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Measuring Environmental Benefits with Contingent Markets

James L. Regens, University of Georgia

Are there feasible means for measuring the potential benefits of alternative environmental protection efforts? That is a question facing environmental management professionals, and in this research note James L. Regens offers a possible answer: the contingent-valuation (CV) method. Applying survey research techniques to measure the public's willingness to pay for a program, the CV approach has been used in a variety of contexts. Regens illustrates the utility of the approach in a case involving proposals to deal with pollution of Norway's Kritiansand Fjord. His analysis covers both the survey instrument and the various techniques used to control for biasing factors. As an instrument for calculating potential program benefits, the CV approach might prove useful in dealing with a wide range of environmental management situations.

Typically, economic valuations of collective goods such as those derived from social regulation are difficult to make. For example, the benefits of U.S. Environmental Protection Agency (EPA) regulations such as ambient air quality standards are, in large part, public goods without direct market price analogues. Yet Executive Order 12,291, issued by President Reagan on February 17, 1981, requires that EPA and other federal agencies evaluate systematically the benefits and costs of major regulatory actions prior to their implementation (46 *Federal Register*, 13, 193). Executive Order 12,291 establishes stringent requirements and detailed guidelines for regulatory impact assessment. Except where expressly forbidden by law, all proposed federal regulations must pass a formal benefit-cost test using microeconomic analysis techniques.¹ The alternative involving the least net cost to society as reflected by compliance costs is supposed to be selected in the rulemaking process. As a result, regulatory agencies like EPA have strong inducements to value monetarily environmental benefits, especially benefits attributable to reduced human health or ecosystem damage.

Once links have been established between undesirable conditions and humanly controllable actions like environmental pollution, an important and controversial question arises. That is, what is the value to be attached to either a given level of improvement in environmental quality or preserving the existing level without additional deterioration? Valuation, especially economic valuation, is important because society confronts difficult policy choices about environmental resources while fiscal resources are finite. As a result, making choices involves implicit, if not explicit, tradeoffs among preferences. This article provides insights into the feasibility of measuring directly such values. It not only provides substantive insights but also methodological ones.

Rationale for Measuring Environmental Benefits

The environmental problems occurring in modern industrial societies are frequently characterized by a high degree of scientific, technical, and economic complexity. Often the effects of pollutants released into the environment are uncertain and difficult to assess. Moreover, pollution may affect widely divergent end points such as the natural environment, human health, outdoor recreation, and industrial activities. The diversity inherent in those pollution-induced effects normally complicates the task of setting regulatory priorities and choosing among available control options (Regens and Donnan, 1986). As a result, environmental management has become a central focus for social regulation since the late 1960s (Rabin, 1986; Regens, Dietz, and Rycroft, 1983; Vogel, 1981). A natural outcome of that focus has been interest in determining the benefits and costs of measures that prevent or reduce pollution (Rycroft, Regens, and Dietz, 1988, 1987).

In many instances, the valuation of effects is central to addressing how to balance the benefits of pollution control with the cost of implementing such actions. Indeed, such analysis provides a framework, albeit a controversial one, for organizing arguments for and against discrete policy options (Mishan, 1982; Stokey and Zechhauser, 1978). First, valuing effects permits a more precise description of what various participants in policy deliberations assume to be environmental benefits. Second, the level of benefits can be compared to the costs of the proposed regulatory intervention. Such comparisons make it possible to grasp the relative economic efficiency of the policy response under consideration. Third, varying levels of benefit can be related to the cost of achieving those benefits.

In simple cases, the measurement of benefits and each individual's corresponding willingness to pay to acquire beneficial effects or avoid harmful effects flows directly from estimates of demand curves for products by individuals (Covello, Bentkover and Mumpower, 1986; Crocker and Regens, 1985). For example, if one were considering the benefits of various methods to remedy highway potholes, individuals could make a "bid" (presumably in the form of increased taxes) based on their knowledge of what potholes do to cars and how much it might cost to repair that damage. Although automobile repair costs may vary, most car owners have some general idea of the range of costs that they potentially would pay in the absence of the remedy. Because it is derived from information about market expenditure patterns, such willingness to pay data enables direct comparisons of differences in benefits and costs. It also permits their aggregation over time and/or individuals in order to simplify the choice process.

When considering techniques to measure the economic benefits derived from social regulation, it is important to remember that environmental quality is a collective (public) good. Because access to collective goods is nonrival and nonexclusive, numerous individuals can avail themselves of

benefits without reducing their availability to others. The fact that people potentially can act as free riders, when goods are nonrival and exclusion is not exercised, helps explain why the benefits of environmental protection lack direct market price analogues. Consequently, it is a substantial analytical challenge to measure with reasonable precision the benefits of major regulatory actions intended to foster environmental quality (Baumol and Oates, 1988; Starrett, 1988).

In contrast to other benefits estimation techniques, which infer the value of nonmarket goods from consumer behavior in related markets, the contingent-valuation (CV) method uses survey research techniques to elicit willingness to pay measures (Cummings, Brookshire, and Schulze, 1986; Thayer, 1981). In essence, individuals are asked how much money they would be willing to pay for an incremental change in the provision of some specified public good using contingent markets. Although alternatives such as the travel-cost method and the hedonic-price method exist for measuring indirectly the value of public goods,² Burness et al. (1983, p. 682) assert that the

CV approach is reasonably accurate, at least when it is used to value the kinds of amenities that are accessible to indirect methods. For example, Heberlein and Bishop (1986) demonstrated using experimental economics that contingent markets were a good predictor of the outcome in real recreational markets. And, parallel work has established that willingness to pay data obtained through contingent valuation are generated in forms consistent with the theory of welfare change measurement (see Brookshire, Randall and Stoll, 1980).

As a result, the CV approach has been employed to measure environmental benefits in a variety of contexts, including outdoor recreation in Maine (O'Neil and Hallberg, 1985), nuclear power plant injuries (Mulligan, 1977), and migratory waterfowl in the Pacific flyway (Brown and Hammock, 1972). Accordingly, using coastal water pollution in Norway as an example, this research illustrates the applicability of the contingent-valuation approach for measuring environmental benefits.

Kristiansand Fjord and Marine Pollution

Kristiansand Fjord, located on the southeastern coast, is one of a number of areas along the Norwegian coast that are heavily polluted. Unlike most of the other contaminated coastal areas, the Kristiansand Fjord is located in an area that is relatively densely populated by Norwegian standards. For example, the city of Kristiansand has a population of approximately 60,000 people and lies at the head of the fjord.

Kristiansand Fjord receives wastewater inputs from a variety of sources, including industrial plants and households. The pollution load consists primarily of organic matter; heavy metals such as iron, nickel, copper, and lead; organochlorine

compounds (mostly hexachlorobenzene, octachlorostyrene, and several chlorinated alkylbenzenes); and polycyclic aromatic hydrocarbons (PAH). The sediments in the Vesterhavn-Fiskabukta area of the fjord have heavy metals concentrations up to 800 times normal, background levels. Sediments and marine organisms in the inner part of the Kristiansand Fjord also exhibit extremely high concentrations of several organic toxins, especially PAH and organochlorines, with sediment levels exceeding normal values by a factor on the order of 10,000 to 100,000.

Not surprisingly, given such monitoring data, a baseline investigation of the Kristiansand Fjord conducted by the Norwegian Institute for Water Research (NIVA) during the period from 1982 to 1984 provided firm evidence that parts of the fjord had been severely affected (Green, Knutzen, and Asen, 1985; Naes, 1985; Rygg, 1985). The local health authorities as well as NIVA were concerned about the possible risk to human health that might arise from the consumption of contaminated fish caught in the fjord. It also appeared likely that the existing level of water pollution made the fjord less usable for recreational purposes such as swimming and sport fishing. Furthermore, local commercial activities, especially the fishery and tourism industries, might suffer an economic loss due to the discharge of municipal sewage into the fjord.

The Survey

In order to establish an economic valuation of the benefits represented by remedial action to cleanup Kristiansand Fjord, a national survey was conducted using a random sample of the Norwegian public ($N = 659$). Personal interviews were conducted by the Norwegian Gallup Institute in early 1986 as part of its monthly "Omnibus" survey, which has a sampling error of ± 3 percent. Those surveyed were given information about the current level of marine pollution in the fjord, various abatement measures' availability, and the results anticipated if the measures were implemented. Specifically, the interviewees were told that after completing remedial action, the water in the inner areas of Kristiansand Fjord would be as clean as in other nearby large towns along the Norwegian coast. They were told that fish caught in the fjord could again be eaten without adverse health effects.

The Instrument and Results

The survey instrument employed the iterative bidding technique to elicit individuals' willingness-to-pay. The steps involved in applying this technique can be summarized as follows. In essence, one assumes that the bidding process helps respondents to clarify their preferences. As is the case with all bidding games, after the item to be valued is described, the willingness-to-pay application begins with the interviewer suggesting an initial bid. If the respondent is willing to pay the starting bid, then the interviewer revises the bid upward in an iterative fashion until a negative response is obtained from the interviewee. On the other hand, if the initial bid produces a negative response, then the interviewer revises the bid downward from that starting point

sequentially until an acceptable level is established by the respondent.

In this study, the following question probed each individual's maximum willingness-to-pay to reduce the pollution of Kristiansand Fjord provided all Norwegian citizens paid a certain amount of the money for that purpose:

Now suppose the costs to clean the Kristiansand Fjord were divided on all taxpayers in the whole of Norway by an extra tax in 1986. If this extra tax was 200 Kroner for an average taxpayer, would you then be willing to support this proposal?

Because prior research has demonstrated that the initial bid can influence final bids (Boyle, Bishop, and Welsh, 1985), the sample was split into two groups of essentially co-equal size. Each of those groups was given differential starting points. The opening bid point for one group (48.1 percent of the sample) was 200 Norwegian Kroner (NOK) and the other group's starting point was 100 NOK.³

The mean value elicited, using a single payment via an extra tax applied nationally to generate funding for pollution control programs, was 422.51 NOK, with a standard deviation of 32.13. A relatively straight-forward approach to benefits estimation would conclude that national willingness-to-pay (WTP) could be calculated by multiplying the mean value by the number of taxpayers (2.28 million) in Norway. Similarly, lower and upper bounds for WTP could be derived by using the mean value minus or plus one standard deviation times the number of taxpayers to estimate those intervals. This suggests the Norwegian public was willing to pay, on average, approximately 963.3 million NOK, with the gross benefits ranging between 890.1 and 1,036.6 million NOK, if one assumed full compliance in terms of tax payment.

Controlling for Survey Bias

Such a calculation ignores the question of whether the WTP distribution is overly sensitive to the differential starting point.⁴ Table 1, in fact, suggests that the initial starting point for the iterative bidding to establish WTP values does influence individuals' choices. As a result, it is important to test the hypothesis that, in the Norwegian population, no statistically significant difference existed in WTP values generated by the two starting points. Because nonparametric procedures are not sensitive to violations of equality of sample variances, minimal assumptions are made about the underlying distributions of the data. The Kolmogorov-Smirnov tests for two samples provides an appropriate statistical technique for comparison of the distribution functions for the two groups (Siegel, 1956). It allows us to determine whether the distribution of WTP values was the same in the two groups, which were defined by their respective starting points for bids. The observed cumulative distributions for both groups as well as the maximum differences are computed. The test is sensitive to any difference between the two distributions. The resulting value for the K-S statistic was 1.62, indicating for a two-tailed test that the null hypothesis of no difference

Table 1
Frequency Distribution for Estimated
Willingness-to-Pay for Water Pollution
Control in Norway

Final bid (NOK)	Total sample (percent)	Initial Starting Point	
		100NOK	200NOK
50	11.2	11.6	10.9
80	0.2	0.0	0.4
90	0.2	0.4	0.0
100	21.7	28.2	14.5
200	31.2	27.8	35.1
400	19.0	17.0	21.4
800	8.2	7.2	9.3
1,500	6.1	6.1	6.0
2,100	0.2	0.4	0.0
5,000	1.9	1.4	2.4
X WTP (NOK)	422.51	387.33	461.82
σ	32.13	40.50	50.78

Kolmogorov-Smirnov statistics = 1.62.
 $p < .01$ α level.

can be rejected at the .01 level of significance. This supports the finding from earlier research that initial bids suggested by interviewers could affect respondents' final bids. Since final bids may be sensitive to the choice of starting point, aggregate WTP for environmental benefits may vary over a substantial range due to fluctuation in the starting bid.

The results of the iterative bidding application underscore the importance of understanding the conditions that are favorable to increasing willingness-to-pay for environmental protection. Simply desiring environmental protection is not sufficient. Instead, willingness-to-pay for pollution control in one context implies opportunity costs in other areas. Allocating resources to one use, in this case cleaning up water pollution, effectively precludes using that money for some other desired outcome. The monetary value of the benefit foregone represents opportunity costs. For instance, asking people what they would spend for environmental protection in general, or even for a series of ameliorative measures, without placing it in the context of what they would spend to deal with other public problems such as highways, education, or health care ignores the inherent tradeoffs in allocating resources. The actual level of resources to allocate among competing demands clearly is finite at a fixed point in time. Hence, policymakers who incorporate WTP information into their choices possess much more robust knowledge bases when opportunity costs are addressed explicitly. This points to the need for analysts and decisionmakers alike to be aware of what can be termed "relativity" or question-framing problems. Unfortunately, explicit tradeoffs were not presented in this instance. As a result, while empirical evidence of the decision calculus for tradeoffs is precluded, it is reasonable to assume that some but not necessarily all respondents made implicit tradeoffs.

In examining the extent to which Norwegians are willing to pay for the clean up of Kristiansand Fjord, it is useful to specify and estimate a model of which demographic factors

affect willingness-to-pay because some are likely to constrain and others foster willingness-to-pay. Such an approach is necessary because the potential for respondents to give biased answers is the major methodological concern associated with reliance on the CV approach to measure benefits. As a result, the key reason for estimating this demand model is to remove the bias introduced into the contingent valuation responses due to their sensitivity to starting point differentials in the iterative bidding procedure. If properly specified, the equation also permits the analysis to test for possible strategic bias, information bias, and hypothetical bias, which can distort valuations. Respondents may be tempted to bid up or bid down rather than offer their actual valuation, if such strategic behavior increased the likelihood of achieving a preferred outcome. For example, individuals who want more aggressive environmental protection programs may inflate their bids in order to provide an answer that assured a high value if the decision about remedial action depends on whether the survey produces a sufficiently large WTP value. As is true for any survey research effort, information bias can occur when respondents lack adequate information with which to provide an informed response; valuations in the absence of understanding are based on erroneous perception. Finally, when respondents are presented contrived choices, the WTP values may be distorted, especially if one does not have to pay in actuality (i.e., free riding). The parameter estimates derived from the regression equation offer a reasonable basis for adjusting the WTP estimates to cope with these potential problems.

Clearly, individuals who are more affluent have more discretionary real income to potentially allocate to environmental amenities as well as other things that they value. And, although the question posed to respondents implies equal sharing of taxes among all citizens, it is reasonable to assume that individuals would give some weight to what they perceive to be their actual share of taxes as well as their income when providing an answer. Income, therefore, represents a proxy for the opportunity-cost constraint imposed on budgetary decisions because it was not possible to capture precise information about tax shares. This also allows testing, but not resolving whether the free-rider problem is occurring in the following way. Obviously, individuals lacking income have no way of paying for environmental benefits. They can, however, reveal their preferences in the CV approach. And, the costs of satisfying their preferences in actuality must be borne by others, if the public sector takes steps to implement programs responsive to those preferences. In essence, they can bid up environmental benefits without having to pay. If this is happening, the sign of the regression coefficient associated with the linear term for income should be negative or insignificant. This allows us to deal with the fact that those who cannot, in point of fact, will not be compelled to pay more in taxes, potentially are allocating other people's money. Thus, a quadratic term is included for the income measure to permit the relative magnitude of the two effects to vary by income.

Similarly, more highly educated individuals may possess greater understanding of environmental risks and be more

inclined to allocate resources to manage those risks. Alternatively, increased education might induce greater sensitivity to the topic rather than knowledge per se, which would foster increased willingness-to-pay nonetheless. Women may be willing-to-pay more than their male counterparts. Age may also influence an individual's willingness-to-pay. Middle-aged individuals may be more inclined to fund such efforts and over time, such an orientation may decrease reflecting an emphasis on present costs rather than future benefits. To test for this inverted U-shaped relationship, age is entered in quadratic form.

Finally, willingness-to-pay may reasonably be linked to perceptions of the scale of the overall effort to protect the environment, with valuations of benefits increasing among individuals who assert that the effort should be enhanced. The original survey allowed respondents to indicate that the total effort to protect the environment is too small, just right or should be reduced. The majority of Norwegians (70.5 percent) perceived it as being too small, 28.5 percent viewed it as just right, and only 1.0 percent asserted that it should be reduced. As a result, this research employs a dummy variable to indicate support for increased effort.

Based on the above conceptualization, the regression equation to be estimated is of the general form:

$$WTP = a + b_1 \text{ START} + b_2 \text{ AGE} + b_3 \text{ AGE}^2 + b_4 \text{ EDUC} + b_5 \text{ INC} + b_6 \text{ INC}^2 + b_7 \text{ GENDER} + b_8 \text{ EFFORT} + e$$

where the variables are defined as follows:

- WTP: Willingness-to-pay (natural logarithm)
 START: Initial starting point (0 = 100 NOK; 1 = 200 NOK)
 AGE; AGE²: Age of the respondent in years
 EDUC: Highest level of education (1 = primary school; 2 = high school; 3 = university)
 INC; INC²: Income (1,000 NOK)
 GENDER: Gender of respondent (0 = male; 1 = female)
 EFFORT: Perception that the total effort to protect the environment is too small (0 = no; 1 = yes).

Ordinary least squares (OLS) is employed to estimate willingness-to-pay because the dependent variable is continuous rather than discrete (Pindyck and Rubinfeld, 1981). It offers easily interpretable results for estimating WTP for this particular environmental benefit. Moreover, by adjusting the R² value to "correct" for the available degrees of freedom in the regression equation, the goodness of fit (i.e., explained variance) for the OLS results is no longer dependent on the number of independent variables in the equation. To test for multicollinearity, each independent variable was regressed on all the other independent variables. None of the R² values exceeded .50, which demonstrates the absence of serious collinearity in the demand equation (Farrar and Glauber, 1967).

Table 2 reveals that the model's explanatory power is modest. In each instance, nonetheless, the sign of the unstandardized regression coefficients is in the expected direction. Willingness-to-pay for pollution control to clean up

Kristiansand Fjord increased substantially as individuals attained greater levels of education. In contrast, while the hypothesized inverted U-shaped relationship between age and willingness-to-pay is reflected in the negative coefficient of AGE and the positive coefficient for AGE², the age and age-squared terms are insignificant. This suggests that the young and elderly were no less inclined, on balance, to be willing to place a high value on remediating the adverse effects than were middle-aged Norwegians.

The economic variables included in this study, measures of income and perception of the adequacy of the existing Norwegian effort to abate pollution nationally, also exert a positive effect. However, because both income coefficients are insignificant, an individual's incremental willingness-to-pay appears to be independent of one's income. This underscores the potential for a free-rider problem in WTP estimates as noted earlier. Support for funding remedial action at the Kristiansand site at higher levels also increases if the starting point is initially higher (p < .01). Moreover, support for increased environmental protection efforts in general tends to bolster willingness-to-pay in the specific case of Kristiansand Fjord (p < .01). Because only 3.3 percent of the respondents indicated that they belonged to an environmental group, this further underscores the broad-based nature of support among the Norwegian public for environmental protection as a collective good. This may offer a partial insight into why previous pollution control efforts in Norway have not been very reliant upon formal interest groups as advocates for their provision. Finally, although it is not possible to establish unambiguously why a gender-based difference emerges,

Table 2
Regression Estimates of Willingness to Pay for Environmental Benefits

Predictor variables	
Intercept	4.90** (14.44)
Age	-0.02 (-1.28)
Age ²	1.78x10 ⁻⁴ (0.93)
Education	0.20* (2.86)
Income	3.74x10 ⁻³ (1.43)
Income ²	-1.31x10 ⁻⁶ (-0.13)
Sex	0.26* (2.56)
Starting point	0.24* (2.60)
Pollution control effort	0.27* (2.54)
Adjusted R ² = .094	
Note: The cell entries are unstandardized regression coefficients with t-statistics in parentheses.	
* p < .01 α level.	
** p < .001 α level.	

Norwegian females tend to be willing to pay more than their male counterparts ($p < .01$).

Clearly, several potential sources of bias appeared to affect potentially the raw willingness-to-pay valuations produced by the survey instrument. Solving the demand equation, however, makes it possible to derive an estimated WTP value, which is adjusted to reasonably take into account potential sources of bias. First, data obtained from Norway's Central Bureau of Statistics are multiplied by the parameter estimates produced by the regression analysis (Statistisk Sentralbyrå, 1989). Then, those products are summed across the demand equation producing an estimated WTP value of 403.24 NOK. Although readily acknowledging that each taxpayer's actual burden may vary were this policy option to be implemented by the Norwegian government, this suggests a gross nonmarket benefit approximating 919.39 million NOK aggregated by all taxpayers in that country. Furthermore, those gross benefits can be placed in perspective if gross costs also are estimated in order to calculate net benefits. Such an approach can offer insights about whether specific policy choices, in this case cleaning up Kristiansand Fjord, yield net gains to society. That information can be useful to decisionmakers in weighing what importance to assign to economic considerations in conjunction with the other institutional, political, and social factors which influence the policy process.

Conclusion

Once links have been established between undesirable conditions such as environmental degradation and humanly controllable actions, an important and controversial question arises. That is, what is the value to be attached to either achieving a given level of improvement or preserving the existing level of environmental quality without additional deterioration? Valuation, especially economic valuation, is important because society confronts difficult policy choices about environmental resources, while fiscal resources are finite. As a result, making choices involves implicit, if not explicit, tradeoffs among preferences. This study provides insights into the feasibility of measuring directly such values.

With regard to the substantive issue, this research demonstrates substantial willingness-to-pay in order to improve the level of environmental quality in Kristiansand Fjord. In fact, even if one employed zero as the starting point, on the grounds that zero is a clear limit on gross benefits, that would only reduce the mean willingness-to-pay by approximately 24 percent to approximately 321 NOK. Using that value, the gross benefits would still be about 732 million NOK. Even applying this relatively conservative approach to benefits estimation, it is plausible to conclude that the willingness-to-pay for the benefits for reducing environmental pollution in this instance would probably be sufficient to achieve a total restoration of the fjord. This follows even if one assumes that the benefits estimates represent upper bounds because the cost estimates for remedial action are in the 210-255 million NOK range (Heiberg et al., 1987).⁵ This potential action's monetary implications can be placed in perspective if one

considers the fact that Norway's 1984 gross national product was \$57 billion. Clearly, were such a project to be undertaken in Norway, it would be a fairly large-scale public effort.

With regard to the methodological issues, it is clearly the case that direct questioning methods can produce benefits estimates which are extremely broad. This appears to be true not only for Norway but mirrors findings from studies in the United States, which also employ willingness-to-pay measures of environmental benefits. That imprecision may reflect possible limitations in the contemporary development of the CV approach as well as possible "noise" in the model introduced by the respondents' attitudes toward what they may interpret as a lump-sum tax method. In point of fact, the benefits estimate appears to always equal or exceed zero since an individual rarely can respond: "I'm willing to spend X less than nothing for that!" This seems to raise a logical barrier against using the CV approach to inform policy choice, but appearances can be deceiving. Adjusting the contingent valuation estimates to net out the effect of the opening bid can produce a negative gross benefit. The actual lower bound for gross benefits, however, logically should be fixed at zero when calculating net benefits because it is impossible to pay less than nothing. As a result, despite some caveats, it seems clear that measures of willingness-to-pay can be used to assign monetary values to nonmarket goods. In general, this suggests that although biases certainly exist, they can be controlled for with suitably designed surveys or appropriate statistical analyses. When individuals being asked what they would pay for environmental improvements have a clear understanding of the situation being considered, it is plausible to conclude that their responses do approximate the benefits range as well as the intensity of their preferences. This would seem to be an obvious strength of the CV approach as well as other benefit-cost techniques because, unlike most voting processes, willingness-to-pay values are sensitive to the differentials in the intensity of preference among individuals for a given environmental amenity.

This gets at the crux of the controversy underlying the application of benefit-cost analysis to social regulation. What value should policymakers assign to such valuations? For example, in the case of environmental benefits, especially those attributable to preventing or ameliorating adverse health effects, citizens commonly lack systematic knowledge of the consequences and alternatives. This makes the calculation of "reasonable" opportunity costs associated with one's choices necessarily imprecise. Despite its limitations, contingent valuation offers a means for illuminating the somewhat uncertain notions held by the public, and on occasion experts, of the risks involved and the range of acceptable costs in the absence of a remedy for those perceived dangers. However, those estimates of the benefits range are only valid if the following assumption is met: respondents possess adequate information with which to provide meaningful indicators of willingness-to-pay. Without some degree of confidence that this methodological constraint is met, substantive policy choices based upon such valuations rest on faith rather than evidence.

Unfortunately, CV studies based on erroneous assumptions or prematurely applying the approach before adequately delineating the environmental problem being addressed may result in implausible benefits estimates which provide support for flawed policy choices. To reduce the likelihood of such error, policymakers and analysts must make prudent responses. Regulatory agencies need to resist the natural temptation to prematurely apply the contingent valuation approach, given their need to promulgate rules while faced with limited time to conduct necessary research. Analysts need to better delineate how respondents consider such factors as instrumentation and framing effects, the potential uncertainty of supply in valuing collective goods, and the role of perceived property rights in influencing willingness-to-pay for environmental amenities. In essence, as an approach for measuring environmental benefits, contingent valuation clearly is an imperfect technique. Nonetheless, attempts to measure environmental benefits can be useful guides for investigating policy directions and research strategies for addressing the nation's environmental problems. The public can provide answers to fairly sophisticated questions about environmental amenities in empirically valuable ways. When the underlying

data are not completely free of possible bias, the resulting benefits estimates derived from those data can be adjusted to control for bias. As a result, the contingent-valuation approach appears to be a rather robust technique for gaining information about the plausible consequences of broad policy choices. Seen in that light, it can make a tangible contribution to regulatory policymaking in an imperfect world.



James L. Regens is professor of political science at the University of Georgia. His research interests are in environmental regulation, energy policy, and political economy. He is the author of numerous articles in journals such as *Public Administration Review*, *Journal of Politics*, *Risk Analysis*, and *Environmental Science & Technology* as well as *The Acid Rain Controversy* (University of Pittsburgh Press, 1988). He currently is a member of the Environmental Advisory Board, U.S. Army Corps of Engineers and previously was Chair of the Group on Energy and Environment, Organization for Economic Cooperation and Development and Joint Chair of the National Acid Precipitation Assessment Program.

Notes

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1. For a discussion of Executive Order 12,291 and its implications for environmental management, see Smith (1984).
2. The travel cost method (see Clawson and Knetsch, 1966) and the hedonic price method (see Rosen, 1974) offer alternative means for valuing some classes of nonmarket goods. The travel cost method yields benefit estimates as a function of the relationship between distance travelled and cost. The hedonic price method involves the identification of attributes associated with a market commodity whose price is decomposed into values attributable to each of the commodity's attributes.

3. In February to March 1986, the exchange rate was approximately 7.14 Norwegian Kroner (NOK) to \$1.00 United States.
4. The way in which the range of possible bids is defined may effect the resulting distribution of responses elicited from those individuals who participate in the survey. For example, it is theoretically plausible that a range started at \$100 and progressing upwards to \$1000 will produce a different array of values than a range of choices between \$0 and \$1000 even if no bids are offered in the \$0 to \$100 range. This underscores the need to be sensitive to starting point bias threats in designing a CV instrument.
5. Due to the lack of definite control plans, the following hypothetical measures to control water pollution were considered as a basis for generating cost estimates: constructing a waste water treatment facility and diverting municipal sewage to it; reducing heavy metal discharges by 80 percent; capping the sediments in the seabed of most of Vesterhavn (see Heiberg *et al.*, 1986: 150-151).

References

- Baumol, W. J. and W. E. Oates, 1988. *The Theory of Environmental Policy*, 2d ed. New York: Cambridge University Press.
- Boyle, K. J., R. C. Bishop, and M. P. Welsh, 1985. "Starting Point Bias in Contingent Valuation Bidding Games." *Land Economics* 61 (May), pp. 188-194.
- Brookshire, D. S., A. Randall, and J. R. Stoll, 1980. "Valuing Increments and Decrements in Natural Resource Service Flows." *American Journal of Agricultural Economics* 62 (August), pp. 478-488.
- Brown, G. M., Jr., and J. Hammock, 1972. "A Preliminary Investigation of the Economics of Migratory Waterfowl." in J.V. Krutilla, ed., *Natural Environments*. Baltimore: John Hopkins University Press.
- Burness, H. S., R. G. Cummings, A. F. Mehr, and M. S. Walbert, 1983. "Valuing Policies Which Reduce Environmental Risk." *Natural Resources Journal* 23 (July): pp. 675-682.
- Clawson, M. and J. L. Knetsch, 1966. *Economics of Outdoor Recreation*. Baltimore, MD: Johns Hopkins University Press.
- Covello, V. T., J. Bentkover, and J. Mumpower, 1986. *Benefits Assessment*. Boston: Reidel.
- Crocker, T. D. and J. L. Regens, 1985. "Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits." *Environmental Science and Technology* 19 (February): pp. 112-116.
- Cummings, R. G., D. S. Brookshire, and W. D. Schulze, 1986. *Valuing Environmental Goods*. Totowa, NJ: Rowan and Allanheld.
- Farrar, D. E., and R. R. Glauber, 1967. "Multicollinearity in Regression Analysis: The Problem Revisited." *Review of Economics and Statistics* 49: pp. 92-107.
- Green, N. W., J. Knutzen, and P. A. Asen, 1985. *Baseline Investigation of Kristiansandfjord: Report 3, Shallow Water Communities*, Monitoring Report 189/85. Oslo: Norwegian Institute for Water Research.
- Heberlein, T. A. and R. C. Bishop, 1986. "Assessing the Validity of Contingent Valuation: Three Field Experiments." *The Science of the Total Environment* 56 (November): pp. 99-107.
- Heiberg, A., K. G. Hem, N. Green, and O. Tryland, 1987. *Evaluation of Measures Against The Pollution of the Kristiansand Fjord: An Example of a Cost-Benefit Analysis Within the Environmental Sector* Report 83-01-23-5. Oslo: Center for Industrial Research.
- Mishan, E. J., 1982. *Cost-Benefit Analysis*, 3d ed. Boston: Allen and Unwin.
- Mulligan, P. J., 1977. "Willingness-to-pay for Decreased Risks of Nuclear

- Accidents," Working Paper no. 3. University Park: Energy Extension Programs, Pennsylvania State University.
- Naes, K., 1985. *Baseline Investigation of Kristiansandfjord: Report 2, Metals in the Water Masses, Metals and Organic Pollutants in the Sediments*, Monitoring Report 193/85. Oslo: Norwegian Institute for Water Research.
- O'Neil, W. and K. Hallberg, 1985. *Estimating the Value of River-Related Recreational Activities*. Orono: Maine Land and Water Resources Center.
- Pindyck, R. S. and D. L. Rubinfeld, 1981. *Econometric Models and Economic Forecasts* 2nd ed. New York: McGraw-Hill.
- Rabin, R. L., 1986. "Federal Regulation in Historical Perspective." *Stanford Law Review* 38 (May): pp. 1189-1326.
- Regens, J. L. and J. A. Donnan, 1986. "Uncertainty and Information Integration in Acidic Deposition Policymaking." *The Environmental Professional* 8 (October): pp. 342-350.
- Regens, J. L., T. Dietz and R. W. Rycroft, 1983. "Risk Assessment in the Policy-Making Process: Environmental Health and Safety Protection." *Public Administration Review*, 43 (March/April): pp. 137-145.
- Rosen, S., 1974. "Hedonic Prices and Implicit Market: Product Differentiation in Pure Competition." *Journal of Political Economy*, 82 (January/February): pp. 34-55.
- Rycroft, R. W., J. L. Regens and T. Dietz, 1988. "Incorporating Risk Assessment and Benefit-Cost Analysis in Environmental Management." *Risk Analysis*, 8 (September): 415-420.
- Rycroft, R. W., J. L. Regens and T. Dietz, 1987. "Acquiring and Utilizing Scientific and Technical Information to Identify Environmental Risks." *Science, Technology, and Human Values*, 12 (Summer/Fall): 125-130.
- Rygg, B., 1985. *Baseline Investigation of Kristiansandfjord: Report 1, Soft Bottom Fauna Investigations 1983*, Monitoring Report 176/85. Oslo: Norwegian Institute for Water Research.
- Siegel, S., 1956. *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-Hill.
- Smith, V.K., ed., 1984. *Environmental Policy Under Reagan's Executive Order*. Chapel Hill: University of North Carolina Press.
- Starrett, D.A., 1988. *Foundations of Public Economics*. New York: Cambridge University Press.
- Statistisk Sentralbyrå, 1989. *Statistisk Arbok*. Oslo: Norwegian Central Bureau of Statistics.
- Stokey, E. and Zeckhauser, R., 1978. *A Primer for Policy Analysis*. New York: Norton.
- Thayer, M. A., 1981. "Contingent Valuation Techniques for Assessing Environmental Impacts: Further Evidence." *Journal of Environmental Economics and Management* 8 (March): 27-44.
- Vogel, D., 1981. "The New Social Regulation in Historical and Comparative Perspective" in T. K. McCraw, ed., *Regulation in Perspective*, 1 Cambridge, MA: Harvard University Press.