The Importance of the Market Area Determination for Estimating Aggregate Benefits of Public Goods: Testing Differences in Resident and Nonresident Willingness to Pay

John B. Loomis and Armando Gonzalez-Caban

A combined telephone contact–mail booklet–telephone interview of California and New England households regarding their willingness to pay for fire management in California and Oregon's old-growth forests was performed to test hypotheses regarding the spatial extent of the public goods market. Using a multiple-bounded contingent valuation question, the study found that New England households' annual willingness to pay for the California and Oregon programs was statistically different from zero. This analysis points out that households receive benefits from fire protection of old-growth forests in states other than their own. In this case study, limiting the survey sample to state residents where the National Forest is located would reflect about 20% of the national benefits. However, using resident values as a proxy for nonresidents would overstate the national benefits by 75%, since the values per household are significantly different. This finding suggests more emphasis in future surveys on selecting an institutionally and economically relevant sample frame rather than an expedient one.

Since passive use or existence values of natural resources are unrelated to actual on-site visitation, the potential "market" for these public goods may be quite large. Typically, political boundaries and expediency often result in only state residents being asked their value for public goods (Carson et al. 1994; Loomis 1988; Rubin, Helfand, and Loomis 1991; Jones and Stokes Associates 1993). In principle, the social value of a public good is the vertical summation of persons who benefit, regardless of the political jurisdiction in which they live. In some situations the political or institutional extent of the market (what Howe calls the accounting stance) may be a normative question to be decided upon by the analyst and the directly affected parties. If there are *federally* financed or produced public goods that provide positive benefits that extend beyond the state boundaries, failure to include these benefits will result in systematic undervaluation of such public goods. Undervaluation of marginal social benefits of public goods results in less than optimal supply of these public goods. When federal financing, federal lands (e.g., national forests), or federally listed species (e.g., the Northern Spotted Owl) are involved, it would seem that the relevant extent of the market is national in scope, since all U.S. taxpayers' interests are affected. The U.S. Water Resources Council, which has established benefit-cost guidelines for agencies such as the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, and the USDA Soil Conservation Service, is quite explicit about this in its instructions to these agencies: "Contributions to NED (National Economic Development) are the direct net benefits that accrue in the planning area *and the rest of the nation*" (1983, p. 1; emphasis added).

Within the politically relevant boundary, how large the market area needs to be to capture total benefits is an empirical question that will vary with

John B. Loomis is a member of the Department of Agricultural and Resource Economics at Colorado State University; Armando Gonzalez-Caban is with the USDA Forest Service in Riverside, California. The authors would like to thank Barbara Alderson, Jim Fletcher, Michael King, and Ben Stout of California State University–Chico's Survey Research Center for performing the pretests and data collection as well as making significant improvements in the wording of the script and layout of the survey booklet. Michael Welsh of Hagler Bailly Inc. was instrumental in facilitating the statistical analysis used in this paper. Funding was provided by the USDA Forest Service, Pacific Southwest Station's Forest Fire Lab, under a cooperative agreement and Agricultural Experiment Station Regional Research Project W-133. Two anonymous reviewers provided suggestions that helped sharpen the focus of the paper. The views expressed represent those of the individual authors and do not reflect any official position of the USDA Forest Service.

the uniqueness and significance of the resource (Freeman 1993, 160). On the one hand, choosing a geographic area that includes only some of the beneficiaries and ignores benefits to those living outside this area will result in undervaluation. On the other hand, overvaluation might occur if the analyst were to assume the *same* magnitude of benefits per household for residents of the area that was surveyed *and nonresidents who were not surveyed*. However, for a given federally financed project the geographic distribution of benefits may be quite limited. Since it is often quite costly to implement in-person or telephone surveys over a larger geographic area, it would be worthwhile to have some guidance as to the geographic distribution of benefits for various types of projects. As Smith (1993, 21) notes, the determination of the extent of the market may have far more influence on the resulting estimate of total benefits than previously studied issues such as the willingness to pay (WTP) question format.

Sutherland and Walsh (1985) present a study that explicitly investigates how WTP for option, existence, and bequest values falls off with distance. They find these values decline quite slowly with distance within the three-state area surrounding Flathead Lake in Montana, where they surveyed. WTP for option, existence, and bequest values did fall to zero at 880, 550, and 600 miles, respectively.

This paper reports research designed to extend the research of Sutherland and Walsh to test for a *national* extent of a market for a fire protection program for old-growth national forests that are habitats to the California Spotted Owl and the Northern Spotted Owl (a federally listed threatened species). In particular we assess: (1) the magnitude of error from ignoring nonresident values; (2) the magnitude of error from assuming the same value per household for residents and nonresidents; and (3) whether California and New England households have the same value for independent old-growth fire management programs in California and Oregon old-growth forests. New England residents represent the extreme end of a spatial market that would be germane to a U.S. or national accounting stance as might be used with national forests.

Hypotheses to Be Tested

The first three hypotheses to be tested are whether nonresidents have total economic values (Randall and Stoll 1983), implicitly including recreation, existence, and bequest values, that are statistically different from zero for fire management of old-growth forests in states other than where they live. Specifically, we test whether the unrestricted mean WTP per household is statistically different from zero:

(1) Ho: $E(WTPca)$ for Oregon forests $= 0$

(2) Ho: $E(WTPne)$ for Oregon forests $= 0$

(3) Ho: $E(WTPne)$ for California forests $= 0$,

where $E(WTPca)$ and $E(WTPne)$ are unrestricted mean willingness to pay per household of California and New England residents, respectively (Hanemann 1989). Hypotheses 1–3 will be tested by determining whether or not the confidence interval around the unrestricted mean WTP includes zero.[1]

The fourth hypothesis evaluates whether *residents'* mean WTP values for fire management of old-growth forests can be used as an estimate of the value *nonresident* households receive:

(4) Ho: $E(WTPca)$ for California forests $=$ $E(WTPne)$ for California forests.

Hypothesis 4 will be tested by using the recently developed method of convolutions (Poe, Severance-Lossin, and Welsh 1994). This technique allows us to test whether the simulated distributions of WTP are statistically different at a given alpha level.

Finally, we can test whether the mean of total economic value is invariant to the distance the nonresident is from the resource being valued. That is, once a resource is located outside a person's state of residence, does it matter how far away it is? Putting this into a testable hypothesis:

(5) Ho: $E(WTPca)$ for Oregon forests $=$ $E(WTPne)$ for Oregon forests.

If proximity of the resource still matters even when the resource is located outside a person's own state, then we would expect to reject the null hypothesis in equation (5).

Valuation Methodology

Estimating WTP for fire management of old-growth forests, which are designated habitats for Northern and California Spotted Owls and hence not available for commercial logging, necessarily involves the use of a nonmarket valuation technique, such as travel cost or contingent valuation methods. The travel cost method is generally believed to measure just on-site or use values. At present, the only method capable of measuring the existence or passive use values that nonvisiting

[1] We appreciate an anonymous reviewer pointing out that to test hypotheses 1–3, the median or unrestricted mean rather than the restricted mean is required.

households may receive is the contingent valuation method (CVM). This method involves constructing a hypothetical market or referendum in a survey instrument. The instrument is then administered to allow respondents to state their WTP in an open-ended or payment card response format or to reveal their WTP through yes/no responses to one or more dichotomous choice questions.

Reliance on statements of behavioral intent rather than actual behavior has been criticized on several grounds (see Diamond and Hausman 1994 for a summary of such criticisms). Our intent here is not to evaluate the arguments for and against CVM. Rather, we note that the method will likely continue to be used by public agencies since it was upheld by the U.S. District Court of Appeals (1989) and viewed as an approach that could provide a reasonable starting point in judicial and administrative determinations of the value of natural resources (Arrow et al. 1993). This paper is limited to addressing the practical issues of: (1) influence of the size of the public good market area on the magnitude of public good values, i.e., the magnitude of error from ignoring nonresident benefits; (2) the accuracy of using resident values as a proxy for nonresident values; (3) whether or not nonresidents of states with different proximities to the resource being valued have the same values.

Data Sources

To fulfill the study objectives, we designed one survey version that was used with both California and New England households. The survey describes a fire management program for reducing the extent of fire in California old-growth forests that are habitat to the California Spotted Owl and a separate program to accomplish the same objective for Oregon old-growth forests that are habitat to the Northern Spotted Owl.

Focus Groups and Pretests

As noted by Johnston et al. (1995, p. 56) in this journal, focus groups are useful to guide the framing of the hypothetical market and to determine if the visual aids and program descriptions are understood as intended by the researchers. We held three focus groups (one in southern California, another in northern California, and a third in Boston) to gain a better understanding of the general public's knowledge of old-growth forests and perceptions of the effects of fire on old-growth forests. Another primary objective was to determine if our basic fire prevention and control program was understandable and realistic. We also checked comprehension of our visual aids depicting fire intensity and elicited suggestions for improving the clarity of visual aids. Another objective was to discuss acceptable ways this program could be funded. The focus groups also provided us with a better understanding of the language that participants normally used to describe events related to forest fires.

Following these focus groups, a complete mail booklet and survey script were developed and then pretested on a small sample of California and New England residents. The procedure was identical to that of the actual survey: (1) making initial telephone contact (using random digit dialing) to solicit participation, obtain a mailing address to send the booklet, and arrange a time for the call-back interview; (2) mailing the booklet; (3) completing the interview over the phone. During the interview we repeatedly probed the respondent to determine if any features of the program descriptions or questions were confusing or unclear. Finally, the pretest was used to refine the range of bid amounts for the multiple-bounded WTP questions.

There were two resources to be valued: (1) a fire prevention and control program for five million acres of old-growth forests in California and (2) a similar program for three million acres of old-growth forests in Northern Spotted Owl Critical Habitat Units (CHUs) in Oregon. Respondents were reminded of the locations of the old-growth forests at risk by the use of maps of these areas throughout the survey booklet.

After the focus groups and pretests, we refined the elements of the fire prevention and control program that were listed and described them to respondents as follows:

1. Fire hazard reduction: Reduce the number and area of high intensity fires through physical removal of brush and small kindling-like deadwood on the forest floor and through once-a-decade prescribed fires. This will reduce the risk of high intensity fires that burn all the way to the top of the large mature trees.
2. Earlier fire detection: This includes more fire lookouts and fire detection airplane flights to discover small, low intensity fires before they grow into large, high intensity fires.
3. Increased fire protection: This includes more fire patrols, maintenance of existing firebreaks surrounding these old growth forests, fire safety education, and enforcement of fire regulations.
4. Quicker and larger fire control response: This requires having more fire fighters and equipment located closer to old growth forests.

Respondents were informed that because of past fire suppression, a build-up of brush would result in high intensity fires burning all the way to the tops of the trees and destroying them. Definitive research on the effects of fire on the remaining old-growth forests and the spotted owl, they were told, showed that such high intensity fires were the largest threat to these old-growth forests and spotted owls (see Verner et al. 1992).

Households were also told that there was inadequate funding to pay for the improved fire prevention and control programs. They were told that efforts to raise funds would involve higher recreation user fees and creation of a "check-off" donation option on the federal income tax form. Since 1977, many state income tax forms have had a donation option to allow taxpayers to increase the amount of tax owed or to reduce their refunds by contributing the money to a dedicated trust fund for nongame wildlife. Our check-off was patterned after the nongame check-off on the California state income tax form. The WTP question format asked each household to pay a particular dollar amount each year. With this format, the individual must just decide whether or not the value to him or her is higher than this price. The wording of the California WTP question was:

> Thinking about Program B which reduces the proportion of high intensity fires and also includes a 20% reduction in the acreage of old growth forest that burns each year: If Program B were the only program available and your household was asked to pay $XX each year to help pay for Program B would you pay this amount?
> YES NO (don't know)

If the individual responded *yes*, the dollar amount was increased (but less than double the $XX). If the individual responded *no*, the dollar amount was reduced by about half. If the individual indicated he/she would not pay this lower bid amount, then the individual was asked if he/she would pay $1. Stepping the respondent up or down in this way is known as the double-bounded dichotomous choice approach (Hanemann, Loomis, and Kanninen 1991) and has been shown to substantially reduce the variance of WTP. Addition of a lower bound at $1 has been proposed by Hanemann and Kristrom (1994) for the single-bounded logit, but we appear to be the first to use it for the double-bounded dichotomous choice. The gain in statistical efficiency arises from the series of WTP questions that allows the researcher to bracket many of the respondents' WTPs between two of the dollar bid amounts. Welsh and Bishop's (1993) multiple-bounded approach can be used to statistically estimate the parameters from a questioning sequence such as ours. However, Cameron and Quiggin (1994) have raised concerns over the independence of responses to double-bounded dichotomous choice questions and suggest that ignoring the correlation between responses may lead to biased estimates of WTP. Alberini (1995) shows that while there may be a bias in estimating the "naive" double-bounded model, estimated mean WTP is often quite close to the bivariate probit estimate proposed by Cameron and Quiggin and the "naive" estimate usually has smaller mean square error.

The same basic wording was also used to ask the WTP question for Oregon forests. Note that the individual was told to treat the California and Oregon programs as separate, independent programs when answering the valuation question. That is, when deciding whether to pay the given amount for the Oregon program, the respondent was told to assume that it was the only program he/she would be asked to pay for. This was done to avoid sequencing effects and any path dependence.

Estimation of the Multiple-Bounded Model

Each respondent was asked at least two different dollar amounts and could have been asked up to three, if he/she said no to the first and no to the second. Our question sequence makes five possible response combinations: (a) Py_iy_u; (b) Py_in_u; (c) Pn_iy_l; (d) $Pn_in_ly_{\$1}$; (e) $Pn_in_ln_{\$1}$, where i is the initial dollar amount asked, u is the upper dollar amount asked, l is the lower dollar amount asked, and $1 is the lowest dollar amount asked of individuals who said no to the lower dollar bid amount.

Response patterns b–d bracket the respondent's WTP between two of the bid amounts he/she was asked. Regarding the fifth response category, Welsh and Bishop (1993, 339) state that when the respondent rejects all bids, the probability the respondent would pay his/her lower bid is zero. The linear in bid model permits the predicted probability to fall into the negative quadrant, allowing some individuals to have a negative WTP. This bracketing is illustrated in figure 1.

Using a multiple-bounded approach to calculate the specific dollar amount a person would pay involves estimating the probability density function

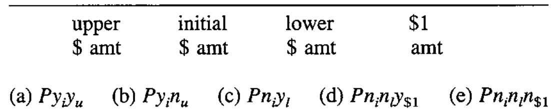

Figure 1. Bracketing of WTP Using the Multiple-Bounded Question Format

only over the bracketed interval. The log likelihood function is:

$$\text{(6)} \quad \ln(\text{Likelihood}) = \sum_{r=1}^{n} \ln(P_{ru} - P_{rl}),$$

where P_{ru} and P_{rl} are the probabilities that respondent r would pay her/his upper dollar amount (u) and lower dollar amount (l), respectively. The other difficulty is dealing with response category a, where the yes-yes response does not allow us to observe an upper bound on the individual's WTP. However, we do know, with probability = 1, that the respondent's WTP is larger than the upper amount. Welsh and Bishop (1993, pp. 339–40) use this information to program the log likelihood function for this first response category.

For ease in computing the log likelihood function, the probability density function of WTP is often assumed to have a logistic distribution. The log likelihood function is maximized with respect to the parameters (**B**s) explaining the pattern of responses observed as in equation (7):

$$\text{(7)} \quad \frac{\partial \ln(\text{Likelihood})}{\partial B} = \sum_{r=1}^{n} \frac{1}{P_{ru} - P_{rl}} * \left[\frac{\partial P_{ru}}{\partial B} - \frac{\partial P_{rl}}{\partial B}\right] = 0.$$

At a minimum, the variables include the bid amount the individual is asked to pay. Additional variables may include responses to attitude questions or the respondent's demographics, such as age and education.

Hanemann (1989) provides a formula to calculate the expected value of the unrestricted mean WTP, which in a linear in bid logit model equals the median WTP:

$$\text{(8)} \quad \text{Median} = \text{Unrestricted Mean WTP} = B_0/(B_1),$$

where B_1 is the coefficient estimate on the bid amount and B_0 is either the estimated constant (if no other independent variables are included) or the grand constant calculated as the sum of the estimated constant plus the product of the other independent variables times their respective means.

If the preservation program were available free and individuals' utility would not be reduced by preservation, then WTP would be greater than or equal to zero. The corresponding formula for mean WTP is given by Hanemann (1989, p. 1059):

$$\text{(9)} \quad \text{Restricted mean WTP} = 1/B_1 * ln(1 + exp(B_0)).$$

Fifteen different bid amounts ranging from \$4 to \$250 were randomly assigned to survey respondents. These initial bid amounts were based on previous CVM responses of Oregon residents for a similar Oregon old-growth fire program (Loomis and Caban 1994) and from our pretests in California and New England.

Statistical Testing of Hypotheses

To test whether WTP for each program is statistically different from zero and whether WTP is different between geographic regions or programs, two statistical techniques will be used. The most direct test of whether median WTP = 0 is to estimate confidence intervals around the median using the variance-covariance matrix (Park, Loomis, and Creel 1991). If the confidence interval for the program does not include zero, then median WTP is statistically greater than zero. When comparing two programs, if their confidence intervals do not overlap, we can conclude that these programs are statistically different (Poe, Severance-Lossin, and Welsh 1994). If confidence intervals overlap, a more rigorous test of whether the two distributions of WTP are significantly different can be performed using the method of convolutions (ibid.). The method of convolutions is a formal statistical test of the differences in empirical WTP distributions derived from dichotomous choice data. As Poe, Severance-Lossin, and Welsh note, their method is less prone to type II error than comparing confidence intervals and more relevant to comparisons of mean WTP. The method involves calculating the probability of all possible differences (i.e., the convolutions) between discrete values in the two distributions. The method then tests whether the 1–alpha confidence interval for this convolution or set of differences includes zero. In addition, the method calculates an alpha level for rejecting the null hypothesis of equality of the two distributions.

To check the representativeness of our returned surveys against the residents of California and New England, demographic questions such as age, education, membership in environmental organizations, and income were asked. The final questionnaire was typeset into a ten-page booklet.

Sample Design

Random digit dialing was used to initially contact 737 households in California and 709 households in the New England states of Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont. The initial contact phase involved briefly explaining the general topic of the survey, soliciting agreement to complete an in-depth telephone interview at a mutually agreed upon date/time, and obtaining the respondent's mailing address to send the information booklet.

After repeated phone calls, 499 California households and 449 New England households were scheduled for in-depth interviews, reflecting an initial participation rate of 68% and 63.3%, respectively. The 948 scheduled households were mailed the survey booklet that contained the background information on old-growth forests and maps, as well as current and proposed fire management programs. In the five to eight days between the initial contact and the scheduled phone interview, 31 households in California and 38 in New England were lost because their phones became disconnected, they moved, or all household members were unavailable during the call-back period. An additional 106 households in California and 94 in New England either refused to be interviewed when contacted or could not be contacted (even after repeated calls). Finally, 7 individuals only partially completed the interview before disconnecting. Thus, 358 interviews were completed out of 499 that were scheduled in California, for a completion rate of 72%. In New England, 314 interviews were completed out of 449, yielding a 70% completion rate. The interviews took place during late 1994 and early 1995.

Results

Response Rate

When both the initial cooperation rate and completed interview rate are combined, an overall response rate of 49% for California and 44% for New England results. These low response rates are disappointing, but the rough equivalence of California and New England response rates is what is required for our hypothesis testing of equal WTP values of residents and nonresidents.

The demographics of the two samples are quite comparable to each other and to the demographics of California and New England households. Both samples are slightly older (by three to four years) than their respective state population levels and slightly more educated (by about one year). Both samples have a slightly larger proportion of males (52–53% male) as compared with the population proportion for California (50%) and New England (48.3%). There is less than a 10% difference between the household incomes of the samples and those of the respective populations.

Checking Respondent Acceptance of the CVM Scenario

As is standard, a follow-up check question was asked after the WTP question to determine whether those refusing to pay represented a valid representation of their value or reflected a protest about some feature of the hypothetical market (Mitchell and Carson 1989). The question was an open-ended one: "What is the main reason you would not pay for these programs?" The interviewer could then check one of twelve precoded response categories or "other." In general the percentage of protest responses was low. To be conservative we included all respondents in the analysis that follows, even protest responses. This procedure tends to slightly understate WTP.

Statistical Analysis

Estimation of WTP from the multiple-bounded WTP questions data involved the use of a maximum likelihood approach applied to a logistic distribution (Welsh and Bishop 1993). Table 1 provides the coefficients and t-statistics for the multiple-bounded logit equations from California and New England residents for both the California and Oregon forest programs. All the coefficients on the bid amount are negative and statistically significant at the .01 level. The consistent negative sign on bid in all the models indicates that the higher the dollar amount the respondents were asked to pay, the *less* likely they would be to agree to pay for the fire program. This result demonstrates that the respondents took the dollar amount they were asked to pay seriously; otherwise, the likelihood of responding yes would have been invariant (and insignificant) with respect to the dollar amount. Demographic variables such as age and education were insignificant. However, attitude variables such as the importance of knowing that old-growth forests exist in California and Oregon (OGEXIST) and the importance of old-growth forests to maintaining the quality of our environment (ENVQUAL) were consistently statistically significant.

Table 2 presents the median (which equals the unrestricted mean used in the hypothesis tests) and restricted mean WTP for both California and New England residents for the California and Oregon

Table 1. Multiple-Bounded Logit Equations for Willingness to Pay Responses

A. California Residents Logit Equation for California Program (n = 343)

Var	Coef	Std. Error	T-Stat	P-Value	Average
CONSTANT	−2.157	0.7343	−2.94	0.004	
OGEXIST	0.488	0.1552	3.14	0.002	3.62
ENVQUAL	0.504	0.1998	2.52	0.012	3.72
BID	−0.0215	0.0013	−15.72	0.000	

B. New England Residents Logit Equation for California Program (n = 299)

Var	Coef	Std. Error	T-Stat	P-Value	Average
CONSTANT	−1.927	0.687	−2.80	0.005	
OGEXIST	0.325	0.126	2.56	0.011	3.33
ENVQUAL	0.5389	0.184	2.92	0.004	3.73
BID	−0.0318	0.002	−15.43	0.000	

C. California Residents Logit Equation for Oregon Program (n = 343)

Var	Coef	Std. Error	T-Stat	P-Value	Average
CONST	−2.3336	0.7655	−3.048	0.002	
OGEXIST	0.4585	0.1550	2.957	0.003	3.62
ENVQUAL	0.4799	0.2023	2.371	0.018	3.78
BID	−0.0247	0.0015	−15.679	0.000	

D. New England Residents Logit Equation for Oregon Program (n = 299)

Var	Coef	Std. Error	T-Stat	P-Value	Average
CONST	−2.06729	0.6920	−2.987	0.003	
OGEXIST	0.31893	0.1276	2.499	0.013	3.33
ENVQUAL	0.60246	0.1845	3.269	0.001	3.73
BID	−0.03411	0.0022	−15.658	0.000	

Note: OGEXIST is the importance of knowing old-growth forests exist in California and Oregon, even if the respondent does not visit. ENVQUAL is the importance of maintaining the quality of the environment.

programs.[2] The statistical efficiency of the multiple-bounded approach is also evident: the 90% confidence intervals are quite tight, averaging about 10% above and below the median or mean.

Discussion of Hypothesis Tests

Table 2 provides the information to test hypotheses 1–3, regarding whether households' median or unrestricted mean WTPs to protect old-growth forests in states other than where they reside are statistically different from zero. California and New England residents' median or unrestricted mean WTP for a 20% reduction in acreage of Oregon old-growth forests that would burn each year is $46 (90% CI = $40–52) and $36 (90% CI = $31–42). As indicated by the 90% CIs that do not include zero, these WTP values are statistically different from zero. In terms of hypothesis 3, New England residents also have a median WTP of $36 (90% CI = $31–42) for the California fire management as well. Therefore, we reject the null hypotheses in 1–3, in favor of the alternative view that the extent of the public good market is nationwide for fire protection programs for old-growth forests. This result contrasts with the findings of Sutherland and Walsh (1985), who found only a three-state market area for water quality improvements in Flathead Lake in Montana. Part of the difference may be due to the national publicity that spotted owl protection has received as compared with much more limited media coverage of water quality problems at Flathead Lake.

[2] As suggested by a reviewer, we also estimated the traditional single-bounded logit model to allow comparisons of WTP. The restricted mean WTPs for the single-bounded models all exceed the multiple-bounded estimates (California residents WTPs for California and Oregon forests are $134 and $94, respectively. New England residents WTPs for California and Oregon forests are $59 and $58, respectively). This higher magnitude with the single-bounded model is consistent with the findings of Hanemann, Loomis, and Kanninen 1991, in the original single-bounded–double-bounded comparison.

Table 2. Annual Willingness to Pay per Household for California and Oregon Fire Control Programs

	California Program	Oregon Program
California residents		
Median (unrestricted mean)	$70.33	$45.83
(90% CI)	($62–79)	($40–52)
Mean (restricted)	$79.40	$57.12
(90% CI)	($72–88)	($51–62)
New England residents		
Median (unrestricted mean)	$36.60	$36.34
(90% CI)	($31–42)	($31–42)
Mean (restricted)	$45.09	$43.78
(90% CI)	($41–50)	($40–49)

Table 3 documents the error that would result from ignoring the significant WTP of nonresidents for fire protection of California old-growth forests. The first line of table 3 estimates the value of the California program using just California residents' WTP values applied to the number of households in California. A simplistic approach to estimate what the rest of U.S. households would pay for the California program is obtained using New England residents' WTP. This approach is simplistic because it fails to account for differences in education, income, and location in transferring benefit estimates. New England is one of the farthest regions from California, and, as will be shown below when comparing California and New England households' WTPs for the Oregon program, WTP drops off significantly with distance. However, New England also has higher incomes and education levels than much of the rest of the country. Even using the New England estimate as a crude estimate of what the rest of the United States would pay per household, when applied to the 87 million households outside California, this procedure results in aggregate benefits of $3.9 billion

Table 3. Importance of NonResident Benefits When Calculating Total Value For Old-Growth Forests

	$/HH	Total WTP (millions)	Percentage
California households only	$79.40	$826	
Rest of United States (@ New England WTP)	$45.09	$3,910	
Total benefits		$4,736	
Total benefits if resident households only			17.44%

for the rest of the nation. Thus, relying solely on California residents' WTP to estimate the value of fire protection of old-growth forests in California reflects only 17% of the estimated national total willingness to pay (assuming all non-California households have values equal to those of New England residents).

With regard to hypothesis 4, results in table 2 suggest rejecting the null hypothesis that New England households are willing to pay just as much as California households for fire management of California forests. New England's unrestricted mean (median) WTP is $36 and its 90% confidence interval is $31–42. This amount is statistically less than California households' unrestricted mean (median) WTP of $70 and its 90% confidence interval of $62–79. This statistical difference is confirmed by the method of convolutions, which indicates that these WTP distributions are significantly different beyond the .01 level. The same conclusion is reached by using the restricted mean WTPs and 90% CIs in table 2 (as well as by the single-bounded logit models; results are available from the authors). Therefore, the need to account for national values of federal programs cannot be met by simply generalizing the state resident values to the rest of the nation. Doing so would overstate total WTP by a factor of 1.75, as compared with using nonresident values.

In hypothesis 5, proximity does seem to produce significantly higher values for nonresidents who live close to the natural resource under study, as compared with those who live a great distance away. In particular, California's unrestricted mean (median) WTP for fire management of Oregon's old-growth forests is $45 (90% CI = $40–52), while New England households would pay only $36 (90% CI = $31–42). The method of convolution suggests that these values are statistically different at the .05 level (the restricted mean WTPs are different at the .01 level). The estimated multiple-bounded logit WTP equations are also significantly different at the .01 level, based on a likelihood ratio test (calculated chi-square = 16.0, critical chi-square with four d.o.f. is 13.27 at the .01 level). Comparing California and New England mean WTPs and 90% CIs for the Oregon program estimated from the single-bounded logit model results in the same conclusion as the multiple-bounded.[3]

[3] In particular, California residents' 90% CI is $79 to $117, while New England residents' 90% CI is $48 to $77.

Conclusion and Implications for Future CVM Surveys

The contingent valuation method was used to obtain estimates of willingness to pay for reducing the number and extent of wildfires within spotted owl habitat of California and Oregon's old-growth forests. With the multiple-bounded format, the mean annual value per household for a fire management program in California is $79 and $45 for California and New England residents, respectively. Failure to include nonresidents' benefits, such as those accruing to New England households, when calculating a national estimate of WTP will understate the total economic value to the nation by 80%. However, generalizing resident values to the rest of the United States would overstate national total economic value by 75%, since the two regions have statistically different mean WTPs per household.

What do these results suggest for future CVM surveys involving federal land, federal funding, or federally listed species? The results suggest that more studies investigate the geographic distribution of WTP for various natural resources of differing national significance. We need to perform sufficient empirical studies on a range of public goods from relatively minor (e.g., open-space preservation) to major (e.g., endangered species protection or wilderness designation) to better understand the determinants of the geographic distribution of WTP. Only in this way can the spatial extent of the public good market be determined and an accurate estimate of the value of the public good in each geographic submarket be obtained. When dealing with programs that may have nationwide effects and are paid for by all U.S. taxpayers, the errors of ignoring benefits to the rest of the nation are so large, relative to other refinements in CVM, that more of our analysis budget should be directed to determining the empirically relevant sampling frame. Failure to do so may result in undersupply of federally financed public goods.

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