BENEFITS FROM IMPROVEMENTS IN CHESAPEAKE BAY WATER QUALITY

Volume II

of

BENEFIT ANALYSIS USING INDIRECT OR IMPUTED MARKET METHODS

(Budget Period II)

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City and County, Howard County, and Harford County). The sub-samples represent groups, each of which exhibits reasonable internal homogeneity, for which we have at least one-hundred and fifty responses. Even with these conditions, however, the statistical results are less significant than the earlier ones because of the smaller sample size.

The results suggest regional similarities and differences (Table 3.9). Some consistency is evident as signs on all coefficients are the same for all regions. Thus an increase in the hypothetical tax decreases the probability of acceptance of the tax associated with water quality improvement. Additionally the effect of participation and race on willingness to pay for the improvement is consistent across all regions.

Table 3.9

Logistic Model Estimates Related to the Probability a Respondent Will Accept a Tax Increase to Improve Chesapeake Bay Water Quality, by Geographic Area

Variable	Southeast[a]	West[b]	North[c]
Constant	.334 (.94)[d]	.71 (.46)	.12 (.30)
$D_1 \cdot$ Constant	.78 (2.36)	1.02 (2.49)	1.67 (4.77)
Amount of Tax	-.050 (3.33)	-.070 (3.04)	-.023 (1.77)
$D_2 \cdot$ Tax	.041 (3.15)	.060 (3.00)	.015 (1.36)
Chi-squared for likelihood ratio	36.5	37.2	48.6

[a]Dist. of Columbia and Counties of Prince George's, Charles and Anne Arundel
[b]Northern Virginia and Montgomery County
[c]Baltimore City and Counties of Baltimore, Harford and Howard
[d]t-ratio in parentheses

There are, however, systematic differences across regions. Users from the Northern region are willing to pay on average substantially more than those from the southeast or western regions. The figures for nonusers are less disparate across regions, with those for the West region somewhat larger. The estimated willingness to pay figures are presented in Table 3.10.

Table 3.10

Estimated Willingness to Pay for Acceptable Water Quality by Region, Participation, and Racial Composition of Household, 1984.

Household Characteristic	Region		
	Southeast	West	North
White, User	$124	$133	$224
Non-White, User	22	25	77
Non-White, Non-user	7	10	5
White, Non-user	37	55	15

Existence Value

In the preceding contingent valuation experiment we present non-zero willingness to pay estimates for non-users as well as users. There are a number of reasons why non-users may be willing to pay for improved water quality. One of these reasons has been labelled existence value by non-market benefit analysts (Krutilla) and stems from early experiences applying benefit cost analysis to water resources projects. Individuals who never use a resource either directly or indirectly <u>and</u> never intend to use it may still be willing to pay to improve its quality or assure its existence. Formal studies of existence value are limited, but some empirical evidence exists. Fisher and Raucher (1984) suggest that nonuse benefits (including both option value and existence value) are some fraction of the use value of water quality changes. Other research (e.g., Walsh et al., 1985; Schulze et al., 1983) suggests that existence value may be greater than use value, and sometimes substantially so.

Existence value is a frequently cited concept in the literature, and several studies have attempted to derive explicit estimates of existence value associated with water quality (Mitchell and Carson, 1981; Cronin, 1982; Walsh et al., 1978; Desvousges et al., 1983). Nonetheless, no consensus exists on the models which underlie the measurement. Behaviorally based methods of welfare measurement are unsatisfactory because, by definition, existence value is unconnected with behavior. Suspicion surrounds contingent valuation estimates of existence value because these estimates are even less susceptible to proof or disproof than contingent valuation estimates of use values. Even more to the point, the success of a contingent valuation approach depends on well defined questions. Without a clear idea of the motivations behind existence value, properly focused questions are difficult to define.

Table 4.3

Annual Benefits per Beach User from a 20 Percent Decrease in Pollutant, by Beach
1984

Beach	Calculation Method A[a]			Calculation Method B[b]		
	Consumer Surplus Before	After	Benefits	Consumer Surplus Before	After	Benefits
Sandy Point	133.94	169.03	35.09	342.04	379.33	37.06
Fort Smallwood	.82	5.17	4.35	57.69	73.13	15.44
Chesapeake Beach	36.32	43.88	7.56	57.89	60.77	2.88
Rod & Reel Club	10.32	16.19	5.87	259.81	284.08	24.27
Porter's New Beach	5.95	8.45	2.50	12.20	12.34	1.14
Rocky Point	80.38	89.53	9.15	179.65	191.02	11.34
Point Lookout	15.86	22.61	6.75	315.27	415.06	99.79
Bay Ridge	178.18	204.76	26.58	171.64	178.98	7.34
Miami Beach	5.38	10.27	4.89	220.68	304.99	84.31

[a]With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beach users whether or not they visited beach j.

[b]With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample which includes <u>only</u> users of beach j.

Table 4.4

Annual Benefits per Beach User from a 10 Percent Decrease in Pollutant, by Beach
1984

Beach	Calculation Method A[a]			Calculation Method B[b]		
	Consumer Surplus Before	Consumer Surplus After	Benefits	Consumer Surplus Before	Consumer Surplus After	Benefits
Sandy Point	133.94	150.39	16.45	342.04	363.35	21.31
Fort Smallwood	.82	1.50	.68	57.69	69.28	11.59
Chesapeake Beach	36.32	39.96	3.64	57.89	61.11	3.22
Rod & Reel Club	10.32	13.00	2.68	259.81	277.73	17.92
Porter's New Beach	5.95	7.12	1.17	12.20	13.55	1.35
Rocky Point	80.38	84.82	4.44	179.65	186.63	6.98
Point Lookout	15.86	18.73	2.87	315.27	363.61	48.34
Bay Ridge	178.18	191.08	12.90	171.46	176.55	5.09
Miami Beach	5.38	7.34	1.96	220.68	261.16	40.48

[a]With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beach users whether or not they visited beach j.

[b]With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample which includes only users of beach j.

Table 4.5

Annual Losses per Beach User from a 20 Percent Increase in Pollutant, by Beach
1984

Beach	Calculation Method A[a]			Calculation Method B[b]		
	Consumer Surplus Before	Consumer Surplus After	Losses	Consumer Surplus Before	Consumer Surplus After	Losses
Sandy Point	133.94	106.54	(27.40)	342.04	311.26	(30.78)
Fort Smallwood	.82	.29	(.53)	57.69	47.63	(10.06)
Chesapeake Beach	36.32	29.81	(6.51)	57.89	55.27	(2.62)
Rod & Reel Club	10.32	6.25	(4.07)	259.81	239.35	(20.46)
Porter's New Beach	5.95	4.05	(1.90)	12.20	11.24	(.96)
Rocky Point	80.38	72.26	(8.12)	179.65	166.81	(12.84)
Point Lookout	15.86	11.92	(3.94)	315.27	253.41	(61.86)
Bay Ridge	178.18	154.56	(23.62)	171.64	164.55	(7.09)
Miami Beach	5.38	3.06	(2.32)	220.68	172.41	(48.27)

[a]With Method A, the average consumer surplus for a change in quality at beach j is taken over a sample which includes all beach users whether or not they visited beach j.

[b]With Method B, the average consumer surplus for a change in quality at beach j is taken over a sample which includes only users of beach j.

where the set J includes the two cases: state and local beaches, γ is the element of the θ vector which serves as the price coefficient, and $v_j^0 = \psi' w_j^0 + (1-\delta)I_j^0$. To expand to annual welfare change, this value is multiplied by the number of choice occasions estimated in the continuous choice model.

These equations were used to estimate the benefits from hypothetical water quality changes. To be consistent with the varying parameters model estimates, we considered a 20 percent reduction and a 20 percent increase in water pollution. The values associated with the changes are $1.08 per trip and $4.70 per household user of western shore beaches. Given that 20 percent of the households used western shore beaches (about 401,000 households), the total gains from a 20 percent improvement in water quality were estimated to be nearly $2 million annually. The estimated loss for a 20 percent degradation was approximately the same.

Discussion

Reiterating, the purpose for our work was to offer benefit estimates based on different methods so as to provide a range of reasonable values. The two models derive from two different conceptualizations of the recreationalists' decisions. The continuous, neoclassical model (represented here by the varying parameters model) is strictly correct only if interior solutions characterize demand for each site, with all individuals attending all sites. Another drawback of this model is that, because of the econometric functions estimated, total benefits cannot legitimately be added across sites. This sort of aggregation provides upwardly biased results.

The discrete/continuous choice model, on the other hand, begins by emphasizing the corner-solution nature of the decision on each choice occasion. Thus, the substitutability among sites receives special attention. The decision about number of trips per season is not well integrated into the estimation process. These models tend to provide low estimates of aggregate benefits because the effect of water quality improvements on demand for trips is not well accounted for by the *ad hoc* inclusive value variables in the trips equation.

The estimated benefit change resulting from changes in Chesapeake Bay water quality at the western shore beaches is presented in Table 4.10 for the two models. Predictably, the varying parameter model offers the largest change.

Table 4.10
Comparison of Benefits Based on a Varying Parameter Model and Discrete/Continuous Choice

Model	Change: 20 Percent Improvement	Change: 20 Percent Degradation
	(in thousands)	
Varying Parameter upper bound	$26,160	- $25,839
Discrete/Continuous Choice	$ 1,885	- $1,884

Table 5.12
Per Boater Annual Benefits from a 10% Decrease in Pollutant
in each Geographical Area

County with Water Quality Change	Calculation Method A			Calculation Method B		
	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits
Anne Arundel	$30.01	$33.30	$3.29	$119.05	$127.46	$8.41
Baltimore	15.07	17.38	2.32	49.83	54.95	5.12
Calvert	17.50	18.60	1.11	108.57	111.38	2.81
Cecil	4.80	5.43	.63	18.55	19.51	.96
Charles	38.79	46.05	7.26	38.34	43.40	5.05
Dorcester	1.61	1.78	.17	75.72	78.15	2.43
Harford	3.45	3.89	.45	47.24	49.63	2.38
Kent	24.08	27.09	3.00	73.71	76.86	3.15
Queen Anne's	26.17	28.99	2.81	51.74	53.98	2.24
St. Mary's	14.80	16.03	1.23	139.22	143.71	4.49
Somerset	7.17	7.60	.44	99.18	101.95	2.77
Wicomico	7.87	8.60	.73	32.82	34.53	1.71

Table 5.13
Per Boater Annual Benefits from a 20% Decrease in Pollutant
in each Geographical Area

County with Water Quality Change	Calculation Method A			Calculation Method B		
	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits	Consumer Surplus Before Change	Consumer Surplus After Change	Benefits
Anne Arundel	$30.01	$37.17	$7.16	$119.05	$137.05	$18.01
Baltimore	15.07	20.33	5.26	49.83	61.20	11.37
Calvert	17.50	19.79	2.30	108.57	114.35	5.78
Cecil	4.80	6.17	1.38	18.55	20.60	2.06
Charles	38.79	55.54	16.75	38.34	50.13	11.79
Dorcester	1.61	1.98	.37	75.72	80.74	5.03
Harford	3.45	4.41	.97	47.24	52.27	5.03
Kent	24.08	30.51	6.42	73.71	80.38	6.67
Queen Anne's	26.17	32.18	6.00	51.74	56.51	4.76
St. Mary's	14.80	17.40	2.61	139.22	148.54	9.32
Somerset	7.17	8.08	.91	99.18	104.88	5.70
Wicomico	7.87	9.46	1.59	32.82	36.44	3.62

Table 5.14
Per Boater Annual Losses from a 20% Increase in Pollutant in each Geographical Area

County with Water Quality Change	Calculation Method A			Calculation Method B		
	Consumer Surplus Before Change	Consumer Surplus After Change	Losses	Consumer Surplus Before Change	Consumer Surplus After Change	Losses
Anne Arundel	$30.01	$24.76	$5.24	$119.05	$105.07	$13.98
Baltimore	15.07	11.68	3.38	49.83	41.96	7.87
Calvert	17.50	15.51	1.99	108.57	103.98	5.19
Cecil	4.80	3.80	1.00	18.55	16.93	1.62
Charles	38.79	28.78	10.01	38.34	31.51	6.83
Dorcester	1.61	1.33	.28	75.72	71.30	4.42
Harford	3.45	2.74	.71	47.24	43.12	4.13
Kent	24.08	19.12	4.96	73.71	68.34	5.37
Queen Anne's	26.17	21.48	4.70	51.74	47.93	3.81
St. Mary's	14.80	12.70	2.09	139.22	131.10	8.12
Somerset	7.17	6.40	.77	99.18	94.08	5.10
Wicomico	7.87	6.68	1.19	32.82	29.88	2.94