
CHAPTER 23

KAKADU CONSERVATION ZONE

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§ 23.1 Introduction

The Australian Parliament, in 1989, set up an independent agency known as the Resource Assessment Commission (RAC) to gather information and make recommendations on a small number of highly controversial decisions concerning natural resources. One of the first cases assigned to the RAC involved Kakadu National Park, a very large park in the sparsely populated Northern Territory. It is known for its abundant and unusual wildlife, unusual geological formations, and aboriginal rock art. Kakadu

and the Great Barrier Reef are Australia's two premier national parks. To American audiences, Kakadu may be best known as the film location for *Crocodile Dundee*.

Kakadu is a fairly new park. The original intention was that Kakadu National Park ("the Park") would completely encompass one of Australia's major river systems, the South Alligator River. The Park has been assembled in several stages, starting with the river delta. The last stage involved the government's taking back some areas that had been formerly leased out for grazing purposes. This area, officially labeled the Kakadu Conservation Zone (KCZ), was not added to Kakadu National Park. The KCZ contains the headwaters of the South Alligator River and is now completely surrounded by the Park. It is the last major piece of the original Park design not currently incorporated into the Park.

The KCZ was not included in previous additions to Kakadu National Park because the area is known to be rich in minerals, and substantial exploration at a site known as Coronation Hill was being undertaken by a consortium of mining companies (Coronation Hill Joint Venture Partners). The particular question the RAC was asked to investigate was whether to complete Kakadu National Park by adding to it the KCZ, or whether to first exploit the significant deposits of gold, platinum, and palladium ore at Coronation Hill.

The KCZ question was politically very divisive. Both the mining industry and the environmental groups saw it as a major test of policy direction and took uncompromising and diametrically opposed positions. The aboriginal elders in charge of the area were opposed to mining on religious tenets, believing Coronation Hill to be sacred ground; some of the younger aborigines were in favor of mining because of its potential to generate jobs. The Prime Minister supported adding the KCZ to the Park, but there was a deep split on the issue within his Labor party. The Conservative party was largely in favor of mining. The RAC was headed by a retired judge with a well-respected nonpartisan reputation. Two "outside commissioners" were appointed to the KCZ Inquiry, one an academic ecologist and the other an economist. Both were well-respected and considered above reproach. Neither had worked on Kakadu or had special expertise in the issues that would arise in the course of the KCZ Inquiry, and neither had taken a public stance on the issue.

The RAC, after an examination of the issues, determined that a benefit-cost analysis would likely be useful input to the decision-making process. An assessment of the net benefits of the KCZ mine was made for the RAC by the Australian Bureau of Agriculture and Resource Economics (ABARE) and was placed at \$82 million (Australian). That estimate was shown by ABARE to be quite sensitive to the discount rate used and to assumptions concerning metal prices and ore quality. The costs of mining—or conversely, the benefits of not mining—were immediately seen to be even more complicated,

involving a host of ecological and cultural issues, as well as a complex risk assessment. Although there was some agreement that there would be a disturbance to the local area around where the mine would be constructed, both the degree and significance were in dispute between the opposing interest groups. Further, the environmental organizations pointed to the possibility of an ecological disaster of massive proportions if a substantial amount of cyanide, which would be used in fairly large quantities in the process of separating the gold, platinum, and palladium from each other and from the rock, reached the South Alligator River, which was less than a mile away, during the wet season. The environmental groups pointed to such an accident with cyanide at a gold mine in Papua, New Guinea, which was run by one of the Coronation Hill Joint Venture Partners. The Coronation Hill Joint Venture Partners, in response, pointed out the elaborate environmental safeguards being taken to prevent such an accident from happening at Kakadu.

After an examination of the available techniques for placing a dollar value on adding the KCZ to the Park rather than mining it, the RAC decided to use the contingent valuation method. I served as an adviser to the RAC on the design of the surveys used in their study. The results of the RAC contingent valuation study suggested that the benefits of adding the KCZ to Kakadu National Park were considerably in excess of mining the KCZ. Those results, as might be expected, immediately became controversial.

This chapter presents my reaction to three critiques of the RAC's contingent valuation study, performed by Ron Brunton (1991), John Stone (1991), and the Tasman Institute (1991).¹ Although I have attempted to treat all the points raised by these three critics in a serious manner, it should be noted at the outset that the position of these critics is that the KCZ cannot be worth much and, as a result, any method that produces a large value for the Kakadu Conservation must be fatally flawed, either in principle or application. I first give a brief overview of the RAC's KCZ contingent valuation study. Next, I take up the major points raised by the critics and then address a number of minor points. Finally, I provide a few concluding remarks on the RAC valuation exercise.

As a postscript for the reader, the government decided, in a cabinet meeting, not to allow mining in the KCZ. The officially stated reason involved

¹ These three critiques, as well as a somewhat longer version of this chapter that contains a section of very technical comments on the RAC study, can be found in "Commentaries on the Resource Assessment Commission's Contingent Valuation Survey of the Kakadu Conservation Zone," Resource Assessment Commission, Canberra, June 1991 (available from the RAC). It may be useful to identify the backgrounds of each of the three who critiqued the study. Brunton, a social scientist, works with a conservative think tank called the Institute of Public Affairs. John Stone, whose column appears in *Financial Review*, is a former treasury minister for the opposition party. The Tasman Institute was hired by mining interests to critique the RAC study; Alan Moran was in charge of this critique.

aboriginal concerns. This reason allowed the KCZ to be considered a special case not impacting other potentially contentious mining issues in the country. Press reports also suggest that public opposition, evidenced in part by the RAC's contingent valuation survey, played a significant role in the government's decision.

The three commissioners on the Kakadu Inquiry made no firm recommendation to the government, but rather set out several possible options, some of which allowed mining and some of which did not. The commissioners did make several interrelated decisions that had a significant bearing on the use and interpretation of the RAC's contingent valuation survey. First, they decided that the mining industry's view of the risk of the mine was for all intents and purposes correct, thereby rejecting much of the environmental groups' position. Second, they decided that mining should not be allowed unless the mine area was restored to its natural state soon after the ore had been extracted. Leaving a huge permanent mine pit was thought to have been a significant influence on the large value of contingent valuation responses. Requiring mine owners to completely restore the site would significantly reduce mine profits, and therefore was deemed undesirable by the Coronation Hill Joint Venture Partners, who originally had argued that the mine would be unprofitable if restoration was required. These two decisions meant that the least severe damage scenario valued in the RAC study was more severe than any of the options allowing mining that the commissioners had put forward to the government. The commissioners eventually rejected most of the critics' complaints about the RAC contingent valuation study. They did, however, accept some arguments (raised by myself, Michael Hanemann, Alan Kneese, John Loomis, Jack Sinden, and V. Kerry Smith, as well as some of the critics supporting the mining industry) concerning household versus individual payment, and lump sum versus annual payment, which tended to substantially reduce the RAC numbers. The commissioners were also troubled by the embedding issue. In the end, they declared that the values in the RAC study were most likely too high, although they stated that the RAC study did confirm that Australians place a considerable value on the preservation of the natural environment.

§ 23.2 An Overview of the RAC Study²

The RAC contingent valuation study was carried out by the professional staff of the Research Branch of the Resource Assessment Commission. The results are contained in a 200-page report by Imber, Stevenson, and Wilks (1991). The contingent valuation survey consisted of approximately 2,500 in-person interviews, divided between two different sampling frames and

² This overview section did not appear in the original version of this chapter.

two different scenarios. The two sampling frames were (1) members of the general adult Australian population, and (2) members of the adult population in the Northern Territory. The Australian sample consisted of 2,029 respondents, and the Northern Territory sample consisted of 507 respondents. Two distinct sampling frames were used because it was thought that, politically, it would be necessary to make clear statements about the Northern Territory population (which represents a very small part of the Australian population); therefore, the Northern Territory population would be randomly assigned only a very small number of interviews in the overall Australian sample. After a pretest and an interviewer training period, the survey instrument was administered in September 1990, by a large commercial survey firm.

Each of these two samples was split equally between a major and a minor risk scenario. The major scenario essentially presented a "toned down" version of the environmental groups' view of the risk to the KCZ and the Park itself. The minor risk scenario essentially presented a "toned up" version of the mining industry's view of the risk. The two scenarios were designed to be as consistent as possible with each other. The primary differences between the two scenarios were that the major risk scenario: (1) displayed a picture of the wetlands far downstream from the mine site and explicitly stated that there was "a remote chance" of an accident; (2) indicated that some animals on the mine site itself were likely to be killed (rather than disturbed, as in the minor scenario); and (3) stated that the "mere existence of the mine could spoil the natural value of Kakadu National Park." Otherwise, the two scenarios displayed the same extensive set of color maps of the area impacted, and the same color depictions of the mine site and impacted wildlife. Both scenarios emphasized the care being taken by the mine operator.

The contingent valuation questions asked respondents whether they would be willing to have their income lowered by a randomly preassigned (stated) amount to add the KCZ to the Park. If the respondent said "yes," a preassigned higher amount was asked; if "no," a preassigned lower amount was asked. This approach yields what is known as interval-censored data: the interval where the respondent's actual willingness to pay (WTP) is known to lie is dependent on the pattern of "yes/no" responses. The amount was given in both annual and weekly terms, and the respondent was told the amount would be paid for over a 10-year period. The 10-year period was chosen to correspond to the time period over which ABARE was calculating the benefits of mining. A decision was made by the RAC staff to use median willingness to pay, partially because this was a conservative and very robust statistic and partially because of its appeal in terms of a voting interpretation. The KCZ was a very visible political issue and the government, by its previous actions, had already consented to the mining exploration.

The survey instrument gathered a large amount of ancillary data. Data were gathered on visits to Kakadu and other parks. An assessment was obtained on what respondents saw as the major environmental problems facing Australia. Attitudes on environment versus economy trade-offs were obtained, as were attitudes on what respondents thought about national parks on a multitude of dimensions. Additionally, respondents were asked whether they recycled and purchased environmentally friendly products. Finally, demographic variables such as age, sex, and income were collected.

Both parametric and nonparametric methods were used to estimate willingness-to-pay amounts. In the Australian sample, the parametric results using a Weibull survival model for interval-censored data showed a median WTP amount of \$143 for the major scenario, and \$80 for the minor scenario. Statistically, the median WTP amounts for the major and minor scenarios are significantly different. For the Northern Territory sample, the median for the major scenario was \$35; for the minor scenario, it was \$33. These two amounts are not significantly different from each other, but both are significantly lower than their Australian sample counterparts. The reported nonparametric results showed the median values for the Australians to be \$124 for a major risk scenario and \$53 for a minor risk scenario. In the Northern Territory sample, the reported median amounts were \$7 for a major risk scenario and \$15 for a minor risk scenario. Based on the nonparametric estimate for the minor risk scenario and an Australian adult population of a little over 12 million, the RAC report suggested benefits of not mining the KCZ to be \$647 million per year, an amount substantially larger than the benefits of mining.

The RAC report provides the marginals for most of the variables, including coded versions of the open-ended questions. A number of bivariate relationships between the WTP amounts and various covariates were also examined. Most of these bivariate relationships showed the expected pattern. However, one exception was income, in which no significant bivariate relationship was found. Visiting Kakadu National Park was found to have a significant negative correlation with WTP amounts. The Northern Territory sample was shown, in general, to have more favorable attitudes toward development than the Australian sample. A multivariate regression model was not estimated.

§ 23.3 Major Points

The major points raised by the Brunton, Stone, and Tasman Institute critiques are:

- The value attributed to the KCZ (too high to be believable);
- Questions about the Northern Territory estimates vis-à-vis the national estimate;

- The effects of the lack of an extensive public debate on the KCZ issue;
- The possibility that there are positive “unpriced externalities” from mining the KCZ;
- The availability of evidence on the validity of contingent valuation (CV);
- The implications of overestimates of various activities reported in the RAC survey on the KCZ willingness-to-pay estimates;
- A lack of familiarity with the resource;
- The possibility that respondents had a “moral free lunch” when answering the KCZ valuation questions;
- The appropriateness of the framing of the KCZ decision;
- An argument that CV is subject to bias and hence should not be used to value the KCZ.

§ 23.4 —Value of the KCZ Is Too High

In the eyes of Brunton, Stone, and the Tasman Institute, the major problem with the RAC's Kakadu contingent valuation survey is simply that the value the public appears to place on the KCZ is too large. Brunton, Stone, and the Tasman Institute present no evidence, beyond personal opinions, that the value is too high. It could just as easily be asserted that the true value of adding the KCZ to Kakadu National Park is much higher than the value estimated by the RAC's survey.³

These critiques consist of little more than an attack, sometimes veiled and sometimes not so veiled, on the use of contingent valuation; some largely unsupported speculation about potential problems with the RAC study; and the advocacy of some peculiar economic positions that are quite inconsistent with modern welfare economics and benefit-cost analysis.

If this were a major regulatory decision or court case in the United States, these three critiques would have received no more than a cursory reading. In those forums, it is necessary to show that the government has erred in its analysis, that the error influenced the results, that an alternative means of estimating the desired quantity is available, and that the alternative is more scientifically correct.

The closest any of the critiques comes to offering real evidence that the RAC's estimate of the value of preserving the KCZ is too high is the Tasman critique's statement that the value must be wrong because, if it were true, then the KCZ would be the most expensive piece of real estate in the world. Unfortunately, the author of the Tasman Institute critique betrays in this and later statements a complete lack of understanding of welfare economics.

³ No doubt the environmental groups believe this to be the case; their usual position is that any environmental amenity like the KCZ is priceless.

Several considerations negate the impact of this glib characterization. If we were to follow the Tasman Institute's logic, Central Park in New York City should be converted to skyscrapers, Buckingham Palace sold for apartments, the Sydney Opera House torn down to make room for another luxury hotel, and the Vatican transformed into a row of fancy eateries, because the public's values for their current uses surely cannot be as large as their value for private uses.

There is often very little connection between the value of land in private hands and its value in public use. The respondents in the KCZ study were not valuing some specific quantity of land, but a significant addition to one of Australia's best known national parks and the prevention of mining development in the middle of it, and thereby, in their eyes, the prevention of the devaluation of the entire park. Indeed, the larger the divergence between the private value and the public value of a property, the more likely the property is already in public hands.⁴ I suspect that the Tasman Institute critic would really be shocked to see the sum the public would be willing to bear in taxes to preserve these "properties" if they were actually threatened with destruction.

The Tasman critique has failed to appreciate that the value of a public good is the sum of what individual members in society are willing to pay to obtain it.⁵ The critique states:

Some of the ironies the report highlights concern the population multipliers. Simply assembling a valuation and multiplying it by the adult population will lead to illogical numbers. Supposing for example that the adult population of Australia were 36 million and not 12 million, would the valuation then be \$1,741 million [as opposed to \$647 million] per annum for 10 years? [p. 3]

The answer from welfare economics is clearly "yes," and this answer has not been questioned by economists since Samuelson's formal mathematical treatment of the issue in 1954. It is possible to argue about the relevant population over which aggregation is to be carried out, but it is clear from economic theory that the larger the population to be aggregated over, the larger the value of a pure public good. If one is going to reject traditional welfare economics and benefit-cost analysis as guides to making decisions, this rejection should be clearly and bravely stated rather than disguised as an attack on a particular technique of economic valuation.

⁴ Most governments have passed laws of eminent domain, ensuring that the government does not have to pay any more than the private value if it needs the land for some overriding public purpose.

⁵ See any rigorous microeconomics text, such as Varian (1978). More comprehensive discussions are contained in texts that specialize in the economics of the public sector, such as Atkinson & Stiglitz (1980), or Bohm (1973).

The nature of a pure public good is not the only place where the Tasman Institute critique rejects traditional benefit-cost analysis in the guise of an attack on contingent valuation. The Tasman Institute critique comes up with a "new" contingent valuation bias termed "valuation bias," noting:

Contingent valuation studies normally measure a different value than that measured by markets. . . . In economics the value (termed consumer surplus) that people receive from goods in excess of the price they pay, is irrelevant. [p. 8]

This is certainly news to most economists who do benefit-cost analysis and estimate consumer surplus measures from market demand curves (Just, Hueth & Schmitz, 1982). By maximizing consumer surplus, consumers maximize their utility; and maximizing consumer surplus has long been thought by economists to be a major objective of public decisions.⁶

It is important to understand that the same concept of value is being used with respect to both the mine and KCZ. It is simply that there is no consumer surplus associated with the outputs of the mine. In private competitive markets, consumer surplus for any particular good is often close to zero because that good is not valued much more highly than a similar good from a competitor.⁷ For a homogeneous good with multiple suppliers, the consumer surplus for any particular supplier's good is zero. As a result, a consumer's maximum willingness to pay for one supplier's good will never be any higher than the price for which that consumer can obtain the good from another seller. Another way of saying this is: once gold reaches a bank vault in Zurich, buyers are indifferent to its origin.

The Tasman Institute critique does raise one good question that is not addressed in the RAC report. That question revolves around the possibility that respondents were giving an amount which was for preserving all of Kakadu, or, perhaps even more broadly, for environmental quality in general. The valuation of a public good much broader than the intended one is not an uncommon problem in contingent valuation surveys, particularly those with vague, poorly specified scenarios, unlike those of the KCZ survey.

Testing this possibility requires examining whether respondents are sensitive to the details of the actual public good they were presented. The natural test of this has already been performed in the RAC study. The Tasman

⁶ Where there is a large divergence between the cost of production and the public's willingness to pay for the good, and competitive market forces do not drive prices down toward the cost of production, the government usually steps in by either regulating profits or providing the good itself. The provision of electricity and water are good examples.

⁷ It is possible for there to be large consumer surpluses with respect to a commodity class but not for individual goods within that class.

Institute's supposition implies that there should be no difference between the minor and major impact scenarios unless respondents were paying close attention to the details of the good they were being asked to value. A formal statistical test rejects, at the 99 percent confidence level, that the willingness-to-pay distributions for the major and minor scenarios are identical. Thus, on the basis of the available evidence, we may safely conclude that the Australian sample was valuing the good they were asked to value.

§ 23.5 —Northern Territory Estimates

The next point to be addressed concerns the willingness-to-pay estimates for the Northern Territory's (NT) sample. Here, there seem to be two issues: (1) that the NT sample appears to be willing to pay more for the minor impact scenario than for the major impact scenario, and (2) that the NT sample on average is willing to pay less than the Australian national sample, even though they are more familiar with and closer to the KCZ. The second issue is perhaps better cast as this question: Are the Northern Territory responses consistent with the responses from elsewhere in Australia?

With regard to the first issue, the problem lies in the presentation in the RAC report, not with the data. The nonparametric Turnbull-Kaplan-Meier estimator (Turnbull, 1976) does not assume smoothness and as a result is only capable of estimating what fraction of the density falls into different intervals defined by the choice of the discrete-choice thresholds.⁸ In an effort to get a "point" estimate, the RAC report has incorrectly assumed that willingness to pay (WTP) within the interval is uniformly distributed. The results of this Turnbull-Kaplan-Meier estimation should be reported as the interval in which the median falls. For the NT sample, the median for both the minor and major scenarios falls into the \$5 to \$20 interval. The fact that the Weibull estimates fall outside the estimated Turnbull-Kaplan-Meier intervals is an indication that the Weibull distributional assumption for the NT sample is not appropriate.⁹ The cumulative distribution function is estimated to be quite flat in the region of the median, and a quite small shift in the distribution of both the NT major and minor scenario responses would move the Turnbull-Kaplan-Meier

⁸ For an earlier exposition of the interval version of the Kaplan-Meier estimator, see Peto (1973). Prentice and Gloeckler (1978) have extended this framework using a multinomial approach to allow for the estimation of covariate effects under certain restrictions.

⁹ The results for the Turnbull-Kaplan-Meier estimator for the national sample should also be reported as intervals rather than point estimates: \$100 to \$250 for the major impact scenario, and \$50 to \$100 for the minor scenario. The Weibull estimates for the national sample are consistent with these Turnbull-Kaplan-Meier estimates, and the Weibull distribution seems to fit this sample reasonably well.

estimates of the interval where the median falls to \$20 to \$50, which is consistent with the Weibull estimates.

One can formally compare, in a statistical sense, whether the NT major and minor scenarios have a different WTP using a likelihood ratio test. In this case, the likelihood ratio test is formed by taking two times the difference between the sum of the log likelihoods from estimating the major and minor scenarios separately ($-515.395 = -262.311 + -253.084$) and the log likelihood from the estimation combining those two samples (-517.518). This test statistic, 4.246, is distributed as a chi-square variate with seven degrees of freedom under the null hypothesis of no difference between the two distributions. It can be compared against the 95 percent critical value of 14.067. The test statistic's p-value is .7510, which is not significant at any conventional confidence level.¹⁰

The lack of a difference between the willingness to pay for the NT major and minor scenario samples should not be surprising. A likely explanation for this lack of a difference was raised in the previous section: Northern Territory respondents may not have paid close attention to the details of the scenario they were presented. It is likely that they felt familiar with the details of the KCZ situation. They may have rejected details of a scenario that clashed with their prior beliefs. It is more likely, though, that both scenarios melded well with prior beliefs. This is because the informational content of the major and minor impact scenarios were designed so that, while presenting different impressions of the risk involved, they were not, for the most part, factually inconsistent with each other.¹¹ If respondents were already well informed about the KCZ situation or had already taken a strong position on the KCZ based on an information set not fundamentally at odds with the information presented in the contingent valuation instrument, one might not expect to see a different response to the different versions of the survey. In this respect, it may be reassuring to see no difference in the two versions of the survey instrument for the Northern Territory sample but to see a difference between the versions for the Australian sample.

Turning now to the second issue, the difference between the national and NT samples, it is useful to establish two basic facts. First, there is a significant difference between the minor and major impact scenarios for the national sample but not the NT sample. Second, the NT sample is much more polarized, having a higher percentage of responses estimated to have a very

¹⁰ In contrast, the same test statistic for the national sample is 27.198, which has a p-value of .0003; therefore, the WTP distributions for the major and minor scenarios for this sample are significantly different at any commonly used significance level.

¹¹ The two different scenarios do reflect different degrees of optimism and hence different interpretations of the basic facts about the risk of the mine. They also stressed differently the consequences of a mine accident.

low and very high willingness to pay.¹² The implication of the first fact is that it is impossible for both the NT minor and major scenario subsamples to have responded in a manner consistent with their national counterparts. This follows from the random assignment of respondents to the scenario type and a differential response by the national but not the NT subsamples. It is possible that one of the two NT versions is consistent with its national counterpart or that both are inconsistent, and it is possible to statistically distinguish between these two alternatives. For one of the NT subsamples to be consistent with its national counterpart, the covariates in a model that predicts willingness to pay must take on different values for the NT and non-NT respondents.

The implication of the second fact is that the NT covariates must take on much more extreme values to explain the larger percentage of both very low and very high responses, if the NT responses are to be consistent with the other Australian responses. An examination of the values of the key predictors indicates much more extreme responses on a number of variables such as Q12 (acceptance of low-risk development activities), Q15 (aboriginal people), and particularly Q17 (development of national parks reduces value), which is the best single predictor of a respondent's willingness to pay for the KCZ. The differences between the frequency distributions of these variables for the NT and Australian samples can be clearly seen in Table 5.10 of the RAC study.

To examine these two alternative questions, we can use the predictive model developed earlier, which includes Q11 (jobs from natural resources), Q12 and Q16 (financial benefits of using natural resources), Q17 and Q18 (create more national parks), a dummy variable for having visited parks, a dummy variable for responding that one both recycles and uses environmentally friendly products, age, income, and a dummy variable for whether the respondent received the major or the minor impact scenario.¹³ We can combine the national sample and the NT sample and ask the following

¹² Because the Turnbull-Kaplan-Meier estimator does not assume smoothness, it is possible to redefine the initial category to be the interval negative infinity to \$2 (as opposed to the interval \$0 to \$2) without influencing the estimated interval where the median lies. This may be the case if those respondents giving no-no responses were indicating that they believed that there were negative "net benefits" to adding the KCZ to the Park. The important implication of this is that allowing respondents to give negative WTP responses would not change the estimate of the interval where median WTP falls.

¹³ Approximately 8 percent of the observations were dropped from this analysis, primarily because the income variable coded is not reflective of the income at the respondents' disposal and, to a lesser degree, for demonstrating an implausible response pattern to a variety of questions. Methods for improving the elicitation of income are discussed in the minor points section. The small percentage of inconsistent responses found is typical of most surveys.

questions: Should an NT dummy variable be included in the equation? Should an interaction between an NT dummy and a type of impact scenario be included?¹⁴ Because of the significant difference between the willingness-to-pay estimates for the major and minor impact scenarios for the Australian sample, we know that this interaction term (NTMAJOR) is likely, and we will try it first. A likelihood ratio test statistic for the inclusion of an interaction between the NT dummy and the major impact dummy is 17.232, which is distributed chi-square with one degree of freedom under the null hypothesis. The 95 percent reference value for a chi-square variate with one degree of freedom is 3.84, and the p-value for this statistic (17.232) is less than .0001. As a result, one can feel comfortable including this variable in the equation. We now add an NT dummy variable to this equation. The likelihood ratio test statistic for the inclusion of this additional variable is 0.514, which is not at all significant with a p-value of .4734. An examination of the coefficients on these two variables is helpful to the interpretation of the results. The NTMAJOR variable has a coefficient of -1.059 ($t = -4.26$), which indicates a large statistically significant negative effect. In contrast, the NT dummy has a coefficient of 0.171 ($t = 0.71$), which is a very small and statistically insignificant positive effect. The combination of these two results suggests that there is not a "general" NT depressing effect on the willingness-to-pay estimates beyond that explained by differences in the covariates.¹⁵ Receiving the major impact scenario did not increase the willingness of the NT residents to pay for the KCZ. The Weibull regression model for the combined NT and national samples is given in § 23.16.

To summarize in nontechnical terms, the NT sample gave essentially the same WTP response to the minor and major impact scenarios. This conclusion holds using either the nonparametric Turnbull-Kaplan-Meier estimator or the parametric Weibull estimator. Those interviewed from the Northern Territory and from the rest of Australia responded in the same fashion on the minor impact scenario, when attitudes and demographic variables are taken into account. Northern Territory respondents did not provide the additional risk premium for the major impact scenario that respondents from elsewhere in Australia did, a result consistent with the fact that the NT respondents were more likely to be well-informed about the issue and to have established positions.

¹⁴ NT dummy takes the value of 1 where respondent lives in the Northern Territories and 0 otherwise.

¹⁵ The most significant differences on the covariates between NT residents and residents of the other states are related to Q12, Q15, and Q17.

§ 23.6 —Lack of Extensive Debate

Both the Brunton and Stone critiques argue that an actual referendum would have produced extensive debate around the issue of the KCZ. They argue that this would have produced different (and acceptable) results.¹⁶ It is interesting that both critiques make this point, in light of the fact that the RAC KCZ study randomly assigned respondents to two different scenarios: one designed to reflect the environmentalist view minus some of its hyperbole and the other designed to reflect the mining industry's view shed slightly of its no-chance-of-an-accident rhetoric. Between the two scenarios, one can get a good impression of what the impact of a civilized and factually correct debate might have been. Indeed, the two competing views of the KCZ result in quite different willingness-to-pay estimates from the Australian subsamples. This demonstrates that respondents were sensitive to the information they received, a demonstration which in turn provides important support for the validity of the contingent valuation estimates.¹⁷

The two-scenario approach taken by the RAC in the contingent valuation study is a major strength of the RAC KCZ report and an honest attempt by the RAC to address the informational issue raised by Brunton and Stone. It represents a good-faith effort to present to the public the vantage points of the two major antagonists on this issue. Respondents spent considerable time in the course of the KCZ survey instrument becoming familiar with the issue and received a fairly comprehensive picture of the decision facing the Australian government. Brunton and Stone suggest no evidence as to how the public debate they desire would have changed respondents' views. Indeed, the respondents to the RAC are probably better informed on the KCZ issues than the average voter would be after such a public debate.¹⁸

Surprisingly, the Tasman critique rejects the referendum analogy and states that Australians lack familiarity with questions that pose a choice

¹⁶ Both Brunton and Stone qualify this position. Brunton argues that because a referendum is binding while the responses to the contingent valuation survey are not, respondents did not take the survey exercise seriously. Stone makes the opposite argument: respondents knew what they were doing and acted strategically.

¹⁷ An interesting outcome from a welfare economics perspective would be to have the estimate of the benefits of the mine fall clearly between the two estimates of the benefits of adding the KCZ to Kakadu National Park. The optimal decision to be made in this case would likely rest on how persuasive the policy makers found the two views of the risk of mining the KCZ.

¹⁸ The fact that those interviewed in an in-person contingent valuation survey, in which the key features of the decision are developed at length, are likely to be much better informed than the average voter in a political referendum disturbs many economists. This concern is mitigated to a large degree by the RAC's use of two different scenarios, which represent the positions of the two major interest group factions. This point is noted in the Tasman critique.

between a loss in income and increased provision of a public good. This shows a surprising lack of faith in the ability of the Australian public to be able to answer a straightforward question: Would you vote to add the KCZ to Kakadu National Park if the cost to you was \$x—yes or no?¹⁹

The Tasman critique contends that a market for a private good should have been emulated when asking a respondent about willingness to pay for the KCZ. In this regard, the Tasman critique is quite dated in its views; most contingent valuation researchers have moved to emulating a referendum where such a market structure is a logical means by which provision of the public good might be determined. Respondents tend to readily accept this framework as legitimate for making policy decisions, and there is a long history of accurately predicting the results of a real referendum on the basis of survey questions.

§ 23.7 —Positive "Unpriced" Externalities from Mining

The Brunton and Stone critiques put forth a novel argument: mining the KCZ would have positive "unpriced" externalities. These critiques seem to be saying that the "no-no" willingness-to-pay responses represent, in reality, negative willingness-to-pay amounts because of positive existence values for mining. As such, they should have been counted as negative numbers rather than as zeros or very small positive amounts as in the RAC report. Before beginning this discussion, I wish to note two things. First, the statistical models used can be modified to incorporate the possibility that the "no-no" response are in reality negative responses; but this does little to change the estimate of median willingness to pay. Second, there are strong indications (see § 23.16) that respondents did take into account the positive externalities from mining.

In my discussion, it will be useful to distinguish between those respondents who took these positive externalities into account when giving their responses and those who did not. It will also be useful to separate arguments that are specifically related to the KCZ and arguments that are related to the implications of the KCZ decision for mining as a whole in Australia.

Respondents who believed that there are positive externalities to mining the KCZ would have lowered their estimate of willingness to pay. This is

¹⁹ Robert Mitchell and I have used this type of question in states like California, where referendums on public goods are frequently held, and in states like Ohio, where they are rarely if ever held. We have also asked this type of question in contingent valuation surveys of both local areas and the entire United States. The same type, "How would you vote if the cost were \$x?", has been used in a number of other countries, including developing countries, and, on the basis of extensive focus group work and the results of those surveys, this question seems to be almost universally understood by respondents.

because they would have essentially done a net benefit calculation, weighing, on one hand, the benefits of adding the KCZ to Kakadu National Park, which for some respondents might be zero, and, on the other hand, possible positive externalities from mining the KCZ.²⁰ This would lead some respondents to have a reduced but still positive willingness to pay for adding the KCZ to Kakadu National Park; others would now have a negative willingness to pay. Mathematically, this poses problems for a standard parametric survival analysis estimator, such as the Weibull used in the RAC report, because this estimator assumes that willingness to pay is nonnegative. It does not, however, influence estimates of the nonparametric Turnbull–Kaplan–Meier estimator also used in that report because that technique simply estimates what fraction of the distribution falls into different dollar intervals. Extending the end-point of the initial interval back to whatever negative number is desired has no effect on the estimate of the interval in which the median falls.²¹ It is also possible to do this with the parametric estimators, using a location translation or three-parameter “shifted” distribution (Nelson, 1982). Doing so results in somewhat better fits by giving the left tail a bit more room to flatten out, but it does not significantly change the estimate of the median.²² Thus, to get any substantial change in the median willingness to pay, one must tell a tale where people were unaware of “facts” that might give rise to positive existence values for mining the KCZ, of which they should have been informed.

It is hard to justify any large, unpriced, positive externality from mining in the KCZ. This is because a different study was undertaken to measure the benefits of mining. This study should have clearly depicted the economic activity that results from mining and will undoubtedly be considered by the Kakadu commissioners. The open-ended responses suggest that a significant fraction of the “no–no” responses are based on a net rather than gross benefit calculation, which suggests in turn that the contingent valuation estimate will underestimate the gross benefits of preserving the KCZ. To a large degree, the Coronation Hill mine is simply too small to have a *large* direct or even indirect positive influence on very many Australians.²³ Although Australians may have positive existence values for “mining as a way

²⁰ The regression results in § 23.16 strongly suggest that a large number, if not all, of the respondents took into consideration jobs and financial benefits from mining, in answering the KCZ willingness-to-pay questions.

²¹ This will not be true if the median falls in the initial interval.

²² The estimate of the mean is reduced by the now negative left tail, with the magnitude of the reduction dependent on the distribution assumed. For the model described in § 23.16, I estimate the smallest willingness-to-pay amount to be approximately a negative \$20. For any of the standard survival distributions, the mean estimate is still much larger than that of the median because the weight in the right tail is still much larger than the estimated weight in the left tail.

²³ Both the major and minor impact scenarios inform respondents that there would be 150 workers housed at the mine and that the minerals to be extracted—gold, platinum, and

of life," one would be hard pressed to see that this positive existence value is specific to a mine in the KCZ as opposed to a mine elsewhere.²⁴

A more persuasive argument can be made if the KCZ decision has some serious implications for the future of the mining industry in Australia of which respondents were not informed. The critiques argue that, if respondents had been informed of these implications, they would not have been willing to pay anything for the KCZ. If this is indeed the case, then the decision being made is clearly not one of preventing mining in the KCZ or probably even mining in national parks but rather one of making it difficult to mine anywhere. If in reality that is the situation, then that is the contingent valuation scenario that should have been put to the Australian public rather than the straightforward decision to preserve or mine the KCZ.

Preventing all natural resource exploration is undoubtedly a goal of some Australian environmental groups, but it is unlikely to be a goal of most Australians. Indeed, if the United States is any guide, then forbidding natural resource development inside national parks has often been seen as responsible for making the public more accepting of natural resource development elsewhere. If so, it will be difficult to argue that a decision to preserve rather than mine the KCZ will have an entirely negative effect on mining opportunities elsewhere.

The Tasman and Stone critiques make similar, but less coherent and less well-developed, arguments on this point. In doing so, these two critiques lose any sense of objectivity by arguing that the KCZ is undistinguished real estate or clapped out buffalo country,²⁵ and by further contending that mining is not incompatible with Kakadu.²⁶

palladium—were likely to have been considered to be valuable exports, making it likely that these benefits from mining were taken into account when answering the willingness-to-pay questions. The multivariate regression estimate in § 23.16 suggests that those who thought that jobs in natural resources were important or that the financial benefits of exploiting natural resources were important were willing to pay much less than those who did not. In any event, none of the critiques seems to be putting forth the old diffuse secondary benefit arguments, which have been largely rejected by economists.

²⁴ It is possible, or course, to advance a perverse sort of argument that such an individual may get enjoyment from destroying something that the "hated" environmentalists cherish. This may indeed be reflected in Brunton's remark (p. 5) that "perhaps more appropriately, how much compensation they [mining advocates] would expect if it [mining the KCZ] did not go ahead."

²⁵ It is worth noting here that the design of the KCZ contingent valuation study was quite sensitive to this position. The first picture displayed to respondents shows Coronation Hill with an old steel drum. Subsequent language and pictures discuss buffalo damage and show the ledges already cut into Coronation Hill. The intent was to let respondents make their own judgment about the quality of the KCZ.

²⁶ Here, Stone and the author of the Tasman Institute critique can be clearly seen to be out of touch with the public. Only 10 percent of the national sample and 21 percent of the NT sample strongly disagree with the statement "If areas within National Parks are set aside for development projects such as mining, the value of the parks is greatly reduced."

Should a subsample of respondents have been asked their willingness to pay to have the KCZ mined rather than added to Kakadu National Park? Perhaps. This certainly would have been an interesting exercise. It is useful, though, to take this thought experiment one step further and ask what it actually implies. First, one has now made the addition of the KCZ to Kakadu National Park. This change in the status quo implies a willingness-to-pay property right for those who would like to see the KCZ taken away from Kakadu National Park and mined, but a willingness-to-accept compensation property right for the rest of the public. This switch in the status quo property rights is highly disadvantageous to the proponents of mining; and it is hard to see how they could ever come out ahead in a comparison of willingness to accept compensation from the preservationists, and willingness to pay from the mining advocates.²⁷

§ 23.8 —Little Evidence on the Validity of CV

Brunton states that there have been no tests of the validity of using contingent valuation to value anything like Kakadu. He further contends that there has been only a fairly small number of tests of the validity of valuing quasi-private goods and no test of pure public goods.

This contention is misleading; there have been quite a large number of tests of quasi-public goods and several tests of pure public goods. A number of the older tests are reviewed in Mitchell and Carson (1989), and a number of the more recent ones appear in academic journals or recent working papers. For the most part, there is reasonably close comparison between the results of contingent valuation and other methods of nonmarket valuation. In instances where there are differences, the contingent valuation estimate may be closer to the true value than the estimates using one of the indirect techniques.²⁸

Brunton makes an apparently plausible suggestion on how to validate the KCZ contingent valuation survey by having a conservation group collect money for a trust to buy the Coronation Hill Joint Venture Partners' interest in the KCZ. The specific problems with Brunton's suggestion are taken up at some length in my concluding remarks. Here I would like to note only that, in some ways, Brunton has proposed an impossible test. By the definition, one cannot verify the value of pure public goods by comparison to an implicit market, as is the case for quasi-private goods. Thus, there is generally

²⁷ See Hanemann (1991) for a discussion of the potential divergence between willingness to pay and willingness to accept compensation.

²⁸ See Randall (1991) for a recent discussion of this issue, and Smith & Desvousges (1986) for an empirical example of the set of assumptions necessary to compare benefit estimates from two different techniques.

no way to carry out Brunton's desired comparison. The only way to "create" the actual market for a pure public good is to hold a referendum and let the public make a binding vote on the issue. If one grants that this is the correct comparison, then it is well-known that public opinion polls provide very good predictors of the actual vote.²⁹ Indeed, being off on a prediction by more than five percentage points is considered a major failure.

In one instance (Carson, Hanemann, and Mitchell, 1987), a contingent valuation survey was done in advance of a large water-quality bond issue that was placed on the ballot in California by the legislature. Respondents were randomly assigned to different tax prices and asked whether they were prepared to vote for that bond issue at that tax price. This allowed tracing out a fairly steep demand curve for the measure as a function of tax. The voters' booklet was later sent out and identified the actual tax price to households. The bond issue received very little publicity during the course of the election and had no real organized support or opposition.³⁰ The percentage who voted in favor of the bond issue was only a few percentage points higher than that predicted by the estimated demand curve at the actual tax price. Quite recently, techniques similar to contingent valuation were used in structuring a ballot proposition in a California election to set the (gasoline) tax price and to select the bundle of transportation improvements to be paid for with those funds. This multibillion-dollar proposition represents one of the largest voter-approved tax increases in California's history.

§ 23.9 —Overestimate of Behavior

Brunton argues that, because respondents in the RAC survey overestimate the extent to which they engage in several activities, the willingness-to-pay estimates derived from that survey should not be taken seriously or, at the very least, represent gross overestimates. There are two problems with Brunton's argument. First, Brunton's contention that the numbers of households visiting Kakadu, belonging to conservation groups, and buying environmentally friendly products are overestimated by the RAC survey is questionable. Second, there is no direct connection between an overestimate of some activity, like the number of people purchasing environmentally friendly products, and whether the estimates of willingness to pay for the preservation of the KCZ are too large. Indeed, the response characteristics

²⁹ If there is a substantial effort by two conflicting groups to present their side of an issue, to be accurate, the poll needs to be taken as closely to the election as possible.

³⁰ California law requires that such bond issues be put to a public vote. There are typically several on the ballot with political candidates, and a number of propositions do not directly involve the issuance of bonds. The important thing from a contingent valuation perspective is that the information set used by the voters was similar to that provided to the contingent valuation respondents.

of these two types of questions are well-known and do not suggest this relationship.

Questions like "Do you regularly buy unbleached toilet paper or environmentally friendly cleaning products?" are well known for eliciting very high estimates of such behavior. There are several reasons for this. The first and primary factor has to do with a very liberal interpretation of the terms "regularly" and "environmentally friendly." Effectively, this question asks "Have you in the past year or so purchased any household product that you thought was better for the environment than some other product which you could have purchased?" There is no real comparison between what this question actually asks and what Brunton implies that it asks by comparing its response to the market share of a few specific products.³¹ Advertisers and marketing firms have long promoted the impression that their products had a benign impact on the environment. This makes it easy for respondents to honestly answer that they believe they engage in this behavior. In contrast to this "fuzzy" kind of question, a contingent valuation scenario like that in the RAC KCZ survey is very specific, and the willingness to vote for a reduction in income question is very concrete.

Second, the purpose of this question was not to try to measure the market or market share for these products.³² Rather, the purpose of this question was to determine whether there was a correlation between people who *thought* they were environmentally oriented consumers and their willingness to pay for preserving the KCZ. This relationship is shown to be positive.

Third, Brunton cites the guilt about not using such products, which some respondents expressed to interviewers, as a reason to suspect that there is an overestimate of the purchase of environmentally friendly products. This can just as easily be interpreted as a sign that most respondents are honest when answering survey questions. It would have been interesting to determine whether these respondents are those who know that many so-called "environmentally friendly" products being pushed in the marketplace are not really all that environmentally friendly.³³

³¹ Brunton explicitly recognizes this when he says (p. 7), "The range of possible products is too broad and ill-defined to obtain accurate figures on their market share." He follows that with a statement which by his own admission can have no real basis, "Nevertheless, the survey results were ridiculously high,"

³² If this was a marketing survey, one would have followed up the question asked by eliciting specific products, frequency of use, how these were environmentally friendly, how they compared to potential competitors, and why the respondent was or was not motivated to buy them.

³³ A large number of such false claims are now being rigorously prosecuted by state and federal officials in the United States, and there are efforts underway to develop a certification process for those who wish to label or advertise that their products are environmentally friendly.

Brunton also contends that the RAC survey overestimates the number of people going to Kakadu National Park and belonging to conservation groups. As to the number of respondents who said that they have been to Kakadu, it is unclear why Brunton suggests there is an incentive for a respondent to answer "yes" when the respondent has not been to Kakadu. The question at issue, Q5a (Have you heard of Kakadu?), is the first question to explicitly mention Kakadu; as a result, respondents cannot have been influenced by the KCZ willingness-to-pay estimates or any other aspect of the KCZ scenario presented to them. The fact that only 12 percent of the Australian sample responded that they had visited Kakadu while 62 percent of the NT sample responded that they had made such a visit suggests that there cannot be some large social desirability factor encouraging respondents to answer "yes."

There are many possible explanations for the divergence between the RAC survey results and Brunton's calculated 5.6 percent estimate of the actual percentage of the Australian population visiting Kakadu. These range from problems in the long chain of assumptions that Brunton is forced to make to get these estimates, to the possible incorrectness of Australian National Parks and Wildlife Service estimates. The latter is perhaps the more likely. The Park Service (1986) believes that its estimate is conservative. Kakadu National Park does not have the large entrance centers and gates that are typical of the large U.S. national parks, such as Yellowstone. As a result, a visitor must go out of the way to register. In instances where there is not formal counting of visitors at entrance points, survey estimates are often believed to provide better estimates than those obtained from informal onsite procedures, and the survey estimates are often used as the official estimates of visitation rates. This is particularly true when the number of trips to the site by the average visitor is small, and a visit to the site is not a typical component of an individual's regular recreation pattern.

Furthermore, when trips to a location are fairly frequent and routine, recall surveys tend to underestimate the number of trips in the past. This underestimate, as one might expect, is more pronounced, the longer the recall period asked about. Finally, I find it odd that Brunton invokes an overestimate of the number of people going to Kakadu as a reason that the willingness-to-pay estimates are too large, when there is a negative and significant bivariate correlation between going to Kakadu and willingness to pay for the KCZ.

The last behavior that Brunton raises is membership in conservation organizations. This question is similar to the environmentally friendly products question in that it invites liberal interpretation. Research that Robert Mitchell has done on similar questions in the United States shows that questions of this type often invoke "yes" responses from members of garden clubs, hunting clubs, political organizations with a strong environmental platform, and a host of local conservation organizations. The number of

respondents who fall into these categories are likely to outnumber those who belong to national conservation organizations. An additional factor to consider is that membership in an organization is often thought of on a household basis and effectively treated that way by the conservation organizations. That correction alone (325,000) results in an estimate less than half the 750,000 Brunton derives from the survey data.³⁴

Finally, a substantial literature on voting suggests that respondents who do not intend to vote for a ballot proposition or candidate either say "no" or say that they "don't know" how they would vote. An overestimate might occur if the "don't knows" were counted as "yes" votes, or if some fraction of the "don't knows" were counted as "yes" votes, or if the "don't knows" were dropped. In the RAC analysis, however, the "don't knows" were counted as "no" votes. This is considered the most conservative method of treating "don't know" answers in forecasting the percentage who are likely to vote "yes" on a referendum.

§ 23.10 —Familiarity and Importance of Resource

Stone's and the Tasman Institute's critiques believe that the lack of familiarity of some respondents with the Park, the failure of most respondents to rate the KCZ as one of the "two or three environmental matters most important to Australia right now," and the small percentage of people who have visited Kakadu indicate that the KCZ cannot be important to the public and, therefore, they cannot have much value for it. To a large degree, Stone and the Tasman Institute have misinterpreted the data on this point.

Nowhere is this more clear than in Stone's contention that only 4 percent of the respondents could correctly identify the KCZ as being in the north-eastern NT. The "open-ended" question at hand, Q5b, asked "Where in Australia is the Kakadu National Park?" To most respondents, this question would seem to call for the name of a state or territory. Seventy percent responded in this manner with a "correct" answer, Northern Territory. Another 5 percent gave a "correct" answer that did not name a state or territory—northern Australia or the Top End—and 4 percent gave Stone's correct answer, a specific location, northeast Northern Territory. Thus, 79 percent of those answering this question should be classified as having definitely answered it correctly. It is possible that some of the 5 percent "other" responses also represent correct answers, such as "out from Darwin." I should also note that, although the 7 percent of the respondents who named Queensland or Western Australia named the incorrect location, they correctly named a distant location in the correct direction from them to

³⁴ Brunton compares this 750,000 number to the 200,000 national conservation group membership.

Kakadu. In any event, relative to the geographical knowledge of the American public, this is remarkable; most Americans cannot name the capital cities of many of the 50 U.S. states. Furthermore, it is amazing that 96 percent of respondents said that they have heard of Kakadu National Park when it has existed as a national park for only a little over a decade.

Also troubling Stone and the Tasman Institute are the small numbers of people who have visited Kakadu and the public's apparently large willingness to pay to preserve the KCZ. Here, the critics have simply looked at the wrong question. It is not who has visited Kakadu in the past, as this is not likely to be a frequent trip for many, but rather who would like to visit Kakadu in the future. The response to this question indicates that 60 percent are likely to visit Kakadu in the future. This is quite a high percentage, indicating that Kakadu in a relatively short time has become one of the places that most Australians think that they should visit at least once in their lives. The response to this question looks similar to that for the Grand Canyon in the United States.

Also troubling to both Stone and the Tasman Institute is the fact that only 2 percent of the respondents identified Kakadu as one of the two or three most important environmental matters facing Australia. Here, they have misinterpreted the purpose of this question and the responses to it.³⁵ This question, which was asked before there had been any mention of Kakadu, was intended to elicit respondent concern about very broad environmental issues and to help later place the KCZ issue within that larger context.³⁶ It has long been the case in the United States that asking a question similar to Q3 (open-ended; most important environmental matters) invokes responses with a big emphasis on general air and water pollution issues, protection of plants and animals, recycling and disposal issues, and global environmental problems.

It is simply not possible to directly infer anything about willingness to pay from a question like Q3. Even if one wanted to argue that the rankings here could be translated into preferences expressed in terms of willingness to pay, one would have to take into account the large sums of money

³⁵ There is much faulty logic going around on this 2 percent. The Tasman Institute, for instance, states (p. 10) that "Only 2 percent of the respondents regarded the preservation of Kakadu National Park as a matter of importance to Australia." The question "Is the preservation of Kakadu National Park a matter of importance to Australia?" was never asked of respondents. Given the high recognition of Kakadu and the responses to Q6, "What is Kakadu best known for?", it is likely that there would have been a very high affirmative response to the question of preserving Kakadu National Park.

³⁶ It would have been possible to attempt to find out how many people knew that the government was considering the KCZ issue and to explicitly ask people to rank-order the KCZ issue with other issues that they believed that the government could take definitive action on at the present time. This would have been necessary for the Tasman Institute's argument (p. 2) to have any basis.

currently being spent on many of the problems named in Q3.³⁷ Indeed, it is possible that a respondent might not be willing to pay anything more for the most important issue if it seemed that the government's spending more on that issue was ineffective. If there is a difference in the responses to this type of question in Australia, it is the much higher percentage of respondents who named logging native forest, mining in sensitive areas, and the preservation of national parks as important environmental concerns than one would likely see in the United States.³⁸

§ 23.11 —Moral Free Lunch

Brunton (p. 3) contends that "Respondents are being offered a comforting moral free lunch" through their answer to the contingent valuation questions. Stone, picking up on Brunton's remark, contends that respondents overbid. The Tasman critique raises several variants of this issue, including the concept of "warm glow bias," which has become popular with some contingent valuation opponents in the United States, and the possibility that respondents wanted to appear generous to interviewers.³⁹

Brunton correctly indicates that, although positive correlations between willingness-to-pay responses and attitude variables that should indicate greater preferences for the good show an internal consistency among the respondents' answers, they do not provide any evidence against the moral free lunch argument. Brunton's argument is greatly strengthened by the apparent absence of a significant positive correlation between income and willingness to pay in the RAC report. As discussed in § 23.16, however, construction of a multivariate predictive model, which controls for attitude variables as well as demographics, shows a fairly strong and significant positive relationship between willingness to pay and income. Brunton's case is now much weaker.

Brunton's argument may be put to rest by remembering that respondents have been randomly assigned to different dollar amounts. An operational test of the moral free lunch hypothesis can be obtained by determining whether the probability of a "yes" response changes with changes

³⁷ One can show that it is possible to infer something about willingness to pay from questions similar to those asked on the (U.S.) General Social Survey by the University of Chicago's National Opinion Research Center whereby respondents are asked if they think spending on particular programs should increase, stay about the same, or decrease.

³⁸ Concern about old growth forest in the United States has been on the rise, particularly in California and the Pacific Northwest, where numbers in the 5 to 10 percent range for a "single" most important environmental issue question are being seen.

³⁹ See the exchange between Daniel Kahnemann and Jack Knetsch, and V. Kerry Smith, in a forthcoming issue of the *Journal of Environmental Economics and Management* for the latest round in this debate.

in the dollar amounts to which the respondent was randomly assigned.⁴⁰ The moral free lunch hypothesis, to have any import, must imply that the respondent ignores this dollar number when answering the willingness-to-pay questions (Q8a, Q8b, and Q8c). This hypothesis can be tested via restrictions on the slope coefficient of a simple probit or logit binary discrete choice estimator based on Q8a, or on the location and scale parameters of a Weibull interval-censored survival model based on the responses to all three questions. Using either approach, the moral free lunch hypothesis can be statistically rejected with greater than the 99 percent confidence level. If respondents are getting a “free lunch,” it is indeed odd that they are much less favorable toward adding the KCZ to Kakadu National Park as the personal cost to them of doing so goes up.

The warm glow hypothesis put forward by the Tasman Institute is a perverse variant of Brunton’s moral free lunch argument.⁴¹ For that hypothesis, respondents get *more* utility the *more* they are willing to pay. The implication of this hypothesis is a *positive correlation* between the probability of a “yes” response and the magnitude of the dollar amount randomly assigned to the respondent. We have already rejected the possibility of no correlation between the assigned amount and the probability of “yes” responses in favor of the alternate hypothesis that the correlation is negative; the warm glow hypothesis is likewise statistically improbable, in addition to being counterintuitive.

The Tasman Institute claims that respondents wanted to appear generous to interviewers. There is little evidence to support this supposition in the contingent valuation literature. What evidence is available to support this proposition relates to obtaining small amounts using the bidding game elicitation method. Under that elicitation format, it is sometimes possible that respondents can be “bullied” into agreeing to some amount as the interviewer progressively drops down from the initial request. As the amount the interviewer asks for drops more and more, one may effectively be asking the respondent “Are you not willing to pay anything for this good which you should be willing to pay something for?”⁴² The binary discrete-choice elicitation format avoids this problem completely, and we have seen no evidence that respondents in contingent valuation surveys

⁴⁰ This test is impossible in contingent valuation surveys that elicit the respondent’s exact willingness-to-pay amount.

⁴¹ The actual description of “warm glow bias” used by the Tasman Institute is confounded with “symbolic bias” (Mitchell & Carson, 1989). Symbolic bias is unlikely in the KCZ study because of the extensive use of maps, local area photos, and a detailed scenario description.

⁴² This problem may be particularly pronounced as the amount the interviewer requests gets closer and closer to zero. As the median estimates from the RAC study are quite a distance from zero, this “scraping zero phenomenon” is not relevant.

have problems saying that they are not willing to pay a particular amount for the good in question.

§ 23.12 —Appropriate Framing of the KCZ Decision

The most serious issue raised in the critiques is whether the KCZ decision should have been framed in the manner that it was. It should be clearly understood at the beginning of this section that this question lies at the heart of benefit-cost analysis. It is not, however, a question tied in any specific way to contingent valuation, although contingent valuation provides one of the most direct ways to demonstrate the effects of framing a decision in different ways.⁴³

Let me illustrate the framing issue—or the embedding effect, as it is sometimes called—at work in a benefit-cost analysis with the now classic example of changing the pollution levels in three lakes that are identical from the public's perspective.⁴⁴ Label the lakes A, B, and C, respectively. If three independent samples, I, II, and III were asked how much they were willing to pay to clean up A, B, and C, respectively, one would find that each respondent had given, on average, the same amount, say \$20, to clean up the one particular lake asked about. The critics have fallen into the trap that, if the value of cleaning up one lake is \$20, then the value of cleaning up all three lakes must be $3 \times \$20 = \60 . This would only be true if one ignored both the income and the substitution effects that drive most of economics. If the question of interest to policy makers was to clean up all three lakes, then that is the question that should have been asked of respondents. Suppose the response to this question is \$30. We would now know that the package of cleaning up the three lakes is less than three times the value of cleaning up any single lake.

This is a disturbing finding for many decision makers. We know that each lake is worth \$20 by itself but that all three lakes are only worth \$30. It is natural to ask whether there is a unique value that can be placed on any of these three lakes. The economics answer is "no." The sequence in which the lakes are cleaned up will determine their value. Taking the first sample, we might find their value for cleaning up lake A is \$20; and given that lake A has already been cleaned up, their value for cleaning up lake B is \$8; and given that both lakes A and B have been cleaned up, their value for lake C is

⁴³ The critics here are certainly not the first, nor will they be the last, to attack contingent valuation on the basis of its being able to show that no good has a unique value that is independent of the context in which the valuation takes place.

⁴⁴ A formal mathematical exposition of the points made in this discussion can be found in the 1989 *American Economic Review* article by John Hoehn and Alan Randall.

\$2. The respondents in sample II are asked a different sequence so that we find lake B is worth \$20, lake A is worth \$8, and lake C is worth \$2. For sample III, lake C, valued first, is worth \$20, lake B is worth \$8, and lake A is worth \$2.

The correct statement to be made from this analysis is that cleaning up the first lake is worth \$20; the second, \$8; and the third, \$2. The fallacy stated in the Tasman Institute critique by adding up the willingness to pay for protection of different animal species should now be clear in a mathematical sense. Independent valuation is incorrect if the purpose is to determine the value of changes in the simultaneous provision of multiple public goods.

Is the answer then to give respondents a list of the possible public goods that might be offered, ask them their total willingness to pay for this set of public goods, and then ask them to break that total apart and assign a value to each good in the set? No; this approach may provide even less information than valuing the goods independently. To see this, assume that there are only two types of individuals in the population of interest and one respondent of each type is selected and asked to value a set of three public goods, Q, R, and S—say, adding water to empty reservoirs in different locations.⁴⁵ Respondent 1 gives \$100, with a breakdown of \$75 for Q, \$20 for R, and \$5 for S. Respondent 2 gives \$100, with a breakdown of \$5 for Q, \$20 for R, and \$75 for S.

Filling any of the three reservoirs will cost \$80 per capita, and there are no economies of scale to filling more than one. Our two respondents' WTP amounts do not necessarily indicate that none of these three public goods should be provided, because all these WTP responses convey is that willingness to pay for any single reservoir in the package is less than or equal to \$100.

Continuing our thought experiment, suppose that each of our two respondents gave their willingness to pay to fill each of our three reservoirs as if each were the only new public good to be provided. Respondent 1 gives \$90 for Q, \$85 for R, and \$50 for S; respondent 2 gives \$50 for Q, \$85 for R, and \$90 for S. The government can improve the public's welfare by filling reservoir R with water.

It is possible to make more general statements about this phenomenon using a willingness-to-pay property rights perspective. Under that perspective, the value of any particular good, be it a private or public good, can be progressively driven down as one offers more and more goods that are substitutes and that compete for the same limited number of dollars. This has

⁴⁵ This example is similar to empirical results on recreation benefits, which can be generated from Frank Ward's model of reservoirs in the State of New Mexico, where the values are determined by estimated recreation participation/travel cost functions rather than by contingent valuation results.

been demonstrated repeatedly in real private-goods markets, in large travel cost models with large choice sets, and in contingent valuation studies.⁴⁶ It would indeed be quite disturbing to economists if this did not happen.

The importance of the property right assumed can be seen by noting that the opposite phenomenon occurs under a willingness-to-accept perspective; that is, the later a good is valued in a sequence, the more highly it is generally valued. This happens because the agent has already given up one or more goods that are at least partial substitutes for the one now under consideration; and, having received additional income for the goods already given up, the agent will now demand increased compensation for the good in question in order to maintain the same level of utility.

Thus, when considering the implications of how the question should be framed, one must consider whether a willingness to pay or a willingness to accept compensation framework is appropriate. This consideration should be made independently of whether a willingness-to-pay question was asked in the contingent valuation survey, because practical difficulties with asking a willingness-to-accept question largely rule out that approach. One can use the Tasman Institute's example of different animal species and tell two quite different stories, depending on whether an agent has the right to destroy the animal species and the public (via the government) must pay that agent not to, or whether the agent seeking to destroy the animal species has to buy from the public the rights to destroy the animal species.⁴⁷ In the first case, the public quickly runs out of money trying to protect the animal species; in the second case, the more animal species destroyed, the richer the public will be and the less willing the public will be to accept additional money for the destruction of additional animal species.

Let us turn now to how this framing issue has been treated in practice. Benefit-cost analysts have traditionally looked at projects in isolation from each other. In doing so, they have implicitly assumed that a particular project is the first project in a sequence of possible projects.⁴⁸ This results in the situation where a large number of projects with benefit-cost ratios larger than the first one are competing for a limited amount of public money.⁴⁹ Undertaking any single project with a benefit-cost ratio greater than one

⁴⁶ The Tolley and Randall (1985) Grand Canyon example cited in the Tasman Institute critique (p. 5) is a well-known demonstration of this phenomenon.

⁴⁷ The notion embodied in the Tasman Institute critique, that all of the public goods currently enjoyed by the public are at risk and that money should be collected for them, represents a very cynical view of the world.

⁴⁸ The benefits of the mine would also suffer if one were to ask the analogous question of what would be the reduction in profits, jobs, and export earnings if, instead of this mine, the next best mining opportunity was exploited.

⁴⁹ In the United States, this situation is particularly well known with respect to water projects that might be undertaken by the U.S. Army Corps of Engineers or the Bureau of Reclamation.

will improve the public welfare, but a decision must be made as to which one should be undertaken. If more than one project is to be undertaken, then interactions between the projects must be considered; undertaking any pair of projects, even the two with the largest benefit-cost ratios, may not be in the public interest.⁵⁰

Three facts should have emerged as important from my discussion thus far: what goods are in the choice set matters, the sequence in which they are offered matters, and whether the agent has the right to sell or buy those goods matters. It will be useful to distinguish between private and public goods at this point. For private goods, the choice set is very large, limited only by the need for potential suppliers to make profits; and the sequence in which those goods are considered is to a large degree controlled by individual consumers. Differences between willingness to pay and willingness to accept compensation in well-functioning private goods markets are generally small because of arbitrage possibilities. It is generally unnecessary for the government to take any actions to inform consumers of their choices in the private-goods markets because sellers have incentives to provide that information and consumers have incentives to learn about the markets.

Public-goods markets differ dramatically from private-goods markets in that everyone consumes the same level of public goods. There is, at most, infrequent public debate over the provision of new public goods or major changes in the level of provision of existing public goods.⁵¹ As a result, an individual's choice set with respect to public goods is always small and sometimes empty. It is not a question of what public goods an individual might want to be offered by the government but a question of what public goods will be offered by the government. In almost all situations, the public consumes the fixed quantity of a public good provided to the public by the government. For instance, someone cannot go out and buy additional fighter planes because he or she thinks that the country's defense needs to be improved. It is difficult to elevate demands by individuals for a new public good to the point where the political process seriously considers

⁵⁰ Even undertaking the single project with the largest benefit-cost ratio may not be *optimal* if it is possible to bundle together other projects to form a larger project with a better benefit-cost ratio. Seeking out the optimal combinations and sequences of projects soon becomes an impossible task in terms of the information required and computational complexity.

⁵¹ It is this point which Brunton misses: he wants to let the public have an opportunity to spend its money on a myriad of possible environmental amenities (p. 5) which are not now currently available to them. Nor is it likely that the public will be offered the opportunity by the Australian government to spend large sums of money on Antarctica, global warming, ozone depletion, eskimos' seal hunting, and so on. In addition, Brunton does not recognize that the public is already spending large sums of money on a number of the environmental amenities that he wishes to offer respondents, such as air quality, water quality, and removal of asbestos.

provision. The sequence in which new public goods are offered is also controlled by the political process.

It has become a common ruse in attacking contingent valuation surveys to throw the door open to the possibility of providing every new public good some interest group may desire and to reallocate money among existing programs. The result, of course, is chaos. No one is perfectly happy with the current provision of public goods. It is the job of government to look at possibilities for providing new public goods that most of the public wants and to provide these goods at the lowest cost possible so as to maximize the public's consumer surplus.⁵²

My final remarks in this section will concern the length of time over which payment in a contingent valuation study is elicited. The use of contingent valuation surveys with a long payment period may pose problems with regard to making good policy decisions. First, let me note two easy situations. One occurs when willingness to pay for a public good is elicited as a one-time lump-sum payment and the good is immediately purchased by the government. In this case, the public's wealth is reduced by the cost of the good and utility is increased by its provision. This good's place in any sequence of future public goods is now irrelevant because it is just like any other public good being currently enjoyed by the public, and its impact on a consumer's disposable income has already been taken. In the second situation, provision of the public good occurs on an ongoing basis. In this instance, eliciting WTP for the good on a regular basis, such as monthly or yearly, does not create any problems. The public can decide it does not want to continue to pay for the good in the future and its provision can be discontinued. Many pollution control issues have this characteristic.

The situation is more confusing when eliciting willingness-to-pay amounts over a longer period for a good that will be purchased once and then continually enjoyed by the public or for a good that will be bought and paid off over a long period with regular payments. Consumers make long-term commitments to pay for durable goods like automobiles and houses. These goods have resale value and consumers tend to look at them in that way. It is also true, in the United States at least, that to provide some public goods, voters can approve bond issues that entail higher taxes for a long period of time in order to pay off the bonds. However, without a special effort, it may be difficult to ensure that respondents in a contingent valuation study clearly understand that they are making a long-term commitment to pay for this good into the distant future. There is increasing evidence from contingent valuation studies, experimental work, and studies of actual consumer behavior with respect to energy conservation

⁵² The government must also always be on the lookout for existing public goods that are now costing more to provide than the public is willing to pay for them.

expenditures that the public either has a very high discount rate for some goods or does not fully understand very long-term payment obligations.⁵³

In general, I believe that it is wise to avoid long-term payment commitments in contingent valuation studies that value goods not provided on a continual basis. This avoidance clearly results in conservative estimates because of precommitted uses for currently available income.⁵⁴ It does, however, avoid the issue of the appropriate discount rate. A further advantage is related to the earlier discussion on public goods choice sets. As long as goods are bought and paid for in the same time period, the problem of defining what should be in the choice set is much less difficult. The longer the time period over which payment is elicited, the more legitimate the question of what new public goods might be offered in the future that the public would rather spend money on.

§ 23.13 —Biases That Imply That CV Should Not Be Used

The Tasman critique (p. 5) states that "Perhaps the most important reason for a lack of consensus regarding the validity of the CV method is the potential for respondents' answers to the valuation question to be biased in some way. This implies that the valuation attained by a CV study is not a true indication of the actual valuation." This nihilistic view could just as easily be expressed about any economic technique used for any purpose. The probability that an estimate from a statistically based economic technique corresponds with the actual or true value of the quantity desired is essentially zero. This is a trivial observation. In fact many of the *potential* contingent valuation biases spoken of in the Tasman critique should be seen as analogous to the potential econometric specification errors that affect other economic valuation techniques or generally affect the collection of survey data.⁵⁵ The key question then is not whether there are potential contingent valuation biases—clearly the answer is "yes"—but rather whether these biases can be avoided to the extent that useful information about the public's willingness to pay for the KCZ can be obtained using contingent valuation. If that question is answered affirmatively, then one asks whether this particular contingent valuation study did so.

⁵³ Long-term payment obligations also increase the likelihood that individuals give their willingness-to-pay answers on the basis of their expected future income rather than their current income.

⁵⁴ The most conservative approach is to ask for a multiyear commitment and then only use the amount for the first year as the estimate of willingness to pay.

⁵⁵ It should also be noted here that most government statistics are ultimately derived from data collected using surveys of the public or businesses.

The Tasman critique puts forth a quite dated list of potential contingent valuation biases and invents a few new ones such as "near-enough" bias and "valuation" bias. Their treatment is directed against the use of the contingent valuation method, with little real reference to the particular contingent valuation survey instrument used to value the KCZ.

Here I will discuss potential contingent valuation biases raised in the Tasman critique.⁵⁶ The first is strategic bias. The Tasman critique asserts that this bias is both likely to be present and upward. This is counter to prevailing opinion among resource economists that it is unlikely to occur and that to the extent that it occurs in willingness-to-pay questions, it is likely to be downward because of free riding and protest zeros.⁵⁷ Strategic behavior is further discouraged by the use of a discrete-choice framework, which prevents any single respondent from exerting too much influence on the eventual aggregate willingness-to-pay estimate. The use of the median instead of the mean completely reduces any potential influence of extremely large positive responses. It is hard to see, as the Tasman critique argues, that there is an upward bias in the KCZ study because of strategic behavior.

The Tasman critique mistakenly invokes starting-point bias in the RAC KCZ study. This bias, as described in the Tasman critique, is specific to the bidding game method; the RAC KCZ study used a binary discrete-choice elicitation method. The binary discrete-choice elicitation is specifically designed to avoid the problem of starting-point bias. The essential feature of starting-point bias is that the respondent assumes that the starting point contains information about the cost of the good and that it is costly in some sense to move away from the starting point offered. In the case of the binary discrete-choice format, one wants the respondent to take the offer as the cost of the good, and the respondent is only asked to say "yes" or "no" to that cost and is not asked to incrementally move away from it.⁵⁸

⁵⁶ A comprehensive list of the potential contingent valuation biases, the conditions under which they are likely, how to test for them, a discussion of empirical evidence of their magnitude, and methods of avoiding them appears in Mitchell and Carson (1989).

⁵⁷ Many contingent valuation studies drop the protest "no" responses and base their estimates on the remaining observations. The RAC study treats the protest "no" responses as real "no" responses, therefore resulting in conservative estimates of the public's willingness to pay.

⁵⁸ The KCZ study respondents were asked a second nonincremental binary discrete-choice question. This second question greatly reduces the confidence interval around willingness-to-pay estimates. However, there may be some anchoring on the first response (see RAC report, pp. 137-38) and this anchoring usually (and does in this case) results in a small downward bias. Effectively, respondents who said "yes" to begin with are less likely to agree to pay a higher amount if the good has already been offered to them for a substantially lower amount; respondents who said "no" are less likely to think that the good will really be made available to them at a lower price and hence are more likely to say "no" again. See Hanemann, Kanninen, and Loomis (forthcoming) for a discussion of this issue.

Related to this discussion, the Tasman Institute has raised a new bias termed "near-enough bias," which asserts that if a respondent's willingness to pay is less but not much less than the dollar amount asked about in the survey, there is a tendency to say "yes" to the amount asked about. Theoretical work (Hoehn and Randall, 1987) suggests the opposite tendency; that is, with a discrete-choice approach, respondents will tend to back away from their actual maximum willingness to pay and say "no" because of risk aversion, uncertainty about their preferences, and the cost involved in exploring their preferences close to the maximum willingness-to-pay point. My empirical work on visibility improvements in Cincinnati, Ohio, with Robert Mitchell and Paul Ruud, based on fairly sophisticated mathematical models of this type of behavior, also suggest downward rather than upward bias. I know of no evidence, theoretical or empirical, that has ever demonstrated a tendency toward a "discontinuous jump" in probability terms from a "no" to a "yes" response as the amount asked about approached the respondent's maximum willingness to pay from *above*, a finding necessary for this hypothesis to have any predictive implications for estimating the distribution of willingness to pay in the population.

Other biases raised by the Tasman Institute are discussed elsewhere in my comments. The notion of opportunity cost is discussed above, in the framing section; the notion of information bias has already been discussed in the information section. The notion of valuation bias the Tasman Institute raises has nothing to do with contingent valuation but rather is a strange attack on benefit-cost analysis and was discussed above in the first section.

The Tasman Institute also raises the issue of "survey" bias. With the exception of raising the issue that the willingness-to-pay responses are for the household rather than the individual (an issue in which there is some merit and which is discussed as a minor point below), this is not an attack on contingent valuation but rather an attack on gathering any type of data via surveys of individuals. For the most part, the issues raised simply have to do with good sampling and survey administration procedures which the RAC, in contrast to many contingent valuation surveys, appears to have been very cognizant of following.⁵⁹

Finally, the Tasman Institute critique cites the failure of the RAC KCZ contingent valuation study to meet the "reference operating conditions" (ROCs) proposed by Cummings, Brookshire, and Schulze (1986) at a 1984

⁵⁹ In a later section of the critique, the Tasman Institute raises one other survey issue (p. 12): how protest responses were handled. The critique asserts that such responses, which were encouraged by the willingness-to-pay question, were dropped from the analysis and as a result the estimates are biased upward. In point of fact, the opposite happened; the protest responses were treated as real "no's" and as a result the estimates are biased downward.

conference sponsored by the U.S. Environmental Protection Agency as an indication that the results of that study are unlikely to be accurate to within 50 percent of their true values. I will provide some discussion of the Cummings, Brookshire, and Schulze reference operating conditions. In doing so, it will be useful to reproduce them directly as stated by the Tasman Institute:

1. Respondents must understand and be familiar with the good to be valued;
2. Respondents must have had prior valuation and choice experience with respect to consumption levels of the commodity;
3. There must be little uncertainty;
4. Willingness-to-pay, not willingness-to-accept, measures are elicited.

Three things should be noted about these ROCs. First, with the exception of condition 4, they have never been accepted *as a group* by most CV researchers as having any significant theoretical foundation or empirical backing. This debate is clearly reflected in the conference volume, where a large number of alternative ROCs were proposed and the 50 percent figure declaimed as simply new speculation.⁶⁰ Second, again as evidenced by the discussion in the conference volume, there is little agreement among leading CV researchers as to what meeting these ROCs means in an operational sense. Cummings, Brookshire, and Schulze correctly point out (p. 108) that meeting any of these ROCs is a matter of degree and not an absolute. Third, Cummings, Brookshire, and Schulze never said that failure to meet these ROCs implied that a study's results were likely to be wrong by more than 50 percent; they simply contended that it was much harder to design a valid CV study in situations where the ROCs could not be met and that there was much less evidence on comparisons between CV estimates and estimates from other methods in such cases.

In spite of my negative remarks on the usefulness of the Cummings, Brookshire, and Schulze ROCs, it may still be interesting to look at how well the RAC survey instrument meets them. Condition 4 is clearly met by virtue of using a willingness-to-pay framework. The survey instrument largely meets condition 3, because respondents are being sold a move from an

⁶⁰ One of the originators of these ROCs, Bill Schulze, has recently stated (forthcoming) that they were intended more to guide future research and, particularly, experimental research. He has argued that ROCs (1) and (2) should be combined into a generalized concern over context and value formation, which provides a conceptual basis both for evaluating the accuracy of the contingent valuation method and for many details of survey design. He further argues that ROCs (3) and (4) are related more to potential difficulties with subjective expected utility theory than to problems with the contingent valuation method itself.

uncertain condition (mining risks to the KCZ) to a certain condition (the preservation of the KCZ and the removal of any possible risk to Kakadu National Park created by the mine). The survey avoids the detailed comparisons of changes in probabilities that are difficult for respondents to understand and assess, instead portraying the risk in nontechnical terms and using two descriptions of the risk to assess the sensitivity of the willingness-to-pay responses to the manner in which the risk is portrayed. Another source of uncertainty that sometimes influences contingent valuation responses is the likelihood that the government can actually provide the good being sold in the contingent valuation survey.⁶¹ Respondents tend to discount their willingness to pay by the perceived likelihood that the good will be paid for but not delivered.

With respect to condition 2, one of the major shifts in contingent valuation at about the time of the 1984 EPA conference was the increasing use of a referendum voting context. In part, this can be seen as an attempt to take the respondent away from an abstract-choice situation and place the respondent in a situation where it was easy to visualize how the actual choice might be operationalized. This also allowed contingent valuation researchers to draw on a large literature concerning polling for elections as a method of validation. With respect to the KCZ, there are only two levels of the commodity to be considered, mining the KCZ or adding it to Kakadu National Park. This is a straightforward choice and causes none of the concerns that valuing a number of gradations in air quality in an unfamiliar location does.

The implication of condition 1 is that one does not need a substantial survey description of the good if respondents are very familiar with the good being sold, and that one needs a very comprehensive survey scenario if respondents are not very familiar with good being sold. The RAC KCZ survey description is quite elaborate, complete with maps and an extensive photo set. Kakadu, itself, has very high public recognition. Thus, condition 1 is also largely met. The RAC has been reasonably successful in meeting each of these ROCs.

§ 23.14 Minor Points

Minor points taken up by the critiques include possible interviewer bias, distortions in the survey instrument, net versus gross benefits, use of CV outside the United States, sources of income, lack of association of income with WTP, negative correlation between age and WTP, and negative correlation between visiting Kakadu and WTP.

⁶¹ It should be noted that the Tasman Institute objects to the RAC's attempt to discuss the risk in lay as opposed to expert terms, arguing that seeing the actual risk estimates of the Coronation Hill's consultant would result in a less pessimistic impression of the risk.

Possible Interviewer Bias

Brunton and Stone contend that there are problems with the impartiality of the interviewing based on experiences reported during the pretesting of the survey. In my experience, finding interviewers who care significantly about a policy issue is not unusual. The overreaction of the critiques on this point betrays a lack of experience with overseeing the administration of in-person surveys. The likelihood that this will be an operational problem is best identified in pretests exactly as the RAC and McNair did. In most instances, interviewer training can eliminate the problem when dealing with professional interviewers and a final survey instrument. In extreme cases, an interviewer must be removed. Screening out interviewers with a strong view on the topic of interest is much more important at the early stages of development because, at that point, the researcher is relying on interviewer feedback to help modify the survey instrument. Perhaps a bit more discussion of the procedures used by McNair for the main study will eliminate this line of speculation by the critics.

Distortions in Survey Instrument

Stone contends that the survey instrument is distorted because the KCZ is clapped-out buffalo country. One can only point out that respondents were told that there had been damage from buffalo (p. 107) and were shown a photograph of a buffalo and damage to the surrounding countryside. To some degree, Stone's premise is incorrect: most of the buffalos have been removed from Kakadu, and the landscape is recovering from the buffalo damage. The Tasman Institute contends that the land is marginal. It is hard to know what this requires in terms of designing a contingent valuation questionnaire, beyond showing respondents pictures of the area including buffalo and previous mining damage.

The Tasman Institute objects to the use of one photo, saying that it gives the impression of a more visible development than one would see from the ground. This photo is an intentional duplicate of another that shows the same area without the artist's impression of the mine. It would be hard to show the entire mine in a single photo, or even several photos, from a close-up ground perspective. My impression of the photograph in question is that it does a pretty good job of showing how various aspects of the mine will be concealed in valleys and below hills.

Stone raises a predictable objection to the display of "the most fetching photos of those rare or endangered species" while the Tasman Institute objects to the display of "fluffy little animals." It is useful to look at what was actually read to respondents and displayed to them. Respondents were told that "the zone is one of several homes in a wider region to a number of bird, mammal, reptile and frog species which are considered to be rare or endangered." The minor scenario goes on to tell respondents that "the mine

owners will take extensive precautions to protect wildlife in the area.”⁶² Respondents are shown a set of animal pictures on a single hand-card. They are displayed in a neutral context, much as one might see in a biology book. Further, the animals displayed are a bat, a gecko, a monitor, a dunnart, a mouse, and a pigeon. None of these animals is thought to occupy a high place on the public’s list of favorite animals, and it would have been legitimate to display some much more recognizable and likable animals in the course of the survey.

Net Versus Gross Benefits

The Tasman Institute (p. 13) correctly notes that many of the reasons given for voting “no” sound as if a net benefit calculation was being made. This critique also goes on to correctly note that this will result in a downward bias in the estimates. This is a somewhat astonishing sleight of hand, though, because this critic then turns the discussion on its head by saying that “the questionnaire whilst endeavoring to be as neutral as possible, causes the respondents to exaggerate their values for preservation because only the negative effects of mining are detailed.”⁶³ In striving for neutrality, the questionnaire leads to upward bias of the preservation value of the Coronation Hill site.” This is true, but it is an upward bias of the willingness to pay for net benefits, not an upward bias to willingness to pay for gross benefits. By treating the estimates as estimates of gross benefits and not net benefits, then, the RAC is using estimates for the KCZ which have a downward bias.

The valuation function estimated in § 23.16 strongly suggests that respondents did provide net rather than gross benefit estimates. Several of the variables that are quite significant in predicting the willingness-to-pay responses should not be significant unless respondents made a net rather than gross benefit calculation. Among these are Q11, an indicator of how important the respondent feels jobs are in making natural resource decisions, and Q16, a variable that measures how important financial benefits are in making natural resource decisions.

Use of CV Outside the United States

The Tasman Institute critique contends that contingent valuation is used little outside of the United States. This statement is not true. Contingent

⁶² The major impact scenario is much more pessimistic, informing respondents that some animals are likely to be killed on the site, that the local habitat will be extensively disturbed, and that there are possible severe consequences for all of Kakadu.

⁶³ Even this statement is not completely true. The questionnaire states that there will be 150 mine workers housed near the mine and names high-valued export minerals—gold, platinum, and palladium—as the products of the mine.

valuation studies are being used fairly extensively in Great Britain, Norway, and Sweden, by the World Bank in developing countries, and, to a lesser degree, in Canada, Finland, France, Israel, Italy, and the Netherlands.⁶⁴

Stone and Brunton also raise the issue that contingent valuation surveys have only been used and are only useful for local public goods in local areas. In the United States, there have been numerous studies of national environmental goods ranging from valuations of the benefits of the Clean Water Act to visibility in all national parks. There have been benefit estimates made using contingent valuation at the state level and for large metropolitan areas. It is perhaps interesting to note that the least use of contingent valuation has been made in small towns, although there has been some work on mosquito control and reduction of trihalomethane and radon levels.⁶⁵ More recently, there are projects underway on valuing gypsy moth control and waste disposal facilities. Many of the local area contingent valuation studies undertaken have been for national and state agencies, such as the U.S. Forest Service, the U.S. Army Corps of Engineers, and the Alaska Department of Fish and Game, to determine what sort of facilities should be built to accommodate recreational visitors and to make allocations between commercial and recreational uses.

Sources of Income

Stone raises the issue of how students, the retired, and the unemployed can pay. Most students who would have been included in the sample have their own sources of income—in most instances, from a full- or part-time job. In other instances, there would be scholarship or fellowship stipends or money from parents. Students are not a class of individuals with large incomes, but they are actively courted by marketers. Retired individuals usually have pension income from one or more sources and often have substantial investment income. The unemployed can be divided into three classes: those who are seasonally unemployed, those who are temporarily unemployed,

⁶⁴ It is interesting that the British uses of contingent valuation have not been the focus of much attention in the mainstream environmental economics literature. In part, this has been because it has been in nonenvironmental areas such as the well-received work on transportation safety by Jones-Lee, Hammerton, and Phillips (1985) or because it is fairly recent in nature, such as the work on the value of waiting time on National Health Service lists by Proper (1990), the extensive work on wildlife and forests by J.F. Benson and K.G. Willis of the Department of Town and Country Planning, University of Newcastle-on-Tyne, and the work on the benefits of flood control and river quality by Colin Green and S.M. Tunstall of the Flood Hazard Center at Middlesex Polytechnic. Much of this work has been sponsored, paid for, and used by government agencies.

⁶⁵ Perhaps the lower transactions cost of local officials determining local preferences makes it more likely that decision makers will turn to contingent valuation and other methods of determining public preferences when the size of the public of interest is large.

and those who are chronically unemployed. The first two classes pose no real problems. The third class may receive some money from the government, charities, or family. In general, students and the unemployed report low incomes and are predicted to have a low willingness to pay for KCZ.

The retired are another story. In the United States, the retired are the wealthiest age group. For this group, "wealth" is usually poorly measured by traditional income questions, and it is the experience of the U.S. Census Bureau that much more extensive efforts must be undertaken if a primary goal is to measure the financial resources actually available to a retired individual. The same situation applies to those with home duties. Many of these are individuals from high-income households.⁶⁶

Brunton and the Tasman Institute raise a related issue: Is willingness to pay being reported on an individual or household basis? The WTP questions ask for an individual response, income is asked on an individual basis, and the Australian tax system is on an individual basis.⁶⁷ This means that if one had to choose whether to treat the WTP responses as individual or household, one should usually treat them as individual. Undoubtedly, though, some individuals gave a household response. This is particularly likely for those with home duties or those who are retired. In calculating a lower bound on the benefits from preserving the KCZ, I would advise treating the WTP responses as household responses. This calculation should be prominently featured in a revised report. Future research effort should be devoted by the RAC and others in Australia to whether Australians tend to see willingness-to-pay questions similar to those used in this RAC study as being individual-specific or pertaining to the household.

WTP Not Associated with Income

Brunton (p. 7) is correctly concerned about the lack of a statistically significant association between willingness to pay and income. The failure of the RAC to find this relationship to be statistically significant stems from two problems. The first is that wealth is badly measured by the individual income variable for some respondents in the survey. The second is that the estimation of the income coefficient from contingent valuation (and other) surveys is known to be sensitive to a small percentage of misreported income values which appear as outliers. When one drops from the sample those observations for which the income variable is likely to be a bad measure of the wealth available to the respondent (one who is retired or has

⁶⁶ It was necessary to drop 106 individuals (approximately 5 percent of the sample) who were retired or who had home duties, reported low incomes, and agreed to pay relatively high amounts in order to get a meaningful estimate of the income coefficient.

⁶⁷ In contrast, most households in the United States with multiple income earners file a "joint" tax return.

home duties) and a few outliers, then income is positively and significantly related to willingness to pay in a multivariate Weibull regression equation (see § 23.16).⁶⁸

Negative Correlation with Age

Stone cites the negative correlation with age reported by the RAC as evidence against the validity of the KCZ willingness-to-pay estimates. This is a very strange argument for a critic to make. A vast body of work on environmental public opinion and on valuation of nonmarketed environmental commodities using a variety of techniques shows a consistent negative relationship between age and preferences for environmental amenities. Although a significant negative correlation is typical and expected, one sometimes sees a statistically insignificant relationship, particularly in small samples. However, a significant positive relationship would be truly unexpected and would likely be disturbing, given the experience with other environmental amenities.

Negative Correlation with Visits to Kakadu

The significant negative correlation between having visited Kakadu and willingness to pay reported in the RAC report is noted by the critiques as evidence against the validity of the CV results. In a multivariate analysis, one finds no significant relationship between having visited Kakadu and willingness to pay, after controlling for other variables.⁶⁹ The likelihood ratio test statistic for adding the visit-Kakadu variable is 1.254 (p-value .2628) for the national sample and 0.158 (p-value .6910) for the combined NT and national samples. The implication is that those who have visited Kakadu are more likely to have prodevelopment attitudes than those who have not. I would recommend looking more closely at variable Q7 (desire for a future visit) than at past visits. My data for the Grand Canyon, for instance, show a significant positive correlation between WTP and a Q7-like variable but not a significant relation between WTP and past visits. The Grand Canyon is a place many people visit only once, and I suspect that Kakadu may be similar.

⁶⁸ This small number of outliers typically had implausible (high or low) incomes, given age and occupation. Their inclusion or deletion has little impact on estimated median willingness to pay but made it impossible to accurately estimate the effect of income on willingness to pay.

⁶⁹ It should also be noted here that several other variables that have significant bivariate relationships with willingness to pay do not hold up in a multivariate framework. Among these are Q13 (important to preserve places for native wildlife and plants) and sex.

§ 23.15 Concluding Remarks

I provide three sets of concluding remarks. The first is a recommendation to look at a very conservative estimate of the willingness to pay to add the KCZ to Kakadu National Park rather than mine it. The second concerns how one might actually test the validity of the contingent valuation estimate with respect to this policy decision. The third suggests some topics for future research, if the RAC intends to use contingent valuation in future inquiries.

A Conservative Calculation

I would recommend looking at willingness to pay for the KCZ under a very conservative set of assumptions. Specifically, I would use the following set of assumptions: that the median WTP is used rather than the mean WTP as the measure of benefits; that the minor as opposed to the major impact scenario is used as the indicator of actual risk; that the WTP response is treated as from the household rather than the individual; that the survey response reflects a one-time lump-sum willingness to pay rather than an annual willingness to pay; that all respondents gave gross rather than net willingness to pay; and that "don't know" and protest responses are really "no." Further, assume that willingness to pay rather than willingness to accept compensation is the correct property rights perspective for the public on this issue. This yields the \$286 million figure provided in an appendix to the RAC draft report (p. 182) as the estimate of the total benefits of adding the KCZ to Kakadu National Park.

Adopting this set of conservative assumptions obviates the few reasonable objections advanced in the three critiques and produces an estimate of \$286 million, which is easy to defend on its merits and yet leaves the clear impression that it is a lower bound estimate and that actual benefits are substantially greater.⁷⁰

A Test of the CV Results

Brunton and Stone propose putting the RAC contingent valuation study to the test by creating a trust fund to collect money for the KCZ. They may be on the right track. However, they have the wrong validation mechanism. The correct test for the purpose of making this decision is to place the KCZ issue on a national ballot with a tax price of only the size necessary to minimally but adequately compensate the Coronation Hill Joint

⁷⁰ Any uncertainty regarding the benefits of other mines in the KCZ could be compared against the increases in the willingness-to-pay estimates that would occur by relaxing one or more of these assumptions.

Venture Partners (CHJVP). Inform the public about the loss of jobs at the mine, the loss of profits to the company, and the loss of the export earnings. Inform them also of the two versions of the risk to the KCZ. Observe the vote. If a majority votes in favor of paying the tax price, then the results of the RAC contingent valuation survey are consistent with the correct course of action. If not, it has failed and is an invalid indicator of the public's preferences.

Why is an actual referendum preferable to the trust fund idea? First, large transactions are associated with trust funds and charities of any kind. Anyone who has been in this business realizes the high fraction of collected money that goes into collecting it. This is particularly true in the absence of any very large donors. Second, extensive focus group work by researchers in the United States has shown that people are skeptical of trust funds—how they are managed, and whether the money will really be used for the purposes solicited. Furthermore, strategic behavior will be rife: some individuals will not contribute because they want a free ride, others will not contribute because they don't want to be suckers for the free riders. A direct vote on a specific issue eliminates this problem.⁷¹ Third, there are always doubts about whether the "good" in question can be delivered by the group promising to deliver it. This is a particularly troubling problem for conservation organizations like the ACF, which Brunton suggests as trustee. The public has seen such organizations promise to influence the government to stop development and to provide environmental amenities. But, there is little in the way of providing new environmental amenities, at least in the United States, that can be directly attributed to these groups.⁷²

A second issue arises from the suggestion of testing the study by creating a trust fund: the amount to be collected. The correct amount, whether accumulated by trust or referendum, is not the \$286 million but instead, of necessity, a lesser amount—the amount required to adequately compensate the CHJVP. Although a referendum for \$286 million would pose an appropriate test of the CV study, the fact that the public is willing to pay \$286 million does not mean that it is practical or appropriate to solicit that amount for a good that may be purchased for substantially less. A trustee is violating a fiduciary duty if it behaves in this fashion; a government violates its moral mandate to provide public goods at minimum public costs. Furthermore, revelations during the referendum about the actual cost to government might suggest a swindle.

For these reasons, the choice is limited to a referendum authorizing a fair (private) market price for the CHJVP. This does not test the actual

⁷¹ Although it does not eliminate more general negative views about how effectively the government spends money.

⁷² No doubt they help crystallize public opinion on environmental issues and make it more or less comfortable for politicians to take positions. Under U.S. environmental statutes, conservation groups have much more ability to stop projects through the court system.

maximum dollar amount a majority say they are willing to approve, but it certainly will refute that amount if the referendum fails. If the referendum passes, the results of the study can be confirmed at least in part.⁷³

Future Work

If the RAC is going to use contingent valuation in the future, then it needs to address a few key issues through a carefully planned course of research. The first and perhaps easiest is the issue of individual versus household payments. In the United States, the tendency has been to use the household rather than the individual as the unit of analysis. This measure has been used largely because most married couples file joint rather than individual income tax returns and because, at the state and local level, there are fairly high property taxes on houses.

The other issues are more complex. The first is how to treat, in the RAC's analysis of policy choices, the public's property rights to natural resources and environmental amenities. Whether a willingness to pay or willingness to accept compensation perspective is adopted has many implications for how other issues are treated.

The other issues—the determination of the choice set; whether to request a lump-sum payment or require payment at regular intervals; and the determination of the population to be aggregated over—are interrelated, and the relevant decisions made may need to be tailored to specific commodities.⁷⁴ For instance, requirement of a lump-sum payment requires much less consideration of what goods the RAC is likely to want to value next. The smaller the population to be aggregated over, the less concern there is likely to be that the total value is being driven by aggregating very small values over a very large population that is largely indifferent to the good being offered.

The issue of aggregation leads naturally into the final issue that I wish to raise. How should the RAC summarize the public's willingness to pay for the good? A very conservative measure, the median, was used in the KCZ study. In contrast, the traditional benefit-cost measure is the mean; yet, contingent valuation studies have difficulty measuring mean willingness to pay because of the potential for a very small number of anomalous observations to drive the total value estimate. The issue is how to identify the small percentage of respondents who have not actually answered the questions

⁷³ Because the contingent valuation study provides an estimate of the percentage of the public who would vote for it at any tax price, it would be possible to confirm that estimate.

⁷⁴ It is surprising that none of the three critiques raised the issue of the appropriate population for aggregation. Perhaps it is because Kakadu is one of Australia's best known national parks and as such the entire Australian population is clearly appropriate. The choice will be much less clear in other circumstances, particularly in some of the forest issues facing the RAC.

asked of them in the survey, whether by inability, inattention, or design, and how to deal with these data if an estimate of the mean is desired.⁷⁵

My recent work on valuing large changes in visibility in the Grand Canyon on 20 days during the winter provides a good example of this potential problem. Almost 90 percent of the households indicate that they are willing to pay nothing at all for this visibility change, and 2 percent of the households offer quite large willingness to pay amounts.⁷⁶ On the basis of the median of zero, the cost of providing the visibility (over \$100 million per year) is obviously not justified. Various robust techniques and outlier detection methods all suggest that the best estimate of the mean is somewhere between \$0.00 and \$0.50. Aggregated over roughly 100 million households, the benefits still do not justify the decision to provide the improved winter visibility. However, the raw mean of the sample is \$2.38, which more than justifies the decision. The RAC will have to decide how it will deal with such situations.

The RAC report shows that it has learned a lot about how to do contingent valuation studies in a relatively short period of time. In part, this results from effectively learning about the key problems and pitfalls from prior work done elsewhere. Part of this is also due to the RAC's willingness and ability to devote to the KCZ project the substantial resources necessary to do a contingent valuation study properly; contingent valuation is very dangerous when done on the cheap. In addition, the RAC made a commitment to do quality work, knowing that work on this project would evoke controversy and close scrutiny. Over time, critics will become more sophisticated, focusing on real issues instead of the sort of wide-scatter attacks in the Brunton, Stone, and Tasman Institute papers. When this happens, the quality of the RAC studies and decisions made using those studies will benefit.

§ 23.16 Technical Note on Valuation Functions

A valuation function predicts a respondent's willingness to pay as a function of tastes (T) for the good, as represented by attitude variables, demographic variables such as age, financial resource (Y) variables such as income, and

⁷⁵ Contingent valuation questions are by no means unique in their elicitation of a small amount of "bad" data. There are a number of statistical techniques for identifying the "bad" data or for taking a "robust" approach to calculating the mean by first trimming off a small percentage, *e.g.*, 5 percent or 10 percent, of the observations with the largest and smallest values and then calculating the mean on the remaining data.

⁷⁶ This study, Carson (1991), provides good evidence against the occasional remark that contingent valuation studies always elicit large values, particularly for changes to very symbolic environmental amenities.

treatment variables such as the characteristics (C) of the particular good being sold:

$$WTP = f(T, Y, C).$$

The estimation of a valuation function serves many purposes. It will allow us to determine whether the willingness-to-pay responses are systematically related to variables that, theory suggests, should be predictors. In particular, we will see whether the apparent bimodal nature of the raw data is explained by differences in possible covariates. Another object of this exercise will be to compare, formally in a statistical sense, valuation functions estimated from the Australian sample and the combined Australian and Northern Territory samples.

This section describes a multivariate regression approach to estimating such valuation functions using KCZ contingent valuation data collected by the RAC. It is substantially abbreviated from the description in the longer version of this chapter.⁷⁷

Results

My preferred valuation function for both the Australian sample and the combined samples is displayed in Table 23-1. The most striking feature of this table is the large number of statistically significant variables (see Table 23-2). MAJOR is significant and of the right sign. INCOMET and AGE are significant and of the expected sign. Of the Q10 to Q18 series, only two variables, Q13, which attempts to get at pure existence motivations, and Q14 (future generations and natural resources), which attempts to get a current versus future use of the resource, can be rejected from the model in the table using a likelihood ratio test. ENVCONSM is of the expected sign and significant, and VISPARKS is of the expected sign, significant in the combined sample, and close to significant in the Australian sample. VKAKADU is not significant and can be rejected as belonging in the valuation function using likelihood ratio tests as can be ENVTV and CONMEM.

This valuation function is capable of explaining the apparent bimodality in the data. Take an individual from the Australian sample and minor impact scenario with a set of covariate values that should indicate a low willingness to pay for KCZ (Q10 = 2, Q11 = 4, Q12 = 4, Q15 = 2, Q16 = 4, Q17 = 2, Q18 = 2, ENVCONSM = 0, VISPARKS = 0, AGE = 60, and

⁷⁷ The longer version provides details on the data-cleaning effort. Most of the observations dropped from the estimation are those for whom available wealth was poorly measured by the income question in the survey. These respondents tend to be retirees or housewives. The longer version also provides an exposition on the statistical framework used and why particular variables should appear in the model estimated.

Table 23-1

Weibull Estimation on Revised Australian and Combined Samples*
Determinants of Willingness to Pay for KCZ

Variable	Parameters	T-Statistics	P-Values	Means
Scale	(2.190; 2.168)	(32.36; 27.79)	(.000; .000)	—
Location	(4.793; 5.054)	(8.93; 8.46)	(.000; .000)	—
Q10	(0.201; 0.140)	(3.18; 1.95)	(.001; .051)	(3.641; 3.689)
Q11	(-0.433; -0.426)	(-6.97; -6.22)	(.000; .000)	(2.616; 2.592)
Q12	(-0.599; -0.576)	(-9.18; -8.14)	(.000; .000)	(2.877; 2.790)
Q15	(0.241; 0.138)	(4.18; 2.12)	(.000; .034)	(3.467; 3.570)
Q16	(-0.612; -0.568)	(-9.12; -7.65)	(.000; .000)	(2.921; 2.915)
Q17	(0.718; 0.708)	(12.09; 10.59)	(.000; .000)	(3.502; 3.643)
Q18	(0.240; 0.279)	(4.06; 4.19)	(.000; .000)	(3.851; 3.864)
ENVCONSM	(0.401; 0.464)	(2.74; 2.86)	(.006; .004)	(0.512; 0.545)
VISPARKS	(0.333; 0.250)	(2.04; 1.46)	(.041; .144)	(0.746; 0.723)
AGE	(-0.022; -0.024)	(-5.05; -4.93)	(.000; .000)	(41.917; 42.968)
INCOMET	(0.012; 0.013)	(2.68; 2.49)	(.007; .013)	(22.046; 21.514)
MAJOR	(0.373; 0.402)	(2.44; 2.54)	(.015; .011)	(0.500; 0.502)
NTMAJOR	(-1.059; —)	(-4.26; —)	(.000; —)	(0.104; —)

* Weibull distribution assumed. N is 2,296 for combined sample and 1,827 for Australian sample. Log likelihood for this model and the combined sample is -1,884.823 and the log likelihood for the model with no covariates is -2,568.494. Log likelihood for this model and the Australian sample is -1,527.865 and the log likelihood for the model with no covariates is -2,020.955.

INCOMET = 20). Using the valuation function, we can calculate the estimated willingness to pay of the individual, which is \$0.52. Now take an individual from the Australian sample, also from the minor impact scenario, with a set of covariate values that should indicate a high willingness to pay for the KCZ (Q10 = 4, Q11 = 2, Q12 = 2, Q15 = 4, Q16 = 2, Q17 = 4, Q18 = 4, ENVCONSM = 0, VISPARKS = 1, AGE = 40, INCOMET = 30). Using the valuation function, we can calculate the estimated willingness to pay of the individual, which is \$349.05. This is an instance where the regression model is capable of moving the willingness-to-pay estimates around quite a bit with changes in the values of the covariates. The bimodality of the data is easily explained with reference to the valuation function

Table 23-2

Variable Definitions

Q10 is a measure of how much the respondent agrees that the greatest value of national parks and nature preserves is in recreational activities such as bushwalking, camping, or just taking photographs. Higher values indicate greater agreement.

Q11 is a measure of how important the respondent feels jobs are in making natural resource (forest and mineral) decisions. Higher values indicate jobs an important factor.

Q12 is a measure of acceptance of low-risk development activities from mining. Higher values indicate greater acceptance of low risk.

Q13 is a measure of how much someone agrees that native wildlife and plants should be preserved even if never seen by the respondent. Higher values indicate stronger agreement with statement.

Q14 is a measure that indicates that the needs of future generations are important in deciding how to use Australia's natural resources. Higher values indicate greater agreement.

Q15 is a measure of how much the importance of Kakadu to aboriginal people should be taken into account as a factor in making decisions concerning Kakadu. Higher values indicate that this factor should be taken into account.

Q16 is a measure of the importance of financial benefits in making natural resource decisions. Higher values indicate greater importance of this factor.

Q17 is a measure of how strongly the respondent feels that mining within national parks reduces the value of the parks. Higher values indicate mining reduces value of parks.

Q18 is a measure of how strongly the respondent feels more national parks should be created from state forests. Higher values indicates respondent favors more parks.

ENVCONSM is a measure of being an environmentally minded consumer. It equals 1 if both Q21 and Q22 equal 1 (recycles and buys environmentally friendly products) and 0 otherwise.

ENVTV is an indicator variable that equals 1 if the respondent watches environmental TV frequently and 0 otherwise (Q23).

CONMEM is an indicator variable that equals 1 if the respondent is a member of a conservation group and 0 otherwise (Q24).

VISPARKS is an indicator of whether respondent has visited a national park or bushland recreation area in last 12 months. It is taken from Q4 and equals 1 if have visited and 0 otherwise.

VKAKADU is an indicator that the respondent has visited Kakadu National Park. It takes on a value of 1 if Q5c equals 1 and 0 otherwise.

AGE is the respondent's age.

INCOMET is the respondent's reported yearly income in thousands of dollars.*

SEX is an indicator of the respondent's sex (male = 1).

MAJOR is an indicator of whether respondent received the major-impact-to-Kakadu version of the questionnaire (MAJOR = 1) or the minor-risk version of the questionnaire (MAJOR = 0).

NTSTATE is an indicator of whether the respondent lives in the Northern Territory. The indicator variable takes on a value of 1 if true and 0 otherwise. Note that most but not all of the respondents for whom this indicator is true are from the NT sample.

NTMAJOR is an indicator variable that is the product of MAJOR*NTSTATE.

*Missing values for INCOMET were imputed by using the mean value of observed Q28 responses by employment classification Q29a. A very small number of missing values for the Q10 to Q18 series were also imputed.

estimated here and the large differences in the covariate values for different respondents.

Three variables, Q12, Q16, and Q17, are primarily responsible for the very large differences in willingness to pay between respondents. That is because they have large coefficients, in an absolute value sense, and have more spread-out distributions, indicating greater polarization than the other attitude variables. The largest effect is from Q17, which indicates the degree to which the respondent agrees with a statement saying that parks are greatly devalued by development activities such as mining within their borders. One can get a shift of over \$100 by changing the value of Q17 from 1 to 5. This result should help provide some interpretation of what people are buying in the RAC survey: the integrity of one of its major national parks. Variable Q16 indicates a belief that the most important aspect of natural resources like mineral deposits is the financial benefit for Australia. Respondents who strongly agreed with this statement are unlikely to be willing to pay very much to add the KCZ to Kakadu National Park. In conjunction with the coefficient on Q11 (importance of jobs), one can conclude net rather than gross benefits were considered when answering the willingness-to-pay questions, at least by a large number of respondents. Variable Q12 is a measure of the respondent's position toward projects with a very low risk of environmental damages. Respondents who think very low-risk mining development projects should proceed are willing to pay substantially less to add the KCZ to Kakadu National Park than those who don't think that very low-risk mining projects should proceed.

Next, I turn to a comparison between the Australian sample and the combined Northern Territory and Australian sample. The most interesting thing to note is how close the parameters in the two regression models are. In most instances, the differences are so small as to be trivial, occurring in the second or third decimal place. The largest difference in coefficient values on the variables is for Q15 (aboriginal variable); here, the combined sample has a somewhat larger coefficient. The other major differences on the variables are for Q10 (park recreation) and VISPARKS, where the combined sample reacts also somewhat more positively in terms of their willingness-to-pay responses for these two covariates. The increase in these parameters is largely compensated by a small decrease in the location parameter. All in all, these coefficients are very close for adding over 25 percent more observations from a sample that appears to have a much lower willingness to pay. This, in conjunction with finding that an NTSTATE variable, which could proportionately lower all of the willingness-to-pay estimates of the Northern Territory respondents, is not needed in the equation once an NTMAJOR interaction term is used, makes me comfortable concluding that those interviewed in the Northern Territory responded in the same basic manner as the rest of the Australian sample for the minor impact scenario, once differences in their answers to attitude and demographic variables are taken into account.

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