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ABSTRACT---

The potential sensitivity of environmental resource valuation to payment vehicles is of interest to researchers and decision-makers involved in estimating and applying these numbers. A conceptual model is developed which provides insight into how the different payment vehicles of a special tax and a tax reallocation affects the willingness to pay (WTP) for environmental goods. Hypothesis testing using contingent valuation data suggests WTP with a tax reallocation is higher than WTP with a special tax for ground water quality protection in Georgia and Maine.

Key word: special tax, tax reallocation, environmental goods, ground water, contingent valuation

Introduction

Much progress has been made in the past two decades in the development of techniques for measuring the economic value of environmental goods. One of the most commonly applied techniques is the contingent valuation (CV) method (Cummings, Brookshire, and Schultz, 1986; Mitchell and Carson, 1989). Previous research has shown that CV results are sensitive to payment vehicles; for example, taxes, entrance fees and utility bills (Rowe, d'Arge, and, Brookshire,1980; Greenley, Walsh and Young,1981; Brookshire, Randall, and Stoll,1980). The NOAA blue-ribbon CV panel recommended that the valuation question should be posed as a vote on a referendum (Arrow *et al*., 1993). In such cases, a special tax is a typical payment vehicle and has been used in many previous CV surveys. There are a number of examples of real-world special taxes which are used to finance public goods. One example is special local option sales taxes which must be approved by local voters. The revenues from these special sales taxes are used to finance public projects such as roads, schools, and water and sewer infrastructure.

In many cases, new public goods may be financed by a tax reallocation rather than by new taxes. For example, suppose a state or local government wants to increase expenditures on new police officers and equipment. Rather than increasing taxes, the new police officers and equipment may be financed by reducing expenditures on other public goods such as new roads and schools. To our knowledge, tax reallocations have not been used as a payment vehicle in previous CV surveys. The primary purpose of this paper is to examine conceptually and empirically the question of whether or not people prefer financing provision of environmental goods with new taxes or tax reallocations using a ground water quality case study.

In recent years, ground water quality has received increased attention as results of studies documenting threats to ground water quality. A number of previous studies have applied contingent valuation to value ground water quality protection or remediation (Bergstrom et al, 2001; Edwards,1985; Hanley,1989; Jordan and Elnagheeb,1993; Shultz and Lindsay,1990; Sun, Bergstrom, and Dorfman,1992). These studies employed different types of payment vehicles including property taxes, bonds, water bills, and generic total annual costs to households.

Generally, payment vehicles used in previous CV studies can be classified into two broad categories. One is measured by direct income changes where the total payment cannot be adjusted by a household because the total payment is fixed regardless of the amount consumed. Property taxes and hunting licenses are examples of this type of payment vehicle. The other broad category is measured by commodity price changes where the total payment can be adjusted by a household through the amount of the commodity consumed. Water bills and entrance fees are included in this category. A third and unique type of payment vehicle examined in this paper is a tax reallocation that neither changes an individual's income or the price of an environmental good. A tax reallocation may lead to a different theoretical welfare measure constructs as compared to payment vehicles used in previous environmental good valuation studies as illustrated in the next section.

Conceptual Model

The tax reallocation payment vehicle reallocates fixed tax expenditures to finance environmental goods, thereby reducing the amount of a household's tax money which can be spent on other public goods. Consider a household with a utility function and utility maximization problem as follows:

$$\underset{X}{Maximize} \quad u = u(X,Q,Z) \qquad subject\ to \quad M = PX + Z$$

where u is a direct utility function; X is a vector of market goods ($X = x_1,\cdots,x_i,\cdots,x_n$); P is a price vector of market goods; Q is ground water quality, Z is a composite commodity of all other public goods (omitting a ground water quality protection program) with unit price and its value equals a tax charged to a household, and M is a nominal income. Hence, M-Z dented by M_d is a household's disposable income which is spent on market goods purchases PX . We assume that utility is positively related to X, Q, and Z. This yields a set of conditional demand functions for the market goods $x_i*(P, Q, Z, M_d)$. Inserting x_i* into the direct utility function gives the conditional indirect utility function:

(1) $$u = v(P,Q,Z,M_d).$$

Inverting the conditional indirect function for the disposable income M_d yields a conditional expenditure function,

(2) $$e* = M_d = e*(P,Q,Z,u) .$$

Equation (2) defines the minimum expenditures on <u>private goods</u> required to produce utility level u given P, Q and Z.

The dual to the utility maximization problem can be stated as follows: minimize total expenditures subject to the constraint that utility equals or exceeds some stated level u. The solution to this problem gives the restricted expenditure function:

(3) $$e = e(P,Q,Z,u),$$

which defines the total expenditures on both <u>private and public goods</u> necessary to achieve u given P, Q, and Z. The conditional and restricted expenditure function are related by the following expression:

(4) $$e = e(P,Q,Z,u) = e^*(P,Q,Z,u) + Z$$

where $e(\bullet)$ and $e^*(\bullet)$ are equal to nominal and disposable income, respectively.

Welfare Measures for a Special Tax

Assume that without a ground water quality protection program, ground water quality will be Q^0, and with the program ground water quality will improve from Q^0 to Q^1 ($Q^0 < Q^1$), holding the supply of other public goods at Z^0. When nominal income does not change, willingness to pay (WTP) for ground water quality improvement is given by *compensating surplus* (*CS*) defined using (3) and (4) as:

(5) $$\begin{aligned} CS &= e(P,Q^0,Z^0,u^0) - e(P,Q^1,Z^0,u^0) \\ &= (e^*(P,Q^0,Z^0,u^0) + Z^0) - (e^*(P,Q^1,Z^0,u^0) + Z^0) \\ &= e^*(P,Q^0,Z^0,u^0) - e^*(P,Q^1,Z^0,u^0) \end{aligned}$$

where $u^0 = v(P,Q^0,Z^0,M_d^0)$ is the utility level at which the delegated water quality is Q^0 without the protection program with $M_d^0 = M - Z^o$.

CS is illustrated in Figure 1. The initial position is at point *A*, where the household has disposable income M_d^0 and consumes Z^0, X^0, Q^0 ahieving utility level u^0. The ground water protection program (protection of degradation) shifts *Q* from Q^0 to Q^1. *CS* for this change holding *Z* constant at Z^0 is defined by $M_d^0 - M_d^1$ in the Q,M_d plane in Figure 1.

Welfare Measures Definition for a Tax Reallocation

Assume again that a protection program will improve ground water quality from Q^0 to Q^1. A tax reallocation payment vehicle would require a household to tradeoff some amount of all other public goods (*Z*) to obtain the improvement in *Q*. The tradeoff that an individual is willing to make holding disposable income constant at M_d^0 is shown by Z^o-Z^1 in the Q,Z plane in Figure

1. This welfare measure which we call *compensating tax reallocation* (*CTR)* is defined as:

(6) $$CTR = e(P,Q^0,Z^0,u^0) - e(P,Q^1,Z^1,u^0)$$

With the tax reallocation, a household's disposable income (M-Z=e*) is equivalent for the parameter sets (Q^0,Z^0,u^0) and (Q^1,Z^1,u^0) . This equivalency implies that:

(7) $$e^*(P,Q^0,Z^0,u^0) = e^*(P,Q^1,Z^1,u^0).$$

Using (4), we can rewrite (6) as:

(8) $$CTR = (e^*(P,Q^0,Z^0,u^0) + Z^o) - (e^*(P,Q^1,Z^1,u^0) + Z^1).$$

Equation (7) implies that (8) reduces to:

(9) $$CTR = Z^0 - Z^1.$$

Solving (7) for Z^1 implies:

(10) $$Z^1 = Z^{1*}(P,Q^0,Q^1,Z^0,u^0),$$

implying that the equation for *CTR* can also be written as:

(11) $$CTR = Z^0 - Z^{1*}(P,Q^0,Q^1,Z^0,u^0).$$

Welfare Measure Comparison between Special Tax and Tax Reallocation

In the case of *CS* defined by (5), *P*, *Z* and *u* are held constant, meaning that the total differential of the indirect utility function (1) is:

(12) $$du = \frac{\partial v}{\partial Q}dQ + \frac{\partial v}{\partial M_d}dM_d = 0.$$

Equation (12) implies that:

$$(13) \qquad -\frac{dM_d}{dQ} = \frac{\frac{\partial v}{\partial Q}}{\frac{\partial v}{\partial M_d}} = MRS_{Q,M_d}$$

Equation (13) shows that *CS* corresponding to (5) for an incremental change in *Q* is equal to the marginal rate of substitution between groundwater quality and disposable income.

In the case of *CTR*, disposable income is held constant. With *P*, M_d , and *u* held constant, the total differential of (1) is:

$$(14) \qquad du = \frac{\partial v}{\partial Q}dQ + \frac{\partial v}{\partial Z}dZ = 0.$$

Equation (15) implies that,

$$(15) \qquad -\frac{dZ}{dQ} = \frac{\frac{\partial v}{\partial Q}}{\frac{\partial v}{\partial Z}} = MRS_{Q,Z}$$

Equation (15) implies that *CTR* corresponding to (8) for an incremental change in *Q* is equal to the marginal rate of substitution between groundwater quality and all other public goods.

Equations (13) and (15) imply that the difference between *CS* and *CTR* (*CS* - *CTR*) for an incremental change in *Q* is equal to the difference between $MRS_{Q,Md}$ and $MRS_{Q,Z}$. Thus,

$$(16) \qquad CS \gtreqless CTR \quad if \quad \frac{\frac{\partial v}{\partial Q}}{\frac{\partial v}{\partial M_d}} \gtreqless \frac{\frac{\partial v}{\partial Q}}{\frac{\partial v}{\partial Z}}$$

According to (16), if $MRS_{Q,Md} > MRS_{Q,Z,}$ *then* $CS > CTR$; *if* $MRS_{Q,Md} < MRS_{Q,Z}$ *then* $CS < CTR$; *and if* $MRS_{Q,Md} = MRS_{Q,Z}$, *then* $CS = CTR$.

Using (5) and (8), the derivative of (2) with respect to Z and the total differential of (1) given P, Q and U are unchanged, the difference between *CS* and *CTR* can also be stated as:

$$\begin{aligned}(17) \qquad CTR - CS &= e^*(P,Q^1,Z^0,u^0) - e^*(P,Q^1,Z^1,u^0) + Z^0 - Z^1 \\ &= \int_{Z^1}^{Z^0} (\partial e^*(P,Q^1,Z,u^0)/\partial Z + 1)\, dZ \\ &= \int_{Z^1}^{Z^0} \left(-\frac{\partial v(P,Q^1,Z,u^0)/\partial Z}{\partial v(P,Q^1,Z,u^0)/\partial M_d} + 1\right) dZ\end{aligned}$$

Both (16) and (17) imply that,

$$(18) \qquad CS \gtreqless CTR \quad if \quad \frac{\frac{\partial v}{\partial Z}}{\frac{\partial v}{\partial M_d}} \gtreqless 1.$$

The results shown in (13)-(18) have the following intuitive interpretation. We expect *CS* to be greater than *CTR* if an individual prefers an increase in all other public goods *Z* to an increase in disposable income, or if he or she prefers an increase in a dollar's worth of public goods other than ground water quality to an increase in a dollar's worth of private goods. As an analogy, if we prefer gold to silver, our willingness-to-pay for the same unit of private goods will be less if we purchase the unit with gold rather than silver.

We expect *CTR* to be greater than *CS* if an individual prefers an increase in disposable income to an increase in all other public goods Z, or if he or she prefers an increase in a dollar's worth of private goods to a dollar's worth of public goods other than ground water quality. *CS* equals *CTR* if an individual is indifferent between an increase (or decrease) in private goods and all other public goods, or if he or she is indifferent between an increase (or decrease) in a dollar's worth of public goods other than ground water quality and a dollar's worth of private goods.

Comparative Statics for *CTR*

Previous applied welfare economics literature (e.g., McConnell, 1990) indicates that *WTP* for a good Q measured in terms of *CS* is expected theoretically to be increasing in Q. A positive income effect is also expected if Q is a normal good as would be typical for environmental goods such as water quality. Does *CTR* share these properties? Consider first the effects of changes in Q on *CTR*. When Q is increased from Q^0 to Q^1, and Z is adjusted to offset the change in Q so that utility stays constant at the initial level, the following is implied:

$$u^0 = v(P,Q^0, Z^0,M_d^0) = v(P,Q^1, Z^1,M_d^0). \tag{19}$$

Taking the derivative of (19) with respect to Q^1 and rearranging gives:

$$\partial Z^1/\partial Q^1 = -\partial v/\partial Q^1. \tag{20}$$

Assuming Q is an environmental good with a positive marginal utility, the sign of $\partial v/\partial Q^1$ is positive, implying in (20) that the of sign $\partial Z^1/\partial Q^1$ is negative. Therefore, using (11), the derivative of *CTR* with respect to Q^1 gives

$$(21) \qquad \partial CTR/\partial Q^1 = -\partial Z^1/\partial Q^1 > 0.$$

Thus, *CTR* is increasing in the environmental good *Q*.

Secondly, we examine the effect of nominal income *M* on *CTR*. Taking the derivative of (19) with respect to *M* and rearranging gives:

$$(22) \qquad \partial Z^1/\partial M = \left[\frac{\partial v(P,Q^0,Z^0,M_d^0)}{\partial(M_d^0)} - \frac{\partial v(P,Q^1,Z^1,M_d^0)}{\partial(M_d^0)}\right] \Big/ \frac{\partial v(P,Q^1,Z^1,M_d^0)}{\partial Z^1}.$$

Given $\partial CTR / \partial M = \partial Z^1 / \partial M$ and assuming $\partial v/\partial Z^1$ is positive, (22) implies the following relationship:

$$(23) \qquad \frac{\partial v(P,Q^0,Z^0,M_d^0)}{\partial(M_d^0)} \geq< \frac{\partial v(P,Q^1,Z^1,M_d^0)}{\partial(M_d^0)} \Leftrightarrow \frac{\partial CTR}{M} \geq< 0 \ .$$

Equation (23) states that the effect of nominal income *M* on *CTR* is positive when the marginal utility associated with a small increase of disposal income M_d^0 at the initial *Q* and *Z* levels (Q^0 and Z^0) is larger than the marginal utility at the subsequent (e.g, post-program) levels (Q^1 and Z^1) , and vice versa. In other words, the effect of *M* on *CTR* is positive if substitution of *Q* for other public goods services *Z* decreases the marginal utility of disposable income M_d^0, and vice versa. The effect equals zero when the marginal utility of disposable income does not change between the parameter sets (P,Q^0,Z^0,M_d^0) and (P,Q^1,Z^0,M_d^0).

A Case Study

A case study was conducted to test hypotheses for the difference between *CS* and *CTR* in the case of ground water quality valuation. For the case study, valuation data were collected in Dougherty County, Georgia and Aroostook County, Maine. In Dougherty County, regardless of private well or public water system resources, close to 100 % of people get their drinking water from ground water supplies. Ground water quality monitoring by the Georgia Geologic Survey indicates that at the time of the case study, about 98 % of public and private ground water supplies in Dougherty County had nitrate levels which met the federal safety standard of 10 milligrams per liter (Davis, 1999; Stuart *et al*.,1995). In Aroostook County 83 % of people get their drinking water from underground water supplies. Ground water quality monitoring by the Maine Department of Environment Protection indicates that at the time of the case study about 87 % of public and private ground water supplies in Aroostook County had nitrate levels which met the federal safety standard of 10 milligrams per liter.

A contingent valuation survey was conducted to collect data on preferences and values for ground water protection in both Georgia and Maine. Background and more detail on the survey are provided in Bergstrom *et al*., 2001. The survey involved bid elicitation using mail questionnaires with different payment vehicles: a special tax and tax reallocation. This split-sample design provided data for testing hypotheses about the effects of the special tax and tax reallocation payment vehicles on ground water values.

Payment Vehicle Effects Hypothesis

The theoretical discussion in the previous section suggests that *CS* and *CTR* could be different for ground water quality protection in Georgia and Maine. As indicated by (16) and

(18), the direction of the effect cannot be predicted *a priori*; therefore payment vehicle tests are two-tailed. In the case of open-ended (OE) bids, the hypothesis to be tested is stated formally as:

<u>Hypothesis 1</u>

$H_o^1 : WTP_{ST} = WTP_{TR}$ $\qquad$ $H_a^1 : WTP_{ST} \neq WTP_{TR}$

where WTP_{ST} is willingness to pay measured using a special tax (*CS*) and WTP_{TR} is willingness to pay measured using a tax reallocation (*CTR*). In words, Hypothesis 1 states that different payment vehicles do not affect ground water quality protection values using an OE question. This hypothesis can be tested using standard t-tests for the difference between two means. In the case of dichotomous-choice (DC) responses, the hypothesis to be tested is stated formally as:

<u>Hypothesis 2</u>

$H_o^2 : AR_{ST} = AR_{TR}$ $\qquad$ $H_a^2 : AR_{ST} \neq AR_{TR}$

where AR_{ST} is the DC acceptance rate using the special tax and AR_{TR} is the DC acceptance rate using the tax reallocation. In words, Hypothesis 2 states that the different payment vehicles do not affect the acceptance rate for a ground water quality protection program using a DC question. Hypothesis 2 can be tested using the difference between DC acceptance rates across the split-sample populations.

Survey Design and Procedures

The contingent valuation method was used to elicite a household's *WTP* to protect ground water quality from potential nitrate contamination. The objectives of the survey were to; 1) estimate willingness-to-pay (*WTP*) for a ground water quality protection program, 2) compare

WTP estimates measured using two different payment vehicles, and 3) examine potential factors affecting a household's *WTP*.

Each questionnaire was divided into three sections. The first section asked questions about a respondent's residence, experiences and concerns with ground water quality and other public issues. The second section began by presenting information on ground water supplies, potential contamination sources, and potential health effects of nitrate contamination, and questions to assess background knowledge of these issues. The valuation question for a proposed ground water protection program used one of two payment vehicles: a special tax measuring *CS* and a tax reallocation measuring *CTR*. The special tax needed to fund the program would reduce the amount of money a respondent currently has to spend on other goods and services (see Appendix A). The tax reallocation would not reduce disposable income, but would reduce the amount of a household's tax money which can be spent on other public goods (see Appendix B).

The DC valuation question asked whether respondents would vote to support the ground water quality protection program given a specified program cost in terms of a special tax or a tax reallocation (Question 16 in Appendix A and B). In order to gain additional information, respondents were also asked to state their maximum WTP for the program using an open-ended (i.e., "fill-in-blank") question (Question 17 in Appendix A and B).

The survey was conducted from September, 1996 to March, 1997. A total of 1050 households in Maine and 1049 households in Georgia were randomly selected from county registered voter list and telephone directories provided by a professional survey research firm. The sample was first divided into two groups; the special tax group and tax reallocation group. Each group was further divided into 8 subgroups, which were assigned to receive one of eight offer amounts for DC valuation question. The offer amounts were $25, $50, $75, $100, $150, $200, $350, and $500, respectively. These offer prices were based on meta-analysis of ground water values from previous studies (Boyle, Poe, and Bergstrom,1994) and calculated to get a distribution of *WTP*. The questionnaires also contained an OE valuation question which followed each DC question. An initial questionnaire in Georgia was sent to all households in the sample. One week later a reminder postcard was sent to all households again. Three weeks later, a first follow-up cover letter and replacement questionnaire were sent to all non-respondents. One month later, a second follow up cover letter and replacement questionnaire were sent to all nonrespondents. Parallel procedures were followed in Maine. A third cover letter and replacement questionnaire were sent to the Georgia sample to help boost the response rate.

Hypothesis Tests about Mean Bids and Mean Acceptance Rate

Of 1,049 surveys sent out in Georgia, 262 were bad addresses, leaving an adjusted sample frame size of 787. 417 questionnaires were returned for a response rate of 53.0 %. Also of 1,050 surveys sent out in Maine,130 were bad addresses, leaving an adjusted sample frame size of 920. 486 questionnaires were returned for an response rate of 52.9 %.

Table 1 shows the results of test comparing mean OE bids for the special tax and for the tax reallocation. Mean OE bids for the special tax and the tax reallocation in Maine were $40.27 and $109.10 , respectively. For Georgia, mean OE bids were $64.85 and $113.70 for the special tax and tax reallocation, respectively. Result of t-tests of difference in population means showed t-values of 3.80 and 2.89 with significance at the 0.01 level. These results suggest that hypothesis H_o^1 is rejected in favor of the alternative, H_a^1.

Table 2 shows the results of testing for differences in DC acceptance rates between the special tax and tax reallocation for two sets of populations using a standard normal distribution. Results show that acceptance rates for the tax reallocation in Georgia and Maine were higher than those for the special tax at the 0.01 significance level. These results suggest that hypothesis H_o^2 is rejected in favor of the alternative H_a^2.

OE Bid Function and DC Acceptance Rate Function Specification

An empirical Tobit model for OE bids was specified as:

$$(24) \qquad LWTP = \hat{a}_0 + \hat{a}_1 TAX + \hat{a}_2 INCOME + \hat{a}_3 PROG + \hat{a}_4 WTPROG + \hat{a}_5 WATQLT + \hat{a}_6 AIRWLT + \hat{a}_7 FILTER + \hat{a}_8 STATE + \hat{a}_9 GENDER$$

and an empirical Logit model for the DC question acceptance probability was specified as:

$$(25) \qquad P = [1 + \exp(-K(.))]^{-1}$$

where

$$K(.) = \hat{a}_0 + \hat{a}_1 TAX + \hat{a}_2 INCOME + \hat{a}_3 PROG + \hat{a}_4 WTPROG + \hat{a}_5 WATQLT + \hat{a}_6 AIRQLT + \hat{a}_7 FILTER + \hat{a}_8 STATE + \hat{a}_9 GENDER.$$

Equations (24) and (25) were selected as pragmatic approximations because the true, utility theoretic valuation model is unknown. *LWTP* in (24) is the natural log of *WTP* to protect ground water quality and *P* in (25) is the probability of a “Yes” response to the DC question. The explanatory variables and their expected coefficient signs are as follows: *LTAX* is the natural log of offer price in the DC questions and $\hat{a}_1$ in (24) has an expected negative sign. Based on previous studies of anchoring effects (Herriges and Shogren, 1996; Randall *et al*, 2001), we expected that the OE bid would be influenced by the DC offer price in a positive manner implying a positive sign for $\hat{a}_1$ in (24).

LINCOME is the natural log of household income reported in the survey. Demand for environmental quality is usually expected to increase with income; hence, it was expected that $\hat{a}_2$ in (24) would have a positive sign. However, in the case of the tax reallocation, the effect of nominal income could be either positive or negative. Thus, the sign of $\hat{a}_2$ in (25) could be either positive or negative.

PROG and *WTPROG* are subjective probabilities for ground water safety with and without the protection program, respectively. The more (less) a person expects ground water to be safe with the program, the more (less) he or she is to be willing to pay for the program, respectively. Thus, it was expected that $\hat{a}_3$ and $\hat{a}_4$ in (24) and (25) would have positive and negative signs, respectively. *WATQLT* and *AIRQLT* are dummy variables for a priority on the public agenda for protecting ground water quality and air quality, respectively (1 = very high priority, 0 = otherwise). The more a person has a priority for protecting ground water quality and air quality, the more he or she is likely to be willing to pay for ground water quality protection. Thus, it was expected that $\hat{a}_5$ and $\hat{a}_6$ in (24) and (25) would have positive signs. *FILTER* is a dummy variable for installing a water filter designed to remove harmful chemicals (1 = Yes, 0 = No). If a person has installed a water filter, he or she would likely pay more for protecting ground water quality in order to avoid additional costs associated with water filter maintenance. Therefore, $\hat{a}_6$ in (24) and (25) was expected to have a positive sign. *STATE* is a dummy variable indicating a respondent's state of residence (1= Maine, 0 = Georgia), and *GENDER* indicates a respondent's gender (1 = male, 0 = female). Conceptually, the effect of a person's residence and gender on preferences for environmental quality is rather ambiguous. Thus, $\hat{a}_8$ and $\hat{a}_9$ in (17) and (25) were hypothesized to have either positive or negative signs.

Estimation and Hypothesis Test Results

Equations (24) and (25) were estimated using a pooled Maine and Georgia data set. Tobit estimates of (24) and Maximum likelihood estimates of (25) are shown in Table 3. Tobit and Logit models for the special tax case are designated Model 1 and Model 2, respectively. The coefficients on *LTAX*, *LINCOME*, *PROG* and *WTPROG* were statistically significant. *LTAX* had an expected positive sign in Model 1 and an expected negative sign in Model 2, *LINCOME* and *PROG* had expected positive signs and *WTPROG* had an expected negative sign in both models. *WATQLT*, *AIRQLT* and *FILTER* had expected positive signs but only *WTPROG* in the Logit model was statistically significant. *STATE* and *GENDER* were not statistically significant.

In Table 3, Tobit and Logit models for the tax reallocation case are designated Model 3 and Model 4, respectively. The coefficients for *LTAX* were statistically significant and had an expected positive sign in Model 3 and an expected negative sign in Model 4. The coefficients for *LINCOME* in both models were not statistically significant.

The coefficient for *PROG* and *WTPROG* were statistically significant, and had an expected positive and an expected negative sign in both models, respectively. *WATQLT*, *AIRQLT* and *FILTER* had expected positive signs and were statistically significant in Model 4. *WATQLT* in Model 3 was not statistically significant. *STATE* and *GENDER* were not statistically significant in Model 3 and Model 4.

The mean bids for ground water quality protection estimated from the Tobit models for the OE data were $69.04 for the special tax and $130.40 for the tax reallocation. This difference was statistically significant at the 0.01 level indicating rejection of H_o^1 in favor of the alternative, H_a^1. In the DC case, using the Cameron (1988) estimation approach, mean *WTP* for ground water quality protection was estimated at $47.81 for the special tax and $851.40 for the tax reallocation. Thus, estimated mean *WTP* using the tax reallocation was about 18 times higher as compared to *WTP* using the special tax giving support to rejection of H_o^2 in favor of the alternative, H_a^2.

Conclusions

The empirical results of this study indicate that people in our sample were willing to pay more for ground water quality protection using a tax reallocation financing mechanism as compared to a special tax financing mechanism. This result, following our theoretical model, suggest that the marginal utility of disposable income is larger than that marginal utility of other public good services *Z*. Thus, individuals in our sample, on average, appear to prefer an increase of disposable income over an increase in public good services other than ground water quality protection. These preferences may be reasonable from the perspective of an economically rational individual because public good use is typically more restrictive than private good use.

In addition to eliciting higher values, our results suggest that welfare effects measured by a tax reallocation may not be influenced by nominal income. This result may be desirable from a social justice perspective since the evaluated amount does not depend on a person’s nominal income. This income-neutral effect may be important, for example, if environmental good valuation results were to be applied in a cost benefit analysis with both positive and negative welfare effects; for example, such as when the benefits of a policy or project go primarily to high income people and the costs fall primarily on low income people.

Tax reallocations provide an alternative means for financing environmental goods and for eliciting welfare measures for changes in environmental goods. The conceptual model provided in this paper specifies conditions under which tax reallocation welfare measures will be equivalent to welfare measures using more traditional public good financing mechanisms and payment vehicles such as a special tax. These conditions were not met in our empirical case study where tax reallocations resulted in significantly higher values for a particular environmental good, ground water quality. Thus, welfare analysis using environmental good values measured using tax reallocations should proceed with caution. Because tax reallocations may be more neutral from political and income distribution perspectives, we encourage further conceptual and empirical research to establish the validity of this unique public good financing and environmental good valuation approach.

Appendix A.

The costs of the program would have to be paid by you and other citizens. The program will be founded by a special tax. Thus, paying for the program would reduce the amount of money you have to spend on the other goods and services. If it is approved by voters, the program, including the special tax, will be effect for 10 years only.

Q16. If the program of providing technical and financial assistance to individuals and groups interesting in protecting ground water from potential nitrate contamination were placed on the next ballot, would you vote for the program if the special tax needed to found the program cost your household $100 per year for 10 years ? (Circle one number)

1. Yes - I would vote in favor of the program.
2. No - I would vote against the program.

Q17. If you vote Yes to Question 16, perhaps you would also vote the program at a higher cost. If you vote No to Question 16, perhaps the program would have to cost you nothing ($0) before you would vote for it. What is the highest amount of money the special tax needed to fund the program could cost your household per year for 10 years before you would vote against it. Please write this amount in the space below. (Please fill the blank)

I would vote in favor of the program if the maximum the special tax cost my household was $___ per year for 10 years.

Appendix B.

The cost of program would have to be paid by you and other citizens. The program will not increase your taxes. Payments for the program will be in the form of a reallocation of your tax dollars from other public services (for example, reallocation of tax dollars from spending on roads and bridges, school, park, police protection, health care, etc.). Thus, paying for the program would reduce the amount of other public services which are currently available. If it is approved by voters, the program, including the tax reallocation plan, will be in effect for 10 years only.

Q16. If the program of providing technical and financial assistance to individuals and groups interesting in protecting ground water from potential nitrate contamination were placed on the next ballot, would you vote for the program if reduced the amount of your household's tax money which spent on the other public services by $100 per year ? (Circle one number)

1. Yes - I would vote in favor of the program.
2. No - I would vote against the program.

Q17. If you vote Yes to Question 16, perhaps you would also vote the program at a higher cost. If you vote No to Question 16, perhaps the program would have to cost you nothing ($0) before you would vote for it. What is the highest amount of money that could be reallocated from your household's tax dollars for other public services before you would vote against it. Please write this amount in the space below. (Please fill the blank)

I would vote in favor of the program if the maximum reallocation of my household's tax dollars from other services was $__ per year.

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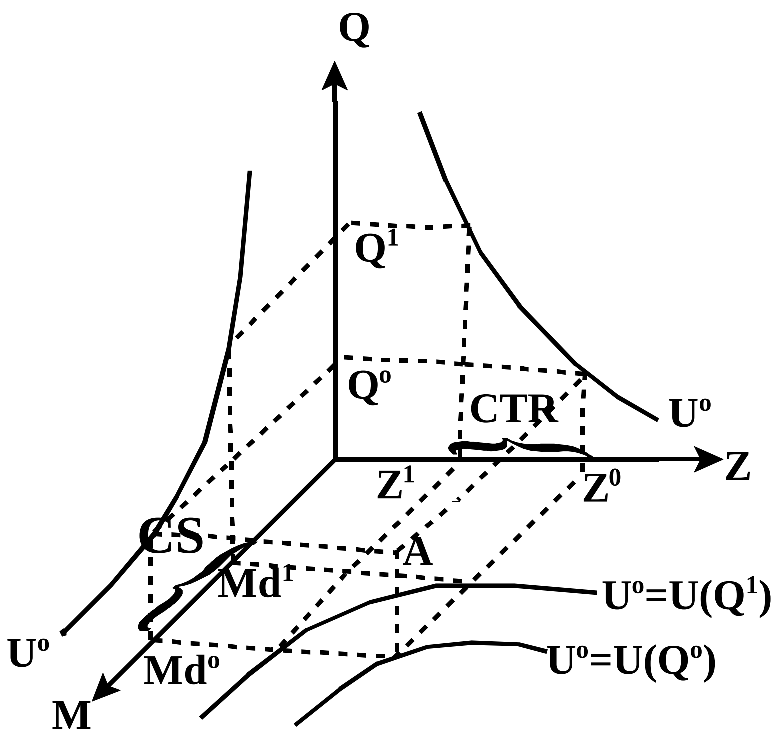

Figure 1. Illustration of CS and CTR for an Environmental Good Increment

Table 1. Comparison in Mean OE Bid between Special Tax and Tax Reallocation

	Special Tax			Tax Reallocation			T-Value
	Mean	(S.D.)	N	Mean	(S.D.)	N	
Maine	40.27	(79.73)	208	109.1	(244.5)	154	3.798***
Georgia	64.85	(124.8)	166	113.7	(167.8)	133	2.885***

1) *** indicates significance at the 0.01 levels.

Table 2. Comparison in Mean Acceptance Rate between Special Tax and Tax Reallocation

	Special Tax			Tax Reallocation			T-Value
	Mean	(S.D.)	N	Mean	(S.D.)	N	
Maine	0.2544	(0.4556)	228	0.6443	(0.4871)	209	5.530***
Georgia	0.4162	(0.4941)	197	0.7667	(0.4241)	180	6.692***

1) *** indicates significance at the 0.01 levels.

Table 3. Comparison of Estimates between Specia1 Tax and Tax Reallocation

	Special Tax		Tax Reallocation	
Variable	Model 1	Model 2	Model 3	Model 4
LTAX	45.72 (5.506)***	-0.7991 (-4.600)***	84.61 (5.180)***	-0.5206 (-2.670)***
LINCOME	36.42 (3.159)***	0.5407 (2.284)**	-2.761 (-0.1268)	-0.4347 (-1.708)
PROG	1.721 (3.761)***	0.03861 (4.023)***	4.504 (4.879)***	0.05387 (4.461)***
WTPROG	-2.390 (-5.518)***	-0.03867 (-4.313)***	-4.084 (-5.078)***	-0.05508 (-4.671)***
WATQLT	18.73 (1.003)	1.067 (2.873)***	-28.22 (-0.8021)	0.7954 (2.071)**
AIRQLT	18.23 (0.9543)	0.1353 (0.03619)	53.21 (1.325)	1.027 (2.222)**
FILTER	25.40 (1.069)	0.1661 (0.3550)	39.59 (0.9010)	1.443 (2.236)**
STATE	-16.69 (-0.9773)	-0.5063 (-1.553)	27.67 (0.7981)	-0.4451 (-1.215)
GENDER	-9.811 (-0.5762)	-0.4642 (-1.336)	15.74 (0.4054)	-0.3872 (-0.9123)
Constant	-293.1 (-4.436)***	-3.033 (-1.164)	-455.0 (-3.632)***	6.786 (2.314)**
N	236	258	210	232
AIC	9.552	1.062	10.20	1.016
R-Squared		0.321		0.329
Mean ($)	69.04	47.81	130.4	851.4

1) Numbers in parentheses are t- statistic.
2)***, ** and * indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.
3)AIC is Akaike Information Criteria and calculated by $-2\log L/n + 2k/n$, where L is log of likelihood, k is a number of parameters, and n is a sample size.