were conducted. Administration methods were via mail, for the national survey, and within the (location witheld) SMSA via mail, face-to-face interview, combined mail-telephone, and telephone alone. The results of this sub-test indicated that the latter two methods did not perform as well as the others. The response rate for the national mail survey was around 35 percent.

A comparison of the sample characteristics with those of the target population confirmed that the results should be representative. The results reported below are for the total sample of all methods and instruments, for which there were 872 observations. The valuation equations for the logit and OLS models had the same significant independent variables, and they were of the same sign: offered-price (-), income (+), and environmental attitude (+). Annual willingness to pay as estimated from the referendum was $694.42, or $60.4 billion for the nation, in 1984 dollars for the program that would decrease air and water pollution loads by 25 percent. This estimate is lower than our multi-market hedonic estimate of $983.39 per household, or $85.5 billion.

CONCLUDING COMMENT

To evaluate a broad-based, nation-wide air and water pollution control policy, we developed the NPER model. A priori, the approach seemed to have several advantages over more conventional, market-oriented CVM formats. Performance of the NPER in a rather substantial national pilot study has reinforced our expectations about the serviceability of the approach.

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