Voter-Weighted Environmental Preferences

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Abstract

This article examines the political economy of preferences with respect to the environment using a new stated preference survey that presents the first benefit values for national water quality levels. The mean valuation greatly exceeds the median value, as the distribution of valuations is highly skewed. The study couples the survey valuations with unique and extensive information on respondent voting patterns. Preferences of registered voters are similar to the preferences of the population at large, but median voters value water quality more than nonvoters. The strongest contrast related to voter-weighted preferences is among voters for different candidates, as those who voted for Gore in the 2000 presidential election have the highest environmental values. © 2009 by the Association for Public Policy Analysis and Management.

INTRODUCTION

Research has established that private provision of public goods often is too low, and there are barriers to public provision as well, such as free rider problems.[1] A possible solution to the problems with private provision of goods is to base policies on a benefit–cost test in which the social welfare maximization objective maximizes the spread between the discounted value of benefits and costs. When making such a calculation, the average valuation across the population typically serves as the unit benefit value for assessing economic benefits.[2]

The most common procedure for assessing societal values of environmental benefits is to use a survey to elicit these amounts. Early survey approaches were known as contingent valuation studies, but more recently the approaches have evolved to include more refined stated preference approaches.[3] Irrespective of the survey methodology used, these studies analyze the valuations only from the standpoint of determining the pertinent willingness to pay value or the willingness to accept amount for purposes of policy analysis.[4] However, the resulting benefit assessments and the policy analyses in which they are incorporated are part of a political process that determines the policy outcome. The ultimate implications of societal valuations

[1] For a review of these obstacles to efficient provision of public goods, see Olson (1965) and Rosen and Gayer (2008).
[2] The total benefit for a public good is consequently the number of citizens multiplied by the average unit benefit value, or equivalently the benefit is the sum of the individual willingness to pay values.
[3] For a review of contingent valuation studies and related literature, see Bishop and Heberlein (1990).
[4] Whether willingness to pay or willingness to accept is the pertinent measure of benefits depends on the nature of ownership of the good. See Zerbe (2001) for development of such an analysis for a wide variety of ownership contexts.

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for policy include a role for preferences other than as an input to an economic analysis. To date there have been no stated preference studies that have linked the valuations of environmental benefits to influential political factors such as voting behavior.

This paper makes four distinct contributions. First, using the results of an original stated preference survey administered to a nationally representative sample, we present the first estimates of the economic value of improvements in national water quality levels.[5] The average value derived from this effort can serve as the unit benefit value in benefit–cost assessments. Second, because the survey elicits water quality values for individual households, the survey yields information on the distribution of values across the population. This distribution is positively skewed, with a mean value that exceeds the median. The implication of this skewness is that the mean will give a misleading estimate of the percentage of citizens who would support a given change. Third, this article presents the first evidence on how environmental benefit values in stated preference surveys vary with key political factors, such as individual voting status and voting behavior. Fourth, the article illustrates the potential implications of the results for the political economy of regulatory policy. One such reference point is obtained by comparing the mean and median values for various groups. An additional perspective is offered by analyzing how policy valuations change if political parties or the preferences of supporters of particular candidates are most influential.

While it may be the case that regulatory policies are governed by maximization of the difference between benefits and costs, there is little reason to believe that economists' idealized social welfare calculus is reflective of the preferences that are actually influential in driving the policy decisions. Regulatory agencies and legislators are subject to a variety of influences other than those that will lead to the maximization of net social benefits. Overall societal preferences are pertinent for social welfare calculations, but it is the preferences of people who vote that influence the representatives who are elected and the policies they support. Not all people vote, and those who do are not a random selection of the population. To address the preferences within the voting population, we explore the distribution of preferences of people who voted in the 2000 presidential election. Within a voter-weighted population, a salient voter is the median voter, whose preferences will guide the outcome in deterministic majority rule models in which voters select their utility-maximizing choice.[6] Although we often find it convenient to discuss the median valuations, we recognize that the situations in which the median voter has an instrumental role are often limited to certain contexts, such as when open space regulations are chosen through a referendum.[7] Heterogeneous preferences will reduce the predictive validity of the median voter model and bring to bear other influences on policies.[8] With heterogeneous districts, political party competition also may not converge to the policy preferences of the median voter.[9]

[5] Previous studies have focused on more localized improvements, such as particular bodies of water or regional water quality. See Smith and Desvousges (1986), Carson and Mitchell (1993), Magat et al. (2000), and Viscusi, Huber, and Bell (2008).

[6] Alternatively, one could formulate a model in which there is probabilistic voting in which there is some nonzero probability that the person will abstain or vote in favor of a candidate offering a lower utility level than the alternative candidate. Under certain conditions, such voting will lead to Pareto optimal outcomes. See Coughlin and Nitzan (1981), Coughlin (1982), and Coughlin, Mueller, and Murrell (1990). While maximization of benefits minus costs is Pareto optimal, not all Pareto optimal outcomes maximize net social benefits.

[7] Examples of analyses of referenda with environmental consequences include Deacon and Shapiro (1975) and Kotchen and Powers (2006). These studies found that different voter characteristics affected the support for the initiatives.

[8] See Gerber and Lewis (2004) for a model of these issues.

[9] See Collender (2005) for a theoretical analysis of these issues.

The presence of substantial heterogeneity in valuations that our results document gives rise to diverse behaviors that also may affect policy outcomes. The importance of heterogeneity of preferences plays a central role more generally in determining the costs that political parties are willing to incur to obtain a good.[10] Rent-seeking behavior of various kinds, such as donations to political candidates and other efforts to affect policy outcomes, arise as consequences of the different intensity of preferences. Thus, the evidence presented on heterogeneity of preferences provides a rationale for why the right-skewed distribution of valuations will be important even if it is not possible to specify exactly how the preference distribution will be mapped into particular policy outcomes.

Existing models highlight the importance of such factors but do not specify how the empirical distribution of preferences will be translated into policy outcomes.[11] Preference intensity and heterogeneity clearly matter and will not necessarily lead to outcomes in accordance with the deterministic median voter model, but exactly how these factors will affect policy valuations implied by the survey valuation data, as compared to the outcome based on economic efficiency norms, is not clear-cut. The advantage of the median reference point is that it is concrete and lends itself to quantification based on the assumption of one vote for one person. Our data make it possible to examine both the mean and the median valuations for the entire population, for those who vote, for members of different political parties, and for those who voted for different candidates, by matching voting information to survey valuations.

The organization of the paper is as follows. The empirical analysis utilizes a new stated preference survey for water quality benefits, which is administered to a nationally representative sample. The survey uses an iterative referendum process to determine how much people are willing to pay for water quality improvements throughout the country. A key factor influencing the implications of the results of the survey is the positively skewed distribution of valuations. Mean valuations, consequently, may be quite different than the median environmental benefit values. The empirical analysis presents what is, to the best of our knowledge, the first examination of the relationship of individuals' expressed environmental benefit tradeoff values to a series of political influences.[12] Among the more interesting ways in which it is possible to analyze differences in preferences is a comparison of the valuations of people who are registered to vote and who actually voted in the presidential election. Even greater differences are found in the valuations for members of the different political parties and for people who voted for the different candidates. The conclusion discusses the competing influences at work. While the median person places a lower value on environmental quality than the societal mean value, a partially offsetting influence is the greater valuations of people who are registered to vote, as compared to society generally. The winning political candidate's supporters may have disproportionate influence on policy. An election victory by Gore in 2000 would have pushed the environmental benefit value closer to the average water quality benefit value across the population based on the median Gore voter preferences, but above that value if the average preferences of Gore voters determined policy.

[10] Following the analysis in Zerbe (2001), let WTP be a party's willingness to pay to obtain a good and WTA be the willingness to accept amount for giving up a good, where WTA > WTP. The respective roles played by WTP and WTA depend on the sense of entitlement that people have for water quality. The differing intensity of preferences will play a critical role in determining who should receive the good and, in this case, who will incur costs to promote their policy preferences.

[11] Among the many influential studies of the role of interest groups with economic theory of regulation are those by Stigler (1971), Posner (1974), Peltzman (1976), Becker (1983), Weingast and Moran (1983), and Shepsle and Weingast (1984). Viscusi, Harrington, and Vernon (2005) provide a review.

[12] There have, of course, been numerous studies of how political factors and characteristics of voters influence environmental policies. See the studies of air pollution policy by Crandall (1983) and Pashigian (1985), the study of strip mining by Kalt and Zupan (1984), and the analysis of Superfund policies by Hamilton and Viscusi (1999).

THE NATIONAL WATER QUALITY BENEFITS SURVEY

The Survey Structure

This study utilizes data from the authors' survey of water quality administered to a nationally representative Web-based panel. The focus of the survey is on the average national quality of inland water bodies, principally from the standpoint of recreation and ecological considerations. Thus, the implications of water quality for drinking water were explicitly excluded from consideration. After narrowing the focus in this manner, the survey engaged the respondents in thinking about water quality and the effect of water quality on their well-being. In doing so, the survey explored the individual's usage of water bodies.

Because of the central role of the definition of water quality, the survey provided information to respondents concerning the attributes of water that led to it being rated as "Good" based on the U.S. Environmental Protection Agency's National Water Quality Inventory definitions.[13] In particular, a survey screen informed the respondent:

> The government rates water quality as either
>
> * Good, or
>
> * Not Good.
>
> Water quality is Good if water in a lake or river is safe for all uses.
> Water quality is Not Good if a lake or river is polluted or unsafe to use.
>
> More specifically, water quality is Not Good if the lake or river
> * Is an unsafe place to swim due to pollution,
> * Has fish that are unsafe to eat, or
> * Supports only a small number of plants, fish, and other aquatic life.

After a series of questions about water quality in the respondent's region and the respondent's valuation of improvements in regional water quality, a referendum format elicited values for improvements in national water quality.[14] To assess the total use and nonuse value of these improvements, the survey asked respondents if they would vote in favor of a policy that increased the amount of national water quality rated "Good" by a specific percentage, where this improvement was tied to a specified increase in the cost of living for the respondent and other households as well. Before engaging in this task, the survey educated respondents about the meaning of the cost-of-living changes and elicited from them the effect that a higher level of cost of living would have on their well-being. The cost-of-living format imposes costs on the respondent and others more broadly, so that this structure recognizes that a credible payment structure for a public referendum must reflect respondents' strong sense that people in other regions should pay their own way.[15]

[13] Thus, the water quality ratings used in the survey follow those used in Magat et al. (2000), Huber, Viscusi, and Bell (2008), and Viscusi, Huber, and Bell (2008) for regional water quality improvements, whereas this article focuses on national improvements using a different choice structure that has a referendum format. The rating of "Good" water quality on the dimensions indicated below differs from the earlier water quality ladder approach used in Carson and Mitchell (1993). The inconsistency of current water quality data with the water ladder approach, which was the previous policy formulation, is examined in Magat et al. (2000).

[14] The results of the regional valuation conjoint questions are reported in Huber, Viscusi, and Bell (2008) and in Viscusi, Huber, and Bell (2008). Those questions did not have a referendum format and focused on regional water quality rather than national water quality.

[15] In earlier pretests, we found that people were unwilling to contribute to other types of environmental policies unless people in the region being benefited also had to contribute.

Although the national water quality survey shares the same water quality definitions as reported in the regional water quality surveys in Magat et al. (2000) and Viscusi, Huber, and Bell (2008), the focus of this paper and the survey questions being analyzed are quite different. The survey questions examined here pertain to national water quality improvements rather than changes in the water quality in a hypothetical region to which a respondent might move. In addition, the question structure in those regional valuation studies was a choice-based conjoint approach. In contrast, the national valuation question in this paper has a referendum format. Finally, neither of the previous articles coupled the analysis with any of the political variables that give this article its distinctive focus from any previous study in the stated preference literature on environmental benefits.

The economic structure of the valuation question has the following form. People have a utility function $u(q,y)$ where q is average national water quality, y is income, u_1, $u_2 > 0$, and u_{11}, $u_{22} < 0$. Respondents have as their starting position $u(q_0,y_0)$. They are offered the opportunity to vote on a referendum that will raise the level of water quality rated Good by Δq, but at a cost of Δy, which has a negative value. People will vote in favor of the referendum if

$$u(q_0 + \Delta q, y_0 + \Delta y) > u(q_0, y_0) \tag{1}$$

The survey structure presents respondents with a series of $(\Delta q,\Delta y)$ pairs that iterate until indifference is reached at some pair $(\Delta q^*,\Delta y^*)$, which satisfies

$$u(q_0 + \Delta q^*, y_0 + \Delta y^*) = u(q_0, y_0) \tag{2}$$

For small values of Δq^* and Δy^*, the average rate of tradeoff between water quality and income will approximate the marginal rate of tradeoff, which we designate by v, or

$$v = \frac{\partial u / \partial q}{\partial u / \partial y} = -\frac{\Delta y^*}{\Delta q^*} \tag{3}$$

Each person i in the sample will consequently have a v_i tradeoff value based on their $-\Delta y_i^*/\Delta q_i^*$. Our focus will be on different aspects of the distribution of v_i values. For purposes of benefit–cost analysis, the pertinent unit benefit value that will be multiplied by the population to obtain the total benefit value is the mean of v_i across the population, or $\bar{v}$. Policies pass an economic efficiency test if the average willingness to pay $\bar{v}$ multiplied by the national water quality improvement plus the average cost per household, which is a negative number, exceeds zero, or

$$\bar{v}\Delta q + \Delta y > 0 \tag{4}$$

If policies are governed by majority rule with deterministic voting, outcomes will be governed by the median of the distribution of v_i values, which we designate by $v_{0.5}$. The distribution of v_i values will consequently affect the relationship between $\bar{v}$ and $v_{0.5}$ and the likely political pressures from substantial differences in these values. The data examined here make it possible to examine the relationship between the mean and median values for the population as well as their values for politically pertinent subgroups: the population who are registered to vote, the population of those who actually vote, the supporters of different political parties, and those who voted for particular candidates.

Figure 1 provides an example of the referendum question format used in the survey. This stated preference survey imposes much more structure than an open-ended contingent valuation question. If a respondent indicates indifference to a cost-of-living increase of \$200 and a 10 percent increase in the percentage of national water quality rated Good, then there are no further referendum questions posed to

Suppose you could vote on a policy that you are sure would improve the water quality in every region of the country, including your own, by **20%.** The entire United States is about 100 times the size of your region.

This policy would increase the cost of living by **$200** per year nationwide.

	Effect of Policy
Increase in Cost of Living	$200
Percent Increase of Lake Acres and River Miles with Good Water Quality	20%

Would you be in favor of this policy?

Select one answer only

* Yes, I am in favor of this policy
* No, I am opposed to this policy
* I have no preference for whether this policy is done or not

Figure 1. Sample National Referendum Question.

the individual. Such a person who has reached indifference to the choice in Figure 1 has a value of water quality improvements of $200/10% improvement, or $20 per 1 percent improvement in national water quality that is rated as being Good. For respondents who vote in favor of the policy, the referendum iterates, decreasing the percentage of water quality improvement from $200 until a point of indifference is reached. Similarly, for respondents indicating that they are opposed to the policy, the cost of the improvement decreases until the respondent indicates indifference.

Figure 2 summarizes iterative structure of a sample referendum question.[16] Some respondents reach the corners of the available referendum choices, and we impute the tradeoffs implied by these responses using censored regressions, described below. Respondents who reach the corners are presented with a dominated choice. If a respondent holds to an irrational preference despite being questioned about it, then that respondent is labeled as inconsistent and is not used in the analysis. Thus, for the example in Figure 2, the pro-environment respondents who go down the sequence of choices on the right and continue to vote in favor of the policy even when reminded that there is a $200 cost for 0 percent improvement are labeled inconsistent. Similarly, those who consistently oppose the policy even when it offers a 20 percent improvement in water quality at $0 cost are also inconsistent. Only 2 percent of the sample failed the consistent response test. The survey responses also satisfied a series of scope tests for the validity of the survey responses. These checks on survey validity are detailed in Appendix A.[17] Note that in addition to passing the standard tests, the survey respondents make a series of iterative choices that constitute an additional consistency test incorporated in the survey structure.

The iterative choice method used provides a valuation measure for each individual, calculated from responses to the referenda questions. However, the trade-off implied by the first vote in the sequence may have an anchoring effect on the final solution. Huber, Viscusi, and Bell (2008) proposed that an "equitable start point" occurs where the first question has an equal chance of being accepted or refused across the population. Analyzing the valuations based on what they would be at the

[16] For 910 respondents, the survey structure included only a single referendum decision rather than the iterative decision tree. Starting cost and quality values varied between respondents, with cost levels ranging from $100 to $500 and quality values ranging from 5 percent to 25 percent.

[17] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

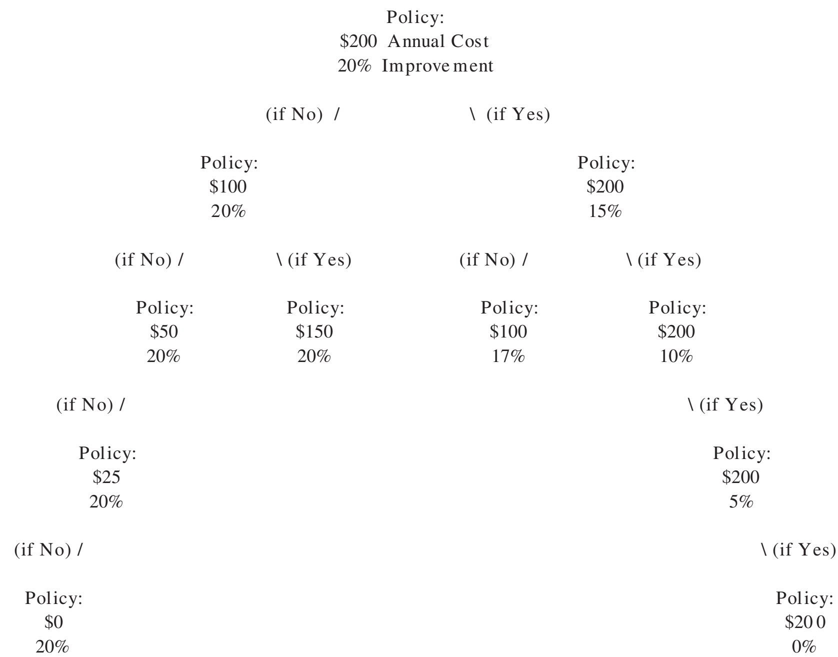

Figure 2. Survey Decision Tree.

equitable start point minimizes any bias from anchoring. Having the equitable start point has a number of advantages, the most notable being that the ultimate valuation cannot be a function of where the analysts decide to set the first trade-off. In our study, initial changes in cost of living and water quality are different across respondents. A start point where the median respondent is approximately neutral was predicted through a choice model using the starting values (change in cost of living and change in water quality) as predictors of the answer to the first referendum. The regression on valuation shown below includes these two terms. Then, when the water quality value is predicted for each person, it is adjusted to starting differences that would produce a 50%–50% split in the first choice. Put more succinctly, each individual valuation is the one predicted had the respondent been presented with an equitable start point with a $402 cost difference and 17 percent quality difference. Except when the discussion focuses on the raw survey values, all benefit values discussed below will be those adjusted to reflect answers as though they had been implemented with the equitable start point.

The Sample

Before undertaking the survey, we engaged in a series of focus groups, pretests, cognitive interviews, and pilot runs to ensure that the questions were well understood. After completing these preliminary states, we administered the survey to a sample drawn from the Web-based panel administered by Knowledge Networks (KN) from February 2003 to October 2004. The KN panel is a nationally representative sample with demographic characteristics that closely parallel those of the U.S. adult population. KN has constructed the panel using a probability random digit dialing approach. To encourage members of the panel to complete our survey, KN provided respondents with a $10 incentive payment to take the survey, which on average took respondents 25 minutes to complete. There was a 75 percent response rate to the survey.

Appendix Table A1[18] summarizes the sample characteristics and the comparable demographic characteristics of the U.S. population. This distribution of respondent characteristics closely mirrors that of the U.S. population generally. There is, for example, excellent representation of minorities, which is often a concern in such surveys. Among the most important differences between the sample characteristics and those of the nation generally are that there are somewhat fewer people who have completed education beyond that of being a college graduate, and low-income groups are slightly underrepresented. Overall, there is an excellent matchup of the sample characteristics with the U.S. population.

Our analysis is restricted to the 3,654 observations that met the following criteria. Because our interest is in voting patterns in the 2000 elections, the sample is restricted to those over age 18 at the time of the elections and consequently focuses on those over age 21 at the time of the survey.[19] In addition, the respondent must have completed the key demographic information, had no missing values on the benefit assessment question of interest, and not failed the national referendum consistency test.

BASELINE NATIONAL VALUES OF WATER QUALITY

Because some respondents reached the corners of the decision tree in Figure 2, we report both raw valuation measures and those based on a regression analysis using a doubly censored regression format. Let v_a be the lower bound value permitted by the iterative choice structure given to the particular respondent, and let v_b be the upper bound value permitted. For the example shown in Figure 2, the value of v_a is \$1.25, that is, \$25/20%, and the value of v_b is \$40, that is, \$200/5%.

The empirical analysis of water quality values will focus on the natural log of these values. If we let x denote the explanatory variable vector and let β denote the coefficient vector, the regression model has the form

$$\ln(v^*) = x'\beta + \varepsilon \tag{5}$$

where

$$\ln(v) = \ln(v_a) \text{ if } v^* \leq v_a \tag{6}$$

$$\ln(v) = \ln(v^*) \text{ if } v_a \leq v^* > v_b \tag{7}$$

and

$$\ln(v) = \ln(v_b) \text{ if } v^* \geq v_b \tag{8}$$

where we assume that $\varepsilon_i|x_i$ is approximately normal $(0, \sigma^2)$. The empirical structure is consequently that of a two-limit censored normal regression where the log-likelihood is the sum of the terms for the three valuation regions specified in equations 6 to 8.

Two-thirds of all respondents reached a point of indifference before hitting a corner of the iterative decision tree. Of the 3,654 observations, 2,470 are uncensored observations, a combination of those indifferent to spending a particular amount of money for the policy and not spending it and those who rejected policies reflecting both higher and lower valuations than accepted policies. These latter people were assigned a value midway between rejected valuations. There were 664 right-censored responses of people who continued to vote for the policy as the percentage increase in water quality declined, and there were 520 left-censored responses of people who continued to vote against the policy despite a decrease in the policy costs. Among

[18] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

[19] The results are quite similar if the omitted younger respondents are included, but doing so introduces a large number of missing values for the political economy variables of interest.

Table 1. Censored regression of log unit value of national water quality benefits.

Variable	Parameter Estimate	Standard Error
Log(Income)	0.0685***	(0.0200)
Years of education	0.0315***	(0.0069)
Age	−0.0064	(0.0063)
Age squared	0.0001*	(0.0001)
Environmental organization membership	0.1663**	(0.0759)
Visits to lakes or rivers, last 12 months	0.0117**	(0.0052)
Visits, outside region, last 12 months	0.0458***	(0.0170)
Race: black	−0.0601	(0.0509)
Race: non-black, non-white	−0.0971	(0.0698)
Hispanic	0.0551	(0.0557)
Gender: female	−0.0044	(0.0337)
Household size	−0.0117	(0.0130)
Region: Northeast	0.1226**	(0.0527)
Region: South	0.0404	(0.0478)
Region: West	−0.0288	(0.0521)
State lake quality	0.0006	(0.0007)
Lake acres per state square mile	0.0021	(0.0018)
Cost difference in first referendum	0.0014***	(0.0002)
Quality difference in first referendum	−0.0600***	(0.0036)
Intercept	2.3065***	(0.2569)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations. Pseudo R-squared: 0.01.

those who continue with the same vote, there is a somewhat greater predilection for supporting environmental policy expenditures than opposing such policies.

Table 1 reports the doubly censored regression results for the unit values v_i for national water quality improvements. This analysis assumes each censored respondent has a value that follows from his/her characteristics and the log normal distribution across the population. Appendix B[20] explores the log normality assumption and presents a sensitivity analysis based on the more flexible, generalized gamma distribution, thus providing a robustness check on the results in Table 1. The natural log of respondent income has the expected positive sign, as does the number of years of education, which is a good proxy for lifetime wealth. Environmental water quality is a normal economic good. Other background characteristics also have the expected directions of influence. Higher valuations are exhibited by people who are environmental group members and by people who have made visits to lakes or rivers in the past 12 months. There is an additional value to people who have also made trips to visit lakes and rivers outside their home region.

It is also of interest to note a number of variables that were not significant. Despite large sample size, once the demographic factors, interests, and activities listed above are taken into account, there is minimal impact of race, gender, household size, water quality, or water density on the value of water quality expressed in the referendum.

The censored regression estimates also make it possible to estimate each respondent's valuation, taking into account the limitations that censoring imposes on the values that respondents expressed through their answers to the series of referendum questions. For each individual in the sample, we use the regression equation in Table 1 to predict the estimated valuation amount v_i. Appendix B[21] presents a

[20] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.
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histogram of the raw responses, indicating their approximately log normal distribution. The raw survey valuations have a mean of $27.31, a standard deviation of $24.54, and a median of $20.00. Using the censored regression model to predict the valuation amounts yields a mean estimated value of $38.42, with a standard deviation of $7.72. The predicted median value of $22.14 using the censored regression estimate is substantially below the mean, consistent with the skewed nature of the unit benefit value distribution.[22]

Because people at the right tail of the valuation distribution have high environmental values, while those placing a low value are constrained to having nonnegative values, the mean valuation amount exceeds the median. This property of the valuation distribution has strong implications for the political economy of water quality. If the decisive voter is the median voter, as with deterministic majority rule, the preferences expressed by the median person will understate the mean value for water quality improvements. This discrepancy leads to an understatement of environmental benefits, as the mean value is pertinent from the standpoint of both political power and economic social welfare considerations. If policy decisions were governed by the median preferences expressed by the full sample, then the expressed values for water quality would understate the pertinent mean economic values by 27 percent based on the raw survey results and by 42 percent based on the censored regression results. Policy decisions in practice are not dictated by such survey valuations, but instead are influenced by the kinds of political factors that are explored in the subsequent sections. However, the skewed distribution of valuations will be a recurring problem for all different perspectives on environmental benefit assessment.

VOTER REGISTRATION AND VOTING BEHAVIOR

The electoral pressures for policies will be based on the preferences of those who vote rather than on the preferences of all individuals. By coupling the data from the responses to the environmental referendum with information on voting behavior, it is possible to explore voter-weighted preferences, which are most pertinent for policy outcomes, and compare these with the preferences of society generally, which are central to social welfare calculations. Because voter registration is quite prevalent, one would expect few differences for the environmental benefit valuations based on voter registration.

For this sample, data on voter registration status are missing for 16 percent of the sample, while 71 percent report being registered and 13 percent report not being registered to vote.[23] The patterns of voter registration are consistent with those that have been identified in the literature, as in Wolfinger and Rosenstone (1980).[24] Appendix Table A2[25] reports the probit regression results for whether individuals are registered to vote. Variables that have a significant positive effect are income,

[22] Because the censored regression model imposes the assumption of a symmetric log normal distribution we use the Train adjustment to estimate the mean value for the model. If a logged distribution has mean M and variance S, then the mean of the unlogged distribution is $e^{(M+S/2)}$. In this application, we took M and S to be the conditional means and variances given the regression. See Train (2003).

[23] The valuation information is available for all these groups so that the absence of voting information for some respondents is not akin to the classic selection problem. Rather, it follows a more standard missing data situation for explanatory variables, which we address by including a separate indicator variable in the regressions for those who do not report voting status.

[24] Consistent with our results, Wolfinger and Rosenstone (1980) find that the propensity to vote is positively related to education, income, being married, and age, and negatively related to age squared, being female, and being African American.

[25] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

education, and female. Variables that have a negative effect include whether the respondent is black, other race, or Hispanic. Minorities are less likely to be registered to vote, while more affluent and better-educated individuals are more likely to be registered to vote. One might hypothesize, based on the high rate of voter registration, that registered voters would not have substantially different values of environmental quality than those who are not registered. This is not borne out in raw survey valuations, where registered voters average $28.04, as compared to $24.60 for those not registered.

Our first test of the effect of voter registration on environmental benefit valuations is to add to the basic equation in Table 1 indicator variables for whether the respondent is registered to vote and whether such registration information is missing. The omitted dummy variable category is for those who report not being registered to vote. The contrast of interest is between the registered to vote group and the not registered to vote category. As the full regression results in Table 2 indicate, voter registration does not have a statistically significant effect. Controlling for all other demographic factors in the basic equation, there is no statistically significant evidence of an incremental effect of voter registration. In terms of point estimates, based on the censored regression results, registered voters have a mean unit benefit value of $38.81, as compared to $36.31 for those who are not registered. The median values are also similar, with a median value of $22.24 for those who are registered and $21.10 for those who are not registered to vote.

The overall difference based on voter registration status may be greater than the differences that account for other individual characteristics, as registration status may reflect the influence of these variables. To assess the full effect of the registration-related differences, in the bottom panel of Table 2, called "Minimal Regression," we report the censored regression results in which the only included variables are the two voter registration categorical variables. The voter registration effect remains statistically insignificant. In terms of the point estimates, registered voters have

Table 2. Effects of voter registration status on water quality values.

	Complete Sample	Registered to Vote in 2000	Not Registered in 2000	Registration Data Missing
Percentage	100	70.96	12.64	16.39
Raw Values				
Mean	$27.31	$28.04***	$24.60**	$26.22
Std. dev.	24.54	25.28	21.02	23.65
Median	$20.00	$20.00	$20.00	$20.00
Full Regression				
Coefficient	—	−0.0730	—	0.0325
Std. error	—	(0.0535)	—	(0.0635)
Predicted mean	$38.47	$38.81	$36.31	$38.65
Predicted std. dev.	7.90	8.20	6.33	7.41
Predicted median	$22.16	$22.24	$21.10	$22.61
Minimal Regression				
Coefficient	—	0.0618	—	0.0587
Std. error	—	(0.0524)	—	(0.0643)
Predicted mean	$37.98	$38.29	$36.00	$38.17

Notes: For *t*-tests and regressions: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Significant levels for means are for comparisons of results in that column to the rest of the sample. Regression results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations.

Table 3. Effects of voting behavior on water quality values.

	Complete Sample	Voted in 2000 Election	Did Not Vote in 2000 Election	Voting Data Missing
Percentage	100	47.95	39.05	13.00
Raw Values				
Mean	$27.31	$28.99***	$26.05**	$24.85**
Std. dev.	24.54	25.11	24.36	22.52
Median	$20.00	$20.00	$20.00	$20.00
Full Regression				
Coefficient	—	−0.0016	—	0.0601
Std. error	—	(0.0384)	—	(0.0539)
Predicted mean	$38.43	$40.29	$36.62	$37.04
Predicted std. dev.	7.77	8.25	6.93	6.65
Predicted median	$22.14	$23.12	$21.18	$21.65
Minimal Regression				
Coefficient	—	0.0906***	—	0.0097
Std. error	—	(0.0367)	—	(0.0545)
Predicted mean	$38.79	$39.46	$38.67	$36.64

Notes: For *t*-tests and regressions: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Significant levels for means are for comparisons of results in that column to the rest of the sample. Regression results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations.

mean values of $38.29, as compared to $36.00 for those not registered to vote. The preferences of the registered voter population with respect to environmental quality do not differ significantly from those of the unregistered population.

Being registered to vote is not, however, the same as actually voting, and it is the preferences of people who vote that will influence who is elected. Voting in an election involves a cost to the voter. The outcome of an election can be viewed as a public good, where voters are willing to pay a higher price for that good than nonvoters, suggesting that they may value the items in referenda more. To analyze the influence of voting behavior, we focus on the voting patterns for the 2000 presidential election. Overall, 48 percent of the sample reported that they voted, and 39 percent indicated that they did not. Others did not respond to this question. Appendix Table A3[26] reports the determinants of whether the respondent voted, which are very similar to the effects for whether a person is registered to vote. There is a positive effect of income, education, age, and a negative effect of being black, other race, Hispanic, or female.

When the voted variable is added to the main regression, those who voted do not differ significantly from those who did not vote, controlling for other demographic variables. However, the predicted mean values for the sample, which also account for the influence of variables correlated with whether the respondent voted, exhibit a larger spread, with a mean of $40.29 for voters and $36.62 for nonvoters.

Controlling for the detailed set of demographic factors increases the effect of the difference in preferences of voting status. The raw unadjusted values for voters have a mean of $28.99 and a median of $20.00, as compared to a mean of $26.05 and median of $20.00 for nonvoters. These effects are borne out in the set of censored regression results at the bottom of Table 3. Controlling for other demographic

[26] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

factors, voters have a mean valuation about $4.00 higher than nonvoters and a median valuation about $2.00 higher. The minimal regression estimates include only the voting status variables in the regression, which consequently will reflect the full effect of voting status differences. Voting in 2000 has a statistically significant effect on overall valuations. Those who voted in 2000 have a mean value of $39.46, as compared to $38.67 for those who did not vote.

In terms of the social welfare implications, recognition of the preferences of voters will move the median preferences somewhat closer to the overall societal mean preferences. Doing so has a beneficial influence in terms of moving the valuations closer to the economically efficient level, because on a society-wide basis, mean environmental values exceed the median. Political processes based on median preferences of the public undervalue the environment. This shortfall is mitigated in part by the higher environmental valuations of people who vote, as compared to those who do not. But this influence is not sufficiently great to fully offset the mean–median disparity.

POLITICAL PARTY MEMBERSHIP AND CANDIDATE PREFERENCES

Environmental values may also be transmitted through subsequent votes by the candidates who are elected rather than through a median voter referendum. In this section we explore two variations on the role of political orientation—the individual's party affiliation and the candidate the person voted for in the 2000 presidential election. While the correlations with environmental valuations follow the expected patterns, the differences with respect to the candidate affiliations are much stronger than those by political party, by voter registration, or by whether the person voted in the election.

The political party distribution shown in Table 4 indicates an edge for Democrats, consistent with national registration data. As Appendix Table A4[27] indicates, the determinants of party affiliation follow the expected patterns. Being a Republican is an increasing function of income, education, and age, and is negatively related to being an environmental group member, a member of a minority group, or being female.

Relative to the group for whom party affiliation is missing, there is a significant negative effect of being a Democrat or Republican, controlling for the full set of explanatory background variables. However, when political parties alone are included in the analysis to capture the full effect of party affiliation, including the influence of parties through the background characteristics of those who belong to different parties, there are no statistically significant differences. Even the mean estimates of the valuations are quite close, with registered Democrats valuing improved water quality at $38.60 per unit increase and registered Republicans having a value of $38.02.

The sample's voting for the presidential candidates in 2000 was close, as was the actual election. For this group of respondents, Bush had a 2 percentage point edge. The results in Appendix Table A5[28] indicate that the people who were more likely to vote for Bush had less education, were not environmental group members, and were not members of minority groups.

As the results in Table 5 indicate, the differences between the Bush and Gore valuations of water quality are significant. In terms of the raw values, Gore voters have the highest mean values, while those who do not report for one of the three major candidates have the lowest values. Bush voters have lower valuation than Gore voters

[28] All appendices are available at the end of this article as it appears in JPAM online. Go to the publisher's Web site and use the search engine to locate the article at http://www3.interscience.wiley.com/cgi-bin/jhome/34787.

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Table 4. Effects of political party membership on water quality values.

	Complete Sample	Republican	Democrat	Other Party	Missing
Percentage	100	34.65	39.55	6.10	19.70
Raw Values					
Mean	$27.31	$27.44	$27.73	$26.42	$26.49
Std. dev.	24.54	23.48	26.09	22.11	23.90
Median	$20.00	$20.00	$20.00	$20.00	$20.00
Full Regression					
Coefficient	—	−0.0423	—	0.0072	0.0887*
Std. error	—	(0.0399)	—	(0.0764)	(0.0474)
Predicted mean	$38.42	$38.02	$38.60	$35.97	$39.56
Predicted std. dev.	7.94	7.76	8.17	6.95	7.88
Predicted median	$22.15	$22.02	$22.08	$20.81	$22.96
Minimal Regression					
Coefficient	—	−0.0122	—	−0.0656	0.0240
Std. error	—	(0.0395)	—	(0.0774)	(0.0471)
Predicted mean	$37.99	$37.65	$38.11	$35.69	$39.04

Notes: For *t*-tests and regressions: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Significant levels for means are for comparisons of results in that column to the rest of the sample. Regression results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations.

Table 5. Effects of 2000 presidential candidate support on water quality values.

						Candidate
	Sample	Bush	Gore	Nader	Candidate	Missing
Percentage	100	23.73	22.41	1.29	0.52	52.10
Raw Values						
Mean	$27.31	$27.39	$30.52***	$32.70	$26.75	$25.75***
Std. dev.	24.54	22.91	26.83	29.45	29.76	23.91
Median	$20.00	$20.00	$22.22	$26.67	$20.00	$20.00
Full Regression						
Coefficient	—	−0.1696***	—	−0.1117	−0.5788**	−0.0794*
Std. error	—	(0.0512)	—	(0.1551)	(0.2370)	(0.0454)
Predicted mean	$38.51	$37.52	$43.91	$41.10	$23.98	$36.71
Predicted std. dev.	8.21	7.08	9.56	8.00	4.54	6.86
Predicted median	$22.16	$21.71	$25.14	$23.69	$13.48	$21.40
Minimal Regression						
Coefficient	—	−0.1493***	—	−0.0605	−0.6159**	−0.1707***
Std. error	—	(0.0505)	—	(0.1565)	(0.2419)	(0.0433)
Predicted mean	$38.06	$37.15	$43.13	$40.60	$23.30	$36.37

Notes: For *t*-tests and regressions: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Significant levels for means are for comparisons of results in that column to the rest of the sample. Regression results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations.

based on the full regression coefficient estimates as well as the minimal regression. The mean predicted values based on the full set of variables regression are $37.52 for Bush and $43.91 for Gore. There is a similar discrepancy based on the predicted values based solely on the voting decision, with Bush supporters averaging a value of $37.15 and Gore supporters averaging a value of $43.13. If the average valuations of these voters determine the policy direction of the winning candidate, then the Bush victory will lead to slight undervaluation of the environment, while a Gore victory will lead to overvaluation relative to the mean population valuation. However, if it is the median voter within these groups who is most influential, then a Gore victory will lead to some narrowing of the shortfall relative to the mean societal value of environmental quality. The median valuations always lead to undervaluation of the environment relative to the average societal value irrespective of the group considered.

The pattern of preferences for political parties across states that voted for particular candidates provides an interesting contrast as well. The largest water quality values are for the Democrats in the Gore states, who have predicted values of $39.80. The lowest values are for Republicans in the states that voted for Gore, whose predicted values average $36.70. With respect to voting pattern effects, the Gore voters in the Gore states have the highest values of $45.31, followed by the Gore voters in the Bush states, who average $42.33, the Bush voters in the Gore states at $38.10, and the Bush voters in the Bush states, with the lowest predicted average of $36.96. Notice that the consistent contrast derives from these two with sharply contrasting environmental positions, while the impact of individual or state party on the question of water quality was, as one might expect, muted.

CONCLUSION

The considerable heterogeneity of environmental benefit values raises potentially serious problems with respect to the weight that the political process places on the environment. The source of the problem is that the preferences of the median person in the population reflect just over half the intensity of preference as the average across the population. Focusing solely on registered voters does little to ameliorate the discrepancy, but there is some benefit from considering only the voting population, as they have somewhat higher values than those who do not vote.

The biggest variations were reflected in the preferences between those who voted for the different candidates. Gore voters have considerably higher valuations than those who voted for Bush, so the weights placed on environmental benefits are quite different. While a Democratic victory or a Gore victory would have pushed the median value for water quality closer to the societal mean value, because of the skewness in the distribution, the valuation amount remains substantially below the average societal benefit value. If, however, mean values of the winning party or candidate are more influential than the preferences of the median voter, then the valuation amounts will be much closer to the societal average value, irrespective of who wins the election. Mean valuations that capture the differing intensity of preferences are able to reflect various pressure group models. Depending on how these preferences influence policy choice, there may remain the risk that public goods will be undervalued when there is a skewed distribution of preferences.

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APPENDIX A: SCOPE TESTS, SAMPLE CHARACTERISTICS, AND VOTING BEHAVIOR

Before considering the regression results for the water quality valuations, let us first review the series of scope tests applied to these responses, following the scope test approach in Heberlein et al. (2005). First, the standard scope test is that people should prefer a lower cost of living amount to a higher cost of living amount, and a higher level of national water quality to a lower level of water quality. People who violate this basic rationality test are captured by the consistency tests included at the end of each iterative tree, as described in the article. If people failed the consistency test, they were not alerted to the problem with their answer and given a chance to try again, but instead were labeled inconsistent. A quite impressive 98 percent of the sample passed the consistency test. Failing this consistency test does not mean that people are irrational. More likely, it suggests that they were not attending sufficiently to the survey task and, as a result, they are excluded from the empirical analysis.*

The second type of scope test is the affective scope test. People who have revealed that they like the environment more should have a higher valuation of improved water quality. Our measure of affective scope is whether the individual is a member of a leading environmental organization, where the groups included: Environmental Defense Fund, Greenpeace, National Audubon Society, National Wildlife Federation, Nature Conservancy, Natural Resources Defense Council, and the Sierra Club. Overall, 5.28 percent of the sample belonged to one or more of these groups. The average valuation that environmental group members have of a 1 percent improvement in national water quality is $50.88, which exceeds the comparable value for non-environmental group members of $37.73 ($t$ = 24.88).

The third type of scope test is behavioral scope. We hypothesize that people who use water bodies to a greater extent should exhibit higher valuation amounts, assuming that the sum of the use and nonuse values of those who use water bodies is greater than the nonuse value of those who do not use water bodies for recreational purposes. Such a relationship is reasonable but may not necessarily hold if the nonuse values are especially large for those who do not use lakes and rivers for recreational purposes. To examine this relationship we break the sample into two groups—those who have visited lakes, rivers, and streams over the last 12 months (67.2 percent of respondents), and those who have not engaged in such usage activities. The valuations of the user group average $39.99, which is significantly larger than the value of $35.20 for the nonuser group (t = 18.41). Similarly, people who have taken trips to use lakes and rivers outside of their home region, which is defined as an area within a 100-mile radius of their home (31.5 percent of respondents), have average national water quality valuations of $42.95, which exceeds the valuations of $37.40 for people who use lakes, rivers, and streams within their region but not outside of it (t = 18.33).

The final scope test is for cognitive scope. People who think more about lakes, rivers, and streams should exhibit higher valuation amounts. The survey included a question asking people whether they viewed lakes and rivers often over the past 12 months, irrespective of whether they have never actually used them (49.9 percent of respondents). The respondents who are classified as having thought about inland water in this manner have a unit valuation of national water quality of $40.62, which exceeds the value of $36.22 for the other respondent group (t = 17.96).

Table A1 summarizes the sample characteristics and compares these values to the U.S. population. Table A2 presents probit regression results for whether the respondent is registered to vote, while Table A3 presents the estimates for whether the respondent voted in 2000. Determinants of political party membership and voting in the 2000 presidential race are analyzed in Tables A4 and A5.

* The results obtained with these responses included are very similar to those reported in the paper.

Table A1. Comparison of KN sample to the national adult population.[a]

Demographic Variable	Survey Participants (n = 3,654) Percent	U.S. Adult Population Percent
Employment Status (16 years or older)		
Employed	61.8	62.3
*Age**		
20–24 years old	7.5	9.5
25–34 years old	22.2	18.3
35–44 years old	20.4	20.4
45–54 years old	19.7	18.7
55–64 years old	12.7	12.2
64–74 years old	12.4	8.4
75 years old or older	5.2	8.1
Educational Attainment		
Less than HS	16.9	15.4
HS diploma or higher	60.2	57.4
Bachelor or higher	22.9	27.2
Race/Ethnicity		
White	80.3	81.9
Black/African American	13.4	11.8
American Indian or Alaska Native	1.6	0.9
Asian/Pacific Islander/other	2.6	5.5
Race/Ethnicity of Household		
Hispanic	10.8	12.1
Gender		
Male	51.2	48.5
Female	48.8	51.5
Marital Status		
Married	62.0	58.8
Single (never married)	21.1	24.4
Divorced	11.4	10.2
Widowed	5.5	6.6
Household Income (2002)		
Less than $15,000	14.7	16.1
$15,000 to $24,999	11.4	13.2
$25,000 to $34,999	12.9	12.3
$35,000 to $49,999	19.1	15.1
$50,000 to $74,999	18.2	18.3
$75,000 or more	23.6	25.1

[a] *Statistical Abstract of the United States, 2004–5*. 2003 adult population (18 years+), unless otherwise noted.

Table A2. Probit regression predicting whether respondent is registered to vote.

Variable: Registered to Vote	Parameter Estimate	Standard Error
Log(Income)	0.0259***	(0.0069)
Years of education	0.0245***	(0.0025)
Age	0.0027	(0.0023)
Age squared	1.82e–5	(2.39e–5)
Environmental organization membership	0.0279	(0.0268)
Visits to lakes or rivers, last 12 months	0.0033*	(0.0018)
Visits, outside region, last 12 months	0.0109*	(0.0064)
Race: black	0.0301*	(0.0163)
Race: non-black, non-white	−0.1002***	(0.0316)
Hispanic	−0.0892***	(0.0243)
Gender: female	0.0353***	(0.0118)
Household size	−0.0032	(0.0045)
Region: Northeast	−0.0152	(0.0194)
Region: South	−0.0097	(0.0169)
Region: West	0.0168	(0.0175)
State lake quality	0.0002	(0.0002)
Lake acres per state square mile	−0.0001	(0.0006)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. $N = 3{,}055$. Observed $p = 0.85$, predicted p at $\bar{x} = 0.88$, and pseudo R-squared = 0.13. Coefficients have been transformed to reflect the marginal effects of the variables.

Table A3. Probit regression predicting whether respondent voted in 2000.

Variable: Voted in 2000	Parameter Estimate	Standard Error
Log(Income)	0.0419***	(0.0114)
Years of education	0.0228***	(0.0039)
Age	0.0045	(0.0037)
Age squared	7.10e–5*	(3.72e–5)
Environmental organization membership	0.0021	(0.0421)
Visits to lakes or rivers, last 12 months	0.0014	(0.0029)
Visits, outside region, last 12 months	0.0104	(0.0094)
Race: black	0.0192	(0.0282)
Race: non-black, non-white	−0.0897**	(0.0395)
Hispanic	−0.0924***	(0.0315)
Gender: female	−0.0724***	(0.0186)
Household size	0.0070	(0.0072)
Region: Northeast	−0.0663**	(0.0293)
Region: South	−0.0643**	(0.0264)
Region: West	−0.0487*	(0.0291)
State lake quality	0.0006*	(0.0004)
Lake acres per state square mile	0.0011	(0.0010)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. $N = 3{,}179$. Observed $p = 0.55$, predicted p at $\bar{x} = 0.56$, and pseudo R-squared = 0.11. Coefficients have been transformed to reflect the marginal effects of the variables.

Table A4. Probit regression predicting respondent political party.

Variable: Republican	Parameter Estimate	Standard Error
Log(Income)	0.0285**	(0.0118)
Years of education	0.0100***	(0.0038)
Age	0.0073**	(0.0036)
Age squared	−6.26e–5*	(3.51e–5)
Environmental organization membership	−0.0864**	(0.0395)
Visits to lakes or rivers, last 12 months	−0.0024	(0.0029)
Visits, outside region, last 12 months	0.0194**	(0.0094)
Race: black	−0.3362***	(0.0206)
Race: non-black, non-white	−0.1049***	(0.0363)
Hispanic	−0.1743***	(0.0278)
Gender: female	−0.0573***	(0.0188)
Household size	0.0183**	(0.0075)
Region: Northeast	−0.0248	(0.0291)
Region: South	0.0191	(0.0266)
Region: West	−0.0131	(0.0288)
State lake quality	0.0006*	(0.0004)
Lake acres per state square mile	−0.0011	(0.0010)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. $N = 2{,}934$. Observed $p = 0.43$, predicted p at $\bar{x} = 0.42$, and pseudo R-squared = 0.06. Coefficients have been transformed to reflect the marginal effects of the variables.

Variable: Other Party (not Democrat or Republican)	Parameter Estimate	Standard Error
Log(Income)	−0.0096*	(0.0054)
Years of education	−0.0092***	(0.0019)
Age	−0.0024	(0.0017)
Age squared	5.57e–06	(1.78e–5)
Environmental organization membership	−0.0020	(0.0216)
Visits to lakes or rivers, last 12 months	0.0013	(0.0014)
Visits, outside region, last 12 months	−0.0025	(0.0047)
Race: black	0.0473***	(0.0176)
Race: non-black, non-white	0.0230	(0.0224)
Hispanic	0.0233	(0.0174)
Gender: female	−0.0003	(0.0091)
Household size	0.0013	(0.0035)
Region: Northeast	−0.0006	(0.0137)
Region: South	−0.0156	(0.0120)
Region: West	−0.0142	(0.0129)
State lake quality	−0.0001	(0.0002)
Lake acres per state square mile	0.0006	(0.0005)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. $N = 2{,}934$. Observed $p = 0.08$, predicted p at $\bar{x} = 0.66$, and pseudo R-squared = 0.05. Coefficients have been transformed to reflect the marginal effects of the variables.

Table A5. Probit regression predicting respondent 2000 presidential candidate.

Variable: Voted for Bush	Parameter Estimate	Standard Error
Log(Income)	0.0259	(0.0168)
Years of education	−0.0085*	(0.0052)
Age	0.0061	(0.0049)
Age squared	−6.42e–5	(4.61e–5)
Environmental organization membership	−0.1161**	(0.0506)
Visits to lakes or rivers, last 12 months	−0.0025	(0.0039)
Visits, outside region, last 12 months	−0.0085	(0.0124)
Race: black	−0.5073***	(0.0198)
Race: non-black, non-white	−0.0970*	(0.0530)
Hispanic	−0.1549***	(0.0421)
Gender: female	−0.1044***	(0.0253)
Household size	0.0009	(0.0105)
Region: Northeast	−0.0455	(0.0386)
Region: South	0.0698*	(0.0357)
Region: West	−0.0019	(0.0384)
State lake quality	−0.0001	(0.0005)
Lake acres per state square mile	−0.0014	(0.0013)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. N = 1,752. Observed p = 0.49, predicted p at $\bar{x} = 0.48$, and pseudo R-squared = 0.12. Coefficients have been transformed to reflect the marginal effects of the variables.

Variable: Voted for Nader	Parameter Estimate	Standard Error
Log (Income)	−0.0070	(0.0036)
Years of education	0.0022*	(0.0013)
Age	−0.0019*	(0.0011)
Age squared	1.42e–5	(1.11e–5)
Environmental organization membership	0.0029	(0.0133)
Visits to lakes or rivers, last 12 months	0.0023***	(0.0009)
Visits, outside region, last 12 months	−0.0010	(0.0028)
Race: black	–	–
Race: non-black, non-white	0.0229	(0.0207)
Hispanic	−0.0059	(0.0099)
Gender: female	−0.0006	(0.0062)
Household size	0.0014	(0.0023)
Region: Northeast	0.0071	(0.0103)
Region: South	−0.0141*	(0.0073)
Region: West	−0.0041	(0.0086)
State lake quality	0.0002	(0.0001)
Lake acres per state square mile	0.0006**	(0.0003)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. N = 1,752. Observed p = 0.03, predicted p at $\bar{x} = 0.02$, and pseudo R-squared = 0.09. Coefficients have been transformed to reflect the marginal effects of the variables.

Variable: Voted for Other Candidate	Parameter Estimate	Standard Error
Log(Income)	−0.0004	(0.0023)
Years of education	−0.0006	(0.0008)
Age	−0.0008	(0.0007)
Age squared	5.39e–6	(6.81e–6)
Environmental organization membership	0.0053	(0.0108)
Visits to lakes or rivers, last 12 months	0.0000	(0.0006)
Visits, outside region, last 12 months	0.0010	(0.0018)
Race: black	−0.0046	(0.0046)
Race: non-black, non-white	0.0065	(0.0113)
Hispanic	0.0074	(0.0093)
Gender: female	−0.0012	(0.0038)
Household size	−0.0007	(0.0016)
Region: Northeast	−0.0060	(0.0046)
Region: South	0.0038	(0.0063)
Region: West	0.0100	(0.0093)
State lake quality	−7.74e–5	(7.89e–5)
Lake acres per state square mile	0.0002	(0.0002)

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. $N = 1{,}752$. Observed $p = 0.01$, predicted p at $\bar{x} = 0.01$, and pseudo R-squared = 0.07. Coefficients have been transformed to reflect the marginal effects of the variables.

APPENDIX B: DISTRIBUTION OF VALUATIONS, SURVIVAL TIME ANALYSIS, GENERALIZED GAMMA VS. LOGNORMAL

For our analysis of national water quality, we examined the distribution of the valuations of water quality, and found the distribution of values for one percent changes in water quality shown in Figure B1. This distribution is similar to a classic log normal distribution, as is indicated by the distribution seen when the logs of the values were examined in Figure B2. Our analysis focuses on logged values. The two-tailed tobit regression accounts for the fact that water quality values could be censored high or low if a respondent continued far enough down one side or the other of the decision tree associated with the iterated referendum question set for national water quality values.

To test the appropriateness of this decision, we undertook a survival time analysis of national water quality value data under two scenarios. The first used our assumption of a log normal distribution of data, while the second used an alternative assumption that the data have a generalized gamma distribution, where neither of these two scenarios accounts for censoring in the data. Werner (1999) introduced the survival analysis approach to analyzing interval-censored data on willingness to pay values. The main concern in that analysis was that people may have zero willingness to pay values even though the lowest specified willingness to pay amount in the survey is positive. The generalized gamma distribution is quite flexible, as it includes the Weibull, gamma, and exponential distributions as special cases.

Table B1 presents three models. The first is the censored regression that is the focus of our analysis. The second column presents a survival analysis assuming a log normal distribution, while the third model is a survival analysis based on a generalized gamma distribution. All three models are similar in the magnitude and sign of the coefficients (only the nonsignificant Hispanic demographic changes signs between models). Each model fits the data similarly, with the generalized gamma having the best fit to the data.

In addition, as Table B2 shows, the two survival analysis runs have predicted water quality benefit values that are close to the observed raw mean of $27.31 (median $20.00). The two-tailed tobit regression analysis predicts a larger mean, $38.42, as it models a distribution of 664 censored high and 520 censored low values beyond the observed responses, and also adjusts for starting point effects (before adjusting for starting point effects, the prediction is $34.16 with a median of $19.57). All three models show a disparity between mean and median values.

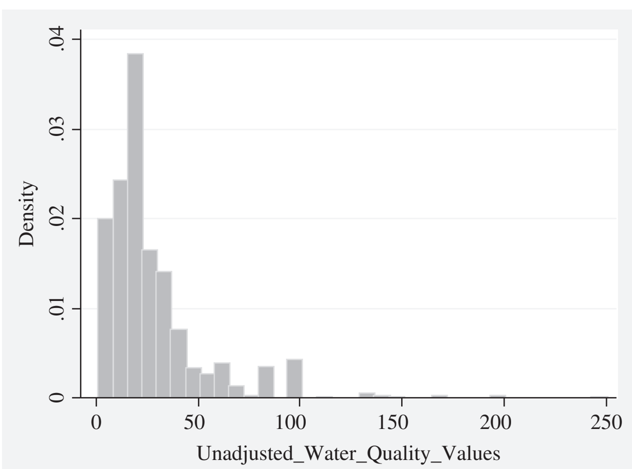

Figure B1. Distribution of National Water Quality Values.

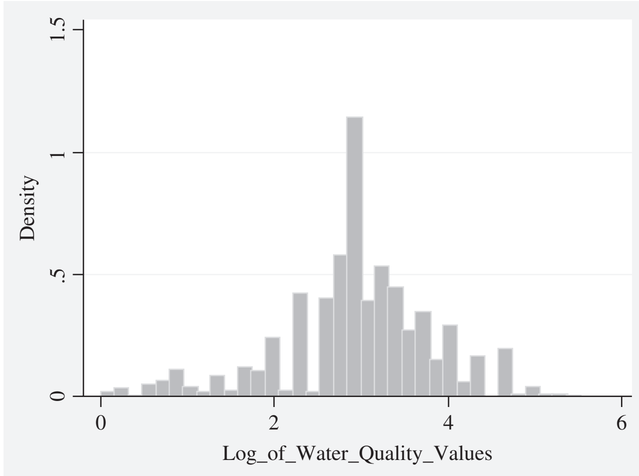

Figure B2. Distribution of National Water Quality Values, Log Transformed.

Table B1. Models predicting log unit value of national water quality benefits.

Variable	Two-T Tobit of Logged Values	Survival Log Normal	Generalized Gamma
Log(Income)	0.0685***	0.0538***	0.0555***
Years of education	0.0315***	0.0217***	0.0229***
Age	−0.0064	−0.0048	−0.0024
Age squared	0.0001*	0.0001*	0.0001
Environmental organization membership	0.1663**	0.1266**	0.1068**
Visits to lakes or rivers, last 12 months	0.0117**	0.0084**	0.0107***
Visits, outside region, last 12 months	0.0458***	0.0426***	0.0381***
Race: black	−0.0601	−0.0300	−0.0314
Race: non-black, non-white	−0.0971	−0.0676	−0.0398
Hispanic	0.0551	−0.0122	−0.0075
Gender: female	−0.0044	0.0034	−0.0021
Household size	−0.0117	−0.0113	−0.0157*
Region: Northeast	0.1226**	0.0873**	0.0772**
Region: South	0.0404	0.0106	0.0106
Region: West	−0.0288	−0.0317	−0.0463
State lake quality	0.0006	0.0004	0.0003
Lake acres per state square mile	0.0021	0.0019	0.0015
Cost difference in first referendum	0.0014***	0.0031***	0.0031***
Quality difference in first referendum	−0.0600***	−0.0740***	−0.0656***
Intercept	2.3065***	2.2806***	2.2203***
Log likelihood	−4341.7729	−4200.8786	−4100.5222

Notes: * significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level, all two-tailed tests. Results are for the consistent sample of 3,654, including 520 left-censored and 664 right-censored observations for the tobit analysis.

Table B2. Predicted mean and median values of national water quality improvements.

National Water Quality Value	Two-Tailed Tobit of Logged Values	Survival Log Normal	Survival Generalized Gamma
Mean	$38.42	$28.90	$27.51
Median	$22.14	$21.58	$22.48