WESTERN REGIONAL RESEARCH PUBLICATION

W-133

Benefits and Costs of Resource Policies Affecting Public and Private Land

Thirteenth Interim Report

June 2000

Proceedings of W-133 Conference 2000

Introduction

This volume contains the proceedings of the 2000 W-133 Western Regional Project Technical Meeting on "Benefits and Costs of Resources Policies Affecting Public and Private Land." The meeting was held in conjunction with the 2000 Western Regional Science Association Meeting at the Sheraton Kauai Resort, Kauai, Hawaii, February 28 – March 1, 2000. The meeting included a joint WRSA-W-133 session that was attended by many WRSA participants.

The Kauai meeting was attended by academic faculty from many W-133 member universities in addition to researchers from non-land grant universities, federal agencies and private consulting firms. A list of those who attended the meeting follows.

The papers included in this volume represent a wide-range of current research addressing the W-133 project objectives, which are: 1) benefits and costs of agro-economic policies, 2) benefits transfer for groundwater quality programs, 3) valuing ecosystem management of forests and watersheds, and 4) valuing changes in recreational access. The complete program for the meeting follows the list of participants.

The trip to Kauai was a long one for most and made the meetings this year smaller than those in recent years. The overwhelming opinion of those who made the trip was that it was well worth it. The sessions were stimulating and the scenery and weather were superb. I'd like to thank Jerry Fletcher, John Loomis, Frank Lupi, Douglass Shaw for their help with this year's meeting and special thanks to David Plane of WRSA for taking care of so many of the logistics of the meeting.

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The Quest for a Benefits Transfer Protocol: Nitrate Contamination of Groundwater

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February 28, 2000

Financial support for this research was provided under Pennsylvania Agricultural Experiment Station Project Number 3647. The authors acknowledge the contributions of John C. Bergstrom and Kevin J. Boyle, who directed the studies in Georgia and Maine and who consulted on procedures used in the valuation studies as well as the benefits transfer study.

INTRODUCTION

Benefits transfer is the practice using benefits estimates from one or more existing studies to value changes in a similar good or service in a different time or place in lieu of directly estimating the benefits. This practice, if successful, reduces research costs (Kask and Shogren 1994) as well as potentially reducing the time it takes policy makers to make informed decisions (Bingham 1992).

There are several additional reasons why benefits transfer is important. Most benefits estimation methods involve some type of transfer. In fact, from a valuation standpoint benefits transfer is a natural extension of non-market valuation (Opaluch and Mazzotta 1992). Unfortunately, the present state of non-market valuation does not adequately serve benefits transfer (Brookshire 1992) because of the issues of aggregation and market scope. From a policy standpoint, however, information about benefits transfer is vital to non-market valuation in the current political and research climate (Feather and Hellerstein 1997).

THE STUDY

The current attempt to develop a benefits transfer protocol used data from three studies coordinated through Regional Research Project W-133. These studies, conducted in Georgia, Maine and Pennsylvania, examined people's willingness-to-pay (WTP) to protect groundwater in their area from contamination with nitrates. The questionnaires were administered in 1996 and were nearly identical in all three studies. The distribution of the bid amount in the dichotomous choice portion was derived from pretests conducted in the three states. The common format among all three studies was a dichotomous choice question asking for a yes/no response to a stated amount of a special tax to support a program designed to protect groundwater from nitrate contamination. The dichotomous choice question was followed by an open-ended question asking the respondent to state the maximum amount his or her household would be willing to pay in a special tax to support the groundwater protection program.

The Pennsylvania questionnaire also contained a group of questions testing respondents' knowledge about nitrate contamination of groundwater--both about physical characteristics of groundwater and about possible health effects from ingesting nitrates. The test contained questions taken directly from the information section common to all three surveys. The inclusion of this information check made the Pennsylvania questionnaire slightly longer than the Maine and Georgia questionnaires. Whether or not this extended version altered respondents' answers is unknowable.

The scenario description in the Pennsylvania questionnaire differed slightly from the others. It told respondents that adopting the proposed program would reduce the proportion of wells exceeding 10 ppm nitrate from the present 50% to 25% after ten years of the program. The Georgia and Maine scenario descriptions did not indicate the target proportion of wells with nitrate contaminated water. In all three questionnaires, respondents were asked to indicate the present level of safety of their water supply as well as estimating the probability that their water would be safe ten years later, both with and without the proposed program.

The response rate for the Pennsylvania study was 68%. The Pennsylvania respondents are statistically representative of the population in the study area with regards to income and education. The response rates for the Georgia and the Maine studies were each 53%.

DEVELOPMENT OF A TRANSFER PROTOCOL

The efforts to develop a benefits transfer protocol began with estimating the mean WTP for each site for both the dichotomous choice (DC) responses and the open-ended (OE) responses. The econometric approach was to find one model that theoretically suits *a priori* expectations of factors contributing to WTP for groundwater safety. An explicit decision was made to retain all theoretically relevant variables in our models. Although this may lead to the inclusion of statistically insignificant variables, it is preferable to excluding possibly relevant variables. Observations with missing data or where the respondent indicated that their response was for reasons that we coded as a protest against the hypothetical program or the scenario were deleted from the data set. The model was estimated using the data from each site individually and combined into a single data set.

Probit regression was used to estimate the model for the DC responses and tobit regression was used for the OE responses. The mean WTP estimates from these regressions were compared to determine if a benefits value approach would give reasonable results. This was done with both the probit and the tobit estimates of mean WTP. The benefit function approach used the parameter estimates from one site and the data from a second site to obtain a transferred WTP value that was compared with the WTP value estimated with the parameters and data from the second site.

RESULTS

Although we analyzed both DC and OE responses in our study, only the results from the DC analysis are presented in this paper. The results of the probit regressions are shown in Table 1. The dependent variable is the yes/no response to one of eight payment amounts: $25, $50, $75, $100, $150, $200, $350 and $500. The independent variables are BID, CHANGE IN H_2O SAFETY, CONCERN, INCOME, PROACTIVE, CHILDREN PRESENT and PRIVATE

WATER.

The independent variables are defined as follows: BID is the payment amount in the dichotomous choice portion of the question format. Perceived effectiveness of the program is the difference between the perceived level of safety with the program and the perceived level of safety without the program (CHANGE IN H_2O SAFETY). Concern for water is a dummy variable equal to one if the respondent both places a high priority on local government expenditures for groundwater protection and is concerned about groundwater safety (CONCERN). INCOME is a categorical income variable although it is treated as a continuous variable by using the midpoint values of each income category. PROACTIVE, another dummy variable, indicates that respondents reported having taken some type of averting action to avoid health risks due to groundwater contamination in the past five years. PRIVATE WATER is a dichotomous variable representing the type of water supply--private well or public supply.

In the combined model, all variables were significant at the 10 percent level or higher. The coefficient estimates for BID, CHANGE IN H_2O SAFETY, CONCERN, and INCOME were significant at better than the one percent level. The negative sign on BID was expected; as the program cost increases, the probability of a yes response decreases. The signs on the other variables are as expected, except for CHILDREN PRESENT and PRIVATE WATER. The negative sign on CHILDREN PRESENT is counter to expectations since young children are most susceptible to adverse health effects. The sign on PRIVATE WATER is also

Table 1. Marginal Effects Probit Results

Variable	Combined	Pennsylvania	Georgia	Maine
Constant	-0.657***	-0.799**	0.0288	-1.27***
	(0.0769)	(0.33)	(0.321)	(0.39)
BID	-0.003***	-0.002***	-0.003***	-0.0029***
	(0.0005)	(0.0008)	(0.0008)	(0.0009)
CHANGE IN H_2O	0.020***	0.020***	0.019***	0.018***
SAFETY	(0.003)	(0.005)	(0.006)	(0.007)
CONCERN	0.524***	0.573**	0.236	0.674**
	(0.14)	(0.239)	(0.266)	(0.271)
INCOME (000)	0.007***	0.011**	-0.0005	0.011*
	(0.003)	(0.0047)	(0.004)	(0.006)
PROACTIVE (0,1)	0.26*	0.177	0.146	0.418*
	(0.142)	(0.246)	(0.261)	(0.237)
CHILDREN	-0.279*	-0.088	-0.393	-0.551
PRESENT (0,1)	(0.170)	(0.254)	(0.328)	(0.372)
PRIVATE	-0.242*	-0.377	-0.052	0.073
WATER (0,1)	(0.140)	(0.246)	(0.300)	(0.282)
WTP(dollars)	65	70	205	-50
Percent yes	42	42	53	31
Percent Yes Predicted	37	38	61	24
Percentage error	12	10	15	23
Percentage correctly predicted by individual model	74	80	65	78

standard errors in parentheses,
***significant at the 1 percent level; **significant at the 5 percent level; *significant at the 10 percent level.

counterintuitive--since the program benefits private well owners more than public water users, who are already protected by regulations. Signs on BID, CHANGE IN H_2O SAFETY, INCOME, CONCERN, and PROACTIVE (averting action behavior) are all as was expected.

In the Pennsylvania model, BID, CHANGE IN H_2O SAFETY, CONCERN, and INCOME are significant, while in Georgia only BID and CHANGE IN H_2O SAFETY remain significant. In Maine all variables are significant except CHILDREN PRESENT and PRIVATE WATER.

The combined model correctly predicts 74% of the outcomes. The Pennsylvania model predicts 80% correctly, while the Georgia model predicts approximately two-thirds correctly and the Maine model correctly predicts nearly 80% of the responses. Because the percent of yes responses differs greatly across the sites (Table 1), we calculated an error percentage to measure the effectiveness of the model at each site. We subtracted the percent of predicted Yes answers from the actual percentage of Yes answers in the sample from each site and divided that difference by the actual value. This provides a relative measure of the estimation error. The Pennsylvania sample had 42% yes responses and the model predicted there would be 38% yes answers. The evaluation yielded a 10% error. The Georgia sample, however, had 53% yes answers and the model predicted 61%, yielding a 15% error. For the Maine sample there were 31% yes answers and the model predicted 24% yielding a 23% error.

Willingness-to-pay estimates vary widely among the combined and individual site models. The combined model and the Pennsylvania model give similar WTP amounts, but the Georgia and Maine amounts are widely divergent. Such a wide difference makes it unlikely that a benefit value approach to benefits transfer will produce reasonable results.

BENEFITS TRANSFER

The probit and tobit estimates of mean WTP for the combined sample and each of the sites are presented in Table 2. The last row of the table shows the difference in the two estimates for each sample. The estimated WTP is about the same for the combined sample and Pennsylvania, but there are substantial differences between the two estimates for Georgia and Maine. If one were to perform a naive benefits transfer using the value of the mean WTP at one site as the estimate of the mean WTP at another site, there will be substantial errors of estimation in almost every case. For example, if the probit estimate for the Pennsylvania site ($70) were used to estimate the mean WTP of either the Georgia or Maine sites, it would underestimate the Georgia value by $135 and overestimate the Maine value by $120. If one chose the tobit estimates of the mean values to use in a benefits transfer, the errors are smaller, but still larger than most policy analysts are willing to accept. That is, the Pennsylvania estimate of mean WTP ($83) is not statistically significantly different from the mean WTP estimates of either Georgia or Maine. But, the Georgia mean is $22 more than the Pennsylvania mean and the Maine mean is $22 less.

Table 2. Directly Estimated WTP (dollars)

	Combined	Pennsylvania	Georgia	Maine
Probit	65	70	205	-50
	(62.63 to 67.37)	(60.44 to 79.56)	(199.12 to 210.88)	(-58.71 to -41.29)
Tobit	80	83	105	61
	(67.96 to 92.04)	(62.34 to 103.66)	(78.90 to 131.10)	(45.91 to 76.09)
Difference	-15	-13	100	-111

95% confidence interval in parentheses

If one chose to use a functional transfer instead of the naive transfer, the results are not encouraging either. In Table 3 the columns show the results of using the parameter estimates of the model for the indicated site with the data from the site indicated by the row heading. Thus, the three estimates of the mean WTP for the Pennsylvania site are shown in the top row: $70 using the Pennsylvania model, $139 using the Georgia model and $25 using the Maine model. Similarly the three estimates for the Georgia site are in the second row and for the Maine site in the third row. The WTP amounts on the diagonal from upper left to lower right are the computed WTP amounts also found in Tables 1 and 2. The estimates shown in Table 3 are statistically significantly different except for one case--Georgia data using Pennsylvania or Georgia parameters. In all other comparisons, the means are significantly different from each other in a statistical sense and there are cases which exhibit large numerical differences.

Table 3. Probit Estimates of Mean WTP Using Functional Transfers (dollars)

	Pennsylvania Parameters	Georgia Parameters	Maine Parameters
Pennsylvania Data	70 (60.44 to 79.56)	139 (128.54 to 149.46)	25 (14.51 to 35.49)
Georgia Data	212 (203.3 to 220.7)	205 (199.12 to 210.88)	60 (50.88 to 70.12)
Maine Data	-23 (-33.09 to -12.91)	135 (125.90 to 144.10)	-50 (-58.71 to -41.29)

95% confidence intervals in parentheses

CONCLUSIONS

It is clear that we have not yet discovered a method for transferring estimates of WTP for protection of groundwater from nitrate contamination from one site to another. This is despite designing the three studies so that the same variables were used in each. While we have not studied reasons for this failure, it may be helpful to speculate about some of the possible reasons.

The most plausible explanation is that the residents of the three study areas have very different perceptions of the likelihood of nitrate contamination in their area and different perceptions about the possible harm that such contamination might cause them and their families. Further, the three study sites are in different regions of the country and focus group discussions revealed substantial differences in people's receptivity to the idea of government taking action to solve such a problem if it developed. Thus, it is possible that the underlying "true WTP" is substantially different among this group of sites and, by extension, could be expected to be substantially different from what would be found in other parts of the United States.

The finding that transferred WTP estimates differ greatly depending on the transfer method used suggests that benefits transfers might be manipulated to produce results in keeping with the prior desires of policy analysts. That is, if a high estimated WTP is desired, one can choose a study site and transfer method that is more likely to produce a high WTP. Similarly, if one desires a low WTP value, other sites and transfer methods can be used to achieve that result. The lack of a clear-cut, proper method for performing WTP transfers leaves open the possibility for intentional manipulation as well as unintentional bias. It may not always be easy to determine when these errors have occurred.

The design of the study reported in this paper also presents a problem for those wanting to apply its results for benefit transfer. The results can be used for benefit value transfers, although the estimated WTP values differ greatly among the three sites and between the probit estimates of the dichotomous choice question and the tobit estimate of the open-ended responses. But, those wishing to use a benefits function transfer will find that many of the key independent variables can be obtained only by a survey of the residents of a site. Such variables as perceived changes in water safety with the proposed program, or concern about groundwater are not available from public records or census reports; they rely on primary data that must be gathered as a part of the study. If a survey is to be conducted to gather such information, it will cost only a little more time and money do a WTP study at the site and estimate WTP directly. This does not avoid the time and money costs of conducting a survey--the primary reason for considering benefits transfer methods in the first place.

Finally, the reader is cautioned to remember that this study focused on developing a protocol for transferring WTP to avoid nitrate contamination of groundwater. Transfers of WTP estimates for other nonmarketed goods and services may be more successful and reliable. Our lack of success does not condemn all benefits transfers. And, we are continuing our efforts to develop an acceptable transfer method for WTP for avoiding groundwater contamination.

REFERENCES

Bingham, Tayler H., ed. 1992. *Benefits Transfer: Procedures, Problems, and Research Needs.* Proceedings of the Association of Environmental and Resource Economists Workshop. Snowbird, Utah, June 3-5, 1992.

Brookshire, David S. 1992. "Issues regarding benefits transfer." From *Benefits Transfer: Procedures, Problems, and Research Needs.* Proceedings of the Association of Environmental and Resource Economists Workshop. Snowbird Utah, June 3-5, 1992.

Feather, Peter and Daniel Hellerstein. 1997. "Calibrating benefit function transfer to assess the conservation reserve program." *American Journal of Agricultural Economics*, 79:151-162.

Kask, Susan F. and Jason F. Shogren. 1994. "Benefit transfer protocol for long-term health risk valuation: a case of surface water contamination." *Water Resources Research*, 30:2813-2823.

Opaluch, James and Marisa J. Mazzotta. 1992. "Fundamental issues in benefit transfer and natural resource damage assessment." From *Benefits Transfer: Procedures, Problems, and Research Needs.* Proceedings of the Association of Environmental and Resource Economists Workshop. Snowbird Utah, June 3-5, 1992.