CHAPTER 9
TESTING THE SENSITIVITY OF THE WTP ESTIMATES TO MODIFICATIONS TO THE MODEL

9.1 INTRODUCTION

This chapter examines the sensitivity of the value estimates to preselected variations in the specification of the main economic model. Technical details of these model variations are presented in Appendix D. One of the most important conclusions of this sensitivity analysis is that the mean values for changes in FCAs are generally robust (insensitive and statistically insignificantly different from the main model), except in models that introduce random heterogeneity of preferences, which result in higher values for reduced FCAs, and thus higher damages from the existence of the current FCAs.

Table 9-1 summarizes the values for the main model (from Chapter 7) and the model variations. In the first set of model variations, discussed in Section 9.1, we use just the data from the A-B choice questions, omitting data from the followup questions on the expected number of Green Bay fishing days to the preferred alternatives or RP data on the actual number of days under current conditions. These variations can be used only to estimate WTP^G. Variations on the main model with homogeneous preferences include the basic model (excluding the followup question or data on actual days) and two variations examining learning and fatigue (one allowing noise parameters to vary over the choice pairs, and one allowing all parameters to vary). Next, using the A-B choice data, heterogeneity of preferences is incorporated. Classic heterogeneity allows the effect of changes in site characteristics on utility to vary with characteristics of the individual such as distance from the site, gender, target species, and income (through the marginal utility of money). Random heterogeneity allows preferences to vary across anglers without having to explain the source of the variation, and allows choice occasions for a given angler to be correlated.

Additional models, discussed in Section 9.2, use the A-B choice data plus the followup expected days question and some or all of the RP data on reported number of fishing days. These models use two alternative strategies to incorporate preference heterogeneity. Both models provide both WTP^G and WTP^F estimates.

Table 9-1
Comparison of Mean WTP Estimates across Models[a]

Model	Mean WTP^G	Mean WTP^F
Main Model	$9.75 [0%]	$4.17 [0%]
A-B models		
▸ homogeneous		
▫ *basic model*	$10.29 [+6%]	NA
▫ *learning and fatigue*	$9.99 [+2%]	NA
▫ *parameters vary over choice pairs*	$10.94 [+12%]	NA
▸ classic heterogeneity		
▫ *distance and gender*[b]	$10.15 [+10%]	NA
▫ *target species*[b]	$9.72 [-1%]	NA
▫ *marginal utility of $*[c]	$12.36 [+27%]	NA
▸ random heterogeneity		
▫ *normal*[d]	$12.90 [+32%]	NA
▫ *lognormal*[d]	$17.67 [+81%]	NA
Models allowing substitution to other sites		
▸ classic heterogeneity in A-B parameters	$9.31 [-5%]	$4.16 [-1%]
▸ classic heterogeneity in V_O	$10.46 [+7%]	$4.49 [+8%]

a. Percentage difference from mean WTP estimates from full main model in Chapter 8 in brackets.
b. Effect of catch time and FCAs on utility is a function of these variables.
c. Utility varies as a function of income group and gender.
d. Catch time and FCA parameters are assumed to be random variables with either a normal or lognormal distribution.

9.2 A-B MODELS

A-B models are designed to explain only the choices between the Green Bay alternatives presented in the eight choice pairs. As such, they only require the data from that portion of the survey, i.e., the SP responses from the choice questions. They do not use the SP expected days data from the followup questions or the RP data on the current number of Green Bay days or total days. The likelihood function is a simplified version of the one discussed in Chapter 6; it is only the joint probability of observing anglers' choices.

The parameters in the A-B models have the same interpretation as those from the A-B portion of the main model, as defined in Chapter 6. The A-B models have fewer parameters to estimate because the A-B parameters are the only parameters in the models. Estimates of these parameters are still consistent (i.e., a simple definition of consistency is that the parameter estimate equals its true value if the sample is sufficiently large), just as they are in the main model, but are estimated less precisely than when all of the data are used. That is, the additional information on choices not used in the A-B models is used in the main model to improve the accuracy of its estimates, which means that the standard deviations on the parameter estimates get smaller as more data are used in the estimates. Because the A-B models do not model the allocation of current days between Green Bay and other sites, only mean WTP^G can be estimated, not the mean WTP^F.

9.2.1 A-B Models with Homogenous Preferences

The parameter estimates from an A-B model with homogeneous preferences are very similar to the A-B estimates from the main model. As a result, mean WTP^G is also very similar to \$9.75: \$10.29. This model also examines learning and fatigue effects and positioning bias effects. Through responding to the choice pairs, the respondent may gain better knowledge and understanding of the survey process, and this learning effect may express itself through a decrease in the random noise in the decision-making process. Conversely, if there is a large number of survey choice pairs, a fatigue effect may set in as the respondent tires during the data elicitation process. This effect may be manifested as an increase in random noise for choice pairs toward the end of the process. Results suggest weak but statistically insignificant learning and fatigue effects. The mean WTP^G from the A-B model with learning and fatigue increases to \$9.99, only 2% higher than the estimate from the model with all variances restricted to be equal, \$9.75. To further investigate the potential for learning and fatigue, the data were divided into three sets: early choice pairs (1 and 2), middle choice pairs (3 through 6), and late choice pairs (7 and 8). The results indicate that parameters do vary across choice occasions when they are not restricted to be the same, but not in a systematic way, which suggests the absence of learning and fatigue effects. The mean WTP^G from the second model examining learning and fatigue is \$10.94.

Finally, we cannot reject the null hypothesis of no positioning bias; that is, there is no evidence that respondents systematically select A or B independent of the characteristics. A homogenous preferences A-B model was estimated to investigate whether respondents are drawn to alternative A in the choice pairs simply because it is the first option presented; a dummy variable for Alternative A was not significant.

9.2.2 A-B Models with Classic Heterogeneity

In other variations of the A-B model, heterogeneity is allowed. The classic heterogeneity method is to let the effects on utility from changes in site characteristics vary as a function of individual characteristics. This method has been employed for many years, and a summary discussion can be found in Pollack and Wales (1992). Interactions between Green Bay characteristics and angler characteristics allow preferences for the site characteristics to vary across people as a function of distance (the closest distance from the angler's home or vacation cabin to Green Bay) and gender; other demographic characteristics were not as important in preliminary analyses. The utility function with these interactions is a modification of Equation 1 in Chapter 6 and can be found in Equation 2 in Appendix D. Simply put, the change in utility from a change in a site characteristic is a linear function of distance and gender. In all, or most all model variations (Table 9-1), mean WTP^G for a reduction in FCAs decreases with distance or if the angler is a male, i.e., women and those living closer to Green Bay have stronger preferences for FCA removal. As noted earlier, a possible explanation is linked to the pregnancy risk associated with PCBs for women. Conversely, men care relatively more about catch rates. Although classic heterogeneity incorporated this way led to a significant improvement in the explanatory power of the model, the mean estimate of WTP^G ($10.15) is affected very little. Details on WTP for each demographic group are reported in Appendix D.

Other classic heterogeneity specifications were pursued as well. For example, the effects on utility from changes in FCAs and catch were allowed to vary as a function of the angler's target species. Catch for a species was significantly more important to anglers targeting that species, and perch and walleye anglers care more about FCAs than other anglers. Angler preferences over Green Bay alternatives were not found to vary as a function of the number of current Green Bay days. Finally, the marginal utility of money was allowed to vary as a function of income stratum and gender, and males and the wealthy were found to have a significantly lower marginal utility of money (and therefore higher WTP). Mean WTP did not differ significantly from the estimates from the main model in any of these specifications. In the last model where marginal utility of money varies, mean WTP was about 27% higher, but its confidence interval was also quite large.

9.2.3 A-B Models with Random Heterogeneity

Another completely different method to accommodate heterogeneity of preferences was also used for comparison. With this method, FCA and catch time demand parameters are assumed to be random variables, where the distribution across the population is assumed to be known, and the parameters of that distribution are estimated. Basically, this method assumes that preferences differ over the population of anglers, but in a way unobservable to the researcher. Random parameters allow for heterogeneity without having to determine its source. Further, the method explicitly recognizes that for an angler, choices across the pairs can be correlated. For example, an angler who has a stronger than average preference for catching fish is likely to have larger catch-time parameters not only in one or some of the pairs, but in all of the pairs. Hausman and

Wise (1978) were the first to explicitly model the assumption of uncorrelated random terms, and the method is currently being used widely to value a wide variety of commodities (see, for example, Layton and Brown, 1998; Train, 1998; and Breffle and Morey, 1999).

Both normal and lognormal distributions are assumed for the random parameters. Randomization of the catch and FCA parameters significantly improves model fit, and the estimated parameters of the parameter distributions match well with other literature (see Appendix D, Section D.1.4). Mean WTP^G is higher from the random parameters model: \$12.90 under the normal distribution and \$17.67 under the lognormal distribution.

9.3 HETEROGENEITY IN MODELS ALLOWING SUBSTITUTION

Two additional models were estimated allowing for heterogeneous preferences. In the first case, preferences for catch and FCAs were allowed to vary as a function of distance and gender, in the same fashion as the A-B model discussed above. This model uses the SP data from the choice pairs, the responses to the followup questions to the choice pairs on expected days of visitation, and the RP data on total days to all sites. Most parameters estimates and model results were roughly similar to the model with no heterogeneity, with the one exception being that FCA and catch effects tend to increase in magnitude with distance. Mean WTP^G is \$9.31. Because the model allows substitution to other fishing sites, mean WTP^F can also be estimated, which is \$4.16. In this model, the amount of noise in the stochastic random term for the generic “other” alternative can be compared to that for the Green Bay choice pairs. A greater level of randomness is expected for the “other” site because explicit characteristics of the site are not included in the model, and that result is shown in the estimates.

The second case allows for heterogeneity in the utility from the index of other alternative sites. This model uses all of the SP and RP data. Utility for the other index is assumed to vary with distance to Green Bay and gender, and the utility function is in Equation 13 in Appendix D, Section D.3. Men and those at a greater distance derive more utility from fishing another site. The effect of distance is reasonable, since trip costs to Green Bay increase with distance. The mean WTP^G is \$10.46, and the mean WTP^F is \$4.49.

A random parameters specification for the full model was not pursued for several reasons. First, mean WTP is robust over the model specifications, and second, the higher values from the random A-B models suggest that values from the full nonrandom model are conservative.