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Analysis of "Don't Know" Responses to Referendum Contingent Valuation Questions

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This paper considers the treatment of "don't know" (DK) responses to referendum contingent valuation questions. The determinants of DK responses are empirically analyzed using a data set from a survey of old growth forest valuation. It is found that DK respondents possess unique characteristics that differentiate them from Yes and No respondents. These findings do not support the most common treatments of DK responses that are currently used. Responses to an open-ended question included in the survey are used to provide further insight into the preferences of DK respondents.

The referendum contingent valuation (CV) approach has become a popular but controversial method of eliciting willingness to pay (WTP). This form of discrete choice CV "describes a choice mechanism that asks each respondent how they would vote if faced with a particular program and the prospect of paying for the program through some means, such as higher taxes" (Carson et al. 1995, p. 2). Researchers claim that the referendum format has a number of advantages over other types of nonmarket benefit estimation techniques. First, the referendum format places the respondent in a familiar social context since it resembles the way that people often make actual choices regarding public programs (Carson et al. 1995). Second, the decision problem is considered less taxing than is requiring a respondent to provide a dollar value representing his/her WTP (Ready, Whitehead, and Blomquist 1995). Finally, some researchers also claim that the referendum format is not susceptible to some of the biases associated with other contingent valuation methods, such as starting point bias.

The most commonly cited advantage of the referendum context is that it is incentive compatible. In the words of Freeman (1993), "if respondents believe that any resource allocation decisions made on the basis of the survey results will be based on a plurality voting rule then the referendum question format is incentive compatible" (p. 174). Therefore, it has been suggested that there is no reason to expect strategic behavior in properly framed referendum questions (Mitchell and Carson 1989).

However, the use of the referendum format and analysis of the responses has been complicated by the recent U.S. NOAA Panel on contingent valuation recommendation that referendum format surveys include a "don't know/not sure/would not vote" (DK) option (Carson et al. 1995). Wang (1997) notes that the rationale for the recommendation

> stemmed from the recognition that a sizable portion of respondents took the "don't know/not sure/would not vote" (DK) option when it was offered as an answer to typical attitude questions in surveys. In contingent valuation surveys without the DK option, there might be a comparable percentage of respondents who give yes/no responses but whose answers do not reflect meaningful preferences on the issues of concern. (p. 219)

Carson et al. (1995) suggest that the panel's decision was also motivated by a desire to promote referendum formats that "mimic the practice of voting in which people can decide not to participate" (p. 3).

The inclusion of the DK option has led to uncertainty in the profession about how to most appropriately treat these responses in empirical analysis and welfare estimation. Several studies have investigated this issue from both theoretical and empirical perspectives. Research in this area

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has resulted in a number of different suggestions for the treatment of DK responses.

In this paper, we perform an empirical analysis of the determinants of "don't know" responses in a survey of old growth forest valuation. We show that the characteristics of this data set do not support one of the most popular treatments of "don't know" responses currently used, that of treating DK as No responses. We also examine DK respondents and their responses to an open-ended question that followed the discrete choice question. This analysis provides further information on the treatment of "don't know" responses.

Reasons for DK Responses

Wang (1997, p. 221) gives a number of reasons why individuals may give a DK response, including:

1. rough indifference between a Yes and a No vote
2. inability to make a decision at that moment, perhaps because of a feeling of being inadequately informed regarding the proposed change
3. preference for some other mechanism for making the decision (i.e., scenario rejection)
4. boredom and survey fatigue causing a desire to end the survey as quickly as possible

For these reasons, some individuals may answer DK because they are genuinely indifferent or unable to make a decision, have made no effort to examine their preferences, or are aware of their preference but give a DK response for some other reason (Wang 1997; Carson et al. 1995).

In light of recent empirical support for the occurrence of "yea-saying" in discrete choice contingent valuation, it is also possible that including a "don't know" option may decrease the number of Yes responses.[1] Yea-saying occurs when individuals are compelled to answer Yes to the referendum question not because they are willing to pay the amount specified but because they do not want to say No. Individuals may avoid saying No because they do not want to displease the interviewer or do not want to feel guilty about not supporting the proposed change (Krosnick 1991). If a DK option is provided, these individuals may answer DK instead since they still avoid the psychological repercussions of answering No.

Estimation and Welfare Analysis when DK Option Offered

Given all these possible reasons for choosing the DK option, it is not obvious how these responses should be treated. According to Wang (1997), "one practice is to drop the DK responses from the data set based on an assumption that the socioeconomic and other personal characteristics of DK respondents are the same as the rest of the sample" (p. 220). Another strategy has been to treat DK responses as No. This method, which is supported by the results of a number of recent empirical studies (including Carson et al. 1995), will lead to conservative welfare measures. Other, more complex treatments of DK responses have also been suggested. For example, Wang (1997) outlines a maximum likelihood procedure that allows the direct use of DK responses in the estimation of WTP. However, this procedure assumes that DK respondents are truly uncertain of their preferences at the time of the interview and does not attempt to address the possibility of strategic bias or scenario rejection.

As mentioned above, a recent study by Carson et al. (1995) supports the recoding of DK responses to No. Carson et al. compare the WTP functions for oil spill prevention generated by data collected using two different survey versions. The two versions are identical except that only one included a "would not vote" option. Carson et al. recode "not sure" and "would not vote" responses as "against" (No) and find that the distribution of respondent votes and the median WTP are not significantly different between survey versions.[2] Carson et al. also estimate a multinomial logit model of "for," "against," and "would not vote" responses. Based on their analysis, Carson et al. (1995) suggest that "would not vote" respondents would most likely vote No if the "would not vote" option were not offered and therefore, the recoding of "would not vote" responses would not affect the "construct validity of CV responses" for their survey (p. 13). They also suggest that offering a "would not vote" option is not necessarily required, since respondents selecting this option are likely to respond No when the "would not vote" option is not available.

Our study examines "don't know" (DK) responses from a single survey where the only voting options were Yes, No, and DK. Although analysis of survey results from versions with and without the DK option could not be completed as in the Carson et al. (1995) study, the determinants of voter response were analyzed using a multinomial logit. Our results are somewhat at odds with those of Carson et al. (1995) and do not support the recoding of DK responses to No.

As explained above, there are a number of reasons why an individual might provide a DK response to a referendum CV question. Discarding all DK responses from the sample implicitly as-

sumes that the preferences of DK respondents cannot be determined, and treating all DK responses as Nos suggests that all the DK respondents are actually against the proposed change. Neither of these scenarios will apply in all cases, however; for welfare estimation, DK responses must either be eliminated or recoded. In this paper, we present an alternative procedure that relies on neither of these assumptions. Instead it utilizes each DK respondent's answers to other questions in the survey to infer whether a Yes or No vote would be consistent with the other information elicited about the individual's preferences. This procedure uses responses to an open-ended payment question to recode referendum responses as either Yes or No. As the following analysis will show, this procedure leads to a welfare measure that appears to be more representative of the respondent's preferences.

Discrete Choice Model

Since the referendum format involves the choice of one option from a range of discrete alternatives, it can be analyzed using discrete choice models. The random utility model (RUM) has become the most commonly used approach to model the referendum decision. The RUM postulates that an individual chooses one alternative over other possible alternatives because he or she derives the most utility from that alternative (Freeman 1993).

The probability that an individual chooses a specific alternative can be estimated using a logit model if it assumed that the random error terms are independently and identically distributed with a Type I Extreme value distribution. The probability that an individual selects choice i can be written as:

$$\Pr(i) = \frac{e^{V_i}}{\sum_{j=1}^{n} e^{V_j}},$$

where V represents the utility associated with an alternative, j.

In the case where there are more than two outcomes, as is the case when Yes, No, and DK options are offered in the referendum question and independent variables consist solely of individual specific attributes, the multinomial logit arises (Greene 1990).[3]

For purposes of estimation, Greene (1990) suggests normalizing the multinomial logit by assuming that the β vector for choice zero of $j = 0, \ldots, J$ is equal to zero, which results in:

$$\Pr(i) = \frac{e^{\beta_i X_n}}{1 + \sum_{k=1}^{J} e^{\beta_k X_n}} \; (\forall j \in C).$$

Data Description

The data used for this analysis were collected as part of the "Ecosystems Alberta" survey. The survey describes the current status of old growth forests in Alberta and their importance as habitat for a number of species including the woodland caribou, which are a threatened species. The preservation of old growth forests is identified as a means of enhancing the caribou population. The preservation program would entail certain land use restrictions, including prohibiting hunting and fishing and limiting overnight camping to designated areas only. Details of the tradeoff between preservation of old growth forests and revenues/employment from the area that could be generated from forestry, oil and gas, and tourism were presented to the respondents. Maintenance of the old growth forest ecosystem and compensation for lost industrial activity rights were identified as reasons why the preservation would most likely require an increase in taxes for Alberta residents.

Respondents were asked to identify how they would vote if the provision of the Old Growth Forest Preservation Program was decided by a referendum and if the amount that the program would cost each household was a specified amount per year in increased taxes. The actual amount specified across surveys varied from CDN $5 to $150. The referendum question as it appeared in the survey is presented in the appendix. In addition to the referendum question, individuals were asked a number of questions designed to assess their recreational usage patterns and to extract demographic information.

Another section of the survey asked individuals to indicate how much money their households would be willing to give up every year to pay for the protection program. The options were $0, $5, $10, $15, $25, $50, $100, $300, an item or items worth another amount, and "I don't know." Where applicable, the option included examples of private goods that cost approximately the same as the dollar amount stated. (The actual question as it appears in the survey is also provided in the appendix.)

The individual-specific and demographic variables included income, household size, age, and a number of dichotomous variables, which are described in Table 1.

Table 1. Description of Variables

Variable Name	Description
Gender	1 = male 0 = female
Education	1 = never attended school; 2 = grade school; 3 = some high school; 4 = high school graduate; 5 = trade school or technical school; 6 = some university; 7 = undergraduate university degree; 8 = some graduate study; 9 = postgraduate university degree
Association	1 = belong to a fishing, hunting, natural history, conservation, or environmental association 0 = do not belong to one of the above types of associations
Camping/hiking	1 = have gone camping or hiking in Alberta in the last 12 months; 0 = have not gone camping or hiking in Alberta in the last 12 months
View	1 = enjoy viewing wildlife when traveling through forest regions of Alberta 0 = do not enjoy viewing wildlife when traveling through forest regions of Alberta
License	1 = someone in the household has held a valid fishing or hunting license in the past 12 months 0 = no one in the household has held a valid fishing or hunting license in the past 12 months

Of the 1000 surveys that were mailed to residents of Edmonton, Alberta, 555 were returned at least partially answered (response rate = 55.5%).[4] Of the returned surveys, 4 did not have responses to the referendum, and there were a number of other cases of item nonresponse. The results of the referendum are summarized in Table 2.

Characteristics and Motivations of DK Respondents

In order to gain insight into the motivation for DK responses, the debriefing questions were reviewed. Table 3 summarizes these responses.[5] Most DK respondents seemed to feel that they did not have enough information to answer the question appropriately. This suggests that given the description of the protection program, they were not able to make a decision.

A multinomial model was used to analyze the choice of response for the data set under consideration.[6] The results of the multinomial logit are listed in Table 4. The model was estimated with Yes as the base. Overall, the model regressors are jointly significant based on the chi-squared statistic of the likelihood ratio test. For the DK option, the coefficients on gender, age, and camping/hiking are all significant at the 90% level or higher.

Because of the form of the multinomial logit, the marginal effect of a change in the value of an attribute will not necessarily have the same sign as the attribute's coefficient of chooseing Yes, No, or DK (Greene 1990). For this reason, marginal effects are listed in table 4. Since attempting to identify the characteristics and motivations of individuals who answer "don't know" to the referendum question is the focus of this investigation, we focus on the specific marginal probabilities for DK responses and any relative similarities or differences compared with the marginal effects for Yes and No responses.

A general comparison of the marginal effects for the three choices suggests that different factors affect the probability of answering Yes, No, and DK. Age is a significant determinant only for the probability of being a No respondent; as age increases, the probability of selecting No increases. The probability of being a Yes respondent and the probability of being a No respondent are both significantly affected by association membership and tax level, as expected by economic theory since tax level is a proxy for price. However, neither of these attributes is a significant factor in determining the probability of being a DK respondent. Although the marginal effect of income is a significant determinant of the probability of being a DK respondent (the probability of answering DK decreases with increasing income), surprisingly it is not significant for Yes or No. Gender and camping and hik-

Table 2. Referendum Results

Variable	Number	Percentage
Referendum response		
Yes	262	47.5%
No	192	34.8%
Don't know	97	17.6%

Table 3. Responses to Debriefing Questions

Reason for Responding DK	Number	Percentage
I need more information to make a decision.	55	69.6%
I think this question is morally offensive.	1	1.2%
I think the situation presented is too hypothetical.	12	15.2%
Other	21	26.6%

Table 4. Multinomial Logit Model of Responses to Referendum Contingent Valuation Question

Response	Variable	Coefficient	Standard Error	Marginal Probability
Yes	Constant			**0.3396
	Tax			**–0.0019
	Income			0.0013
	Gender			0.0372
	Age			–0.0023
	Household size			–0.0157
	Education			0.0023
	Association			**0.2627
	Camping/hiking			–0.0383
	License			0.0368
No	Constant	**–1.8030	0.6091	**–0.3731
	Tax	**0.0088	0.0023	**0.0016
	Income	–0.0025	0.0042	0.0001
	Gender	0.0331	0.2063	0.0367
	Age	**0.0153	0.0074	**0.0036
	Household size	0.0292	0.0819	0.0028
	Education	–0.0119	0.0628	–8.032E-06
	Association	**–1.1719	0.4250	**–0.2137
	Campking/hiking	*0.4121	0.2314	**0.1123
	License	–0.1727	0.2228	–0.0328
DK	Constant	*1.3022	0.7837	0.0335
	Tax	–0.0034	0.0030	0.0003
	Income	–0.0080	0.0058	*–0.0013
	Gender	*–0.5340	0.2696	**–0.0740
	Age	*–0.0177	0.0095	–0.0012
	Household size	0.0654	0.1047	0.0129
	Education	–0.0130	0.0806	–0.0023
	Association	0.3537	0.6013	–0.0490
	Camping/hiking	**–0.7587	0.2856	*–0.0740
	License	0.0821	0.2894	–0.0040
Statistics				
% correctly predicted		49.7%		
Chi-squared		47.66		
Adjusted McFadden R^2		0.0122		

NOTES: The degrees of freedom for all chi-squared values is 18.
*Statistically significant at 90%. **Statistically significant at 95%.
Coefficients of the Yes response are normalized and set to zero.

ing activity also significantly affect the probability of being a DK respondent. The probability of being a DK respondent is lower for males and for those individuals who have been camping or hiking in Alberta in the last twelve months.[7] Interestingly, the probability of being a No respondent is higher if the individual has engaged in camping or hiking activity, perhaps because the survey explicitly states that camping and hiking activity may be restricted in some areas as part of the protection program.

Demographic variables appear to be the main determinants of DK response, whereas the decision to answer Yes or No is also dependent on demographic variables, but most significantly on tax level. These results are in contrast to Carson et al.'s findings (1995), which revealed that DK and No responses shared a number of significant coefficients, including the coefficient on tax amount. Carson et al. (1995) tested the restriction that "the coefficients of 'against' and 'would not vote' are equal for each variable" (p. 13) and found that the hypothesis could not be rejected. In this case, such a hypothesis is rejected, and the coefficients on DK and No are found to be significantly different.[8]

On the one hand, treating all DK responses as Nos suggests that all the DK respondents are similar to No respondents and that their preferences are similar to those of No respondents. On the other hand, dropping DK responses from the data set assumes that "the socioeconomic and other personal characteristics of DK respondents are the same as the rest of the sample" (Wang 1997, p. 220). The mean values of the variables included in the multinomial model are listed for each group of respondents in Table 5. This comparison more clearly illustrates that the demographic profile of DK respondents differs from the rest of the sample and, consequently, that removal of these responses from the sample would bias the resulting welfare

estimate. The comparison also illustrates the demographic differences between DK and No respondents; these differences suggest that recoding all DK responses to Nos may not be appropriate.

The fact that the selection of the DK responses is affected by different demographic characteristics suggests that neither of the two most commonly used procedures for welfare analysis when DK responses are included in the sample is valid. Both methods would introduce bias into the welfare measure. In an attempt to determine the magnitude of the bias, welfare measures were estimated using both of the conventional treatments of DK responses. An alternative procedure was also formulated that involved the recoding of DK responses based on individuals' responses to another section of the survey that elicited a WTP for the protection program using a different payment mechanism. This procedure is discussed and compared with the other DK response treatment methods in the following section.

Empirical Analysis of Alternative Treatments of DK Responses

As mentioned in the data description section, after the referendum questions survey respondents were asked to indicate how much their households would be willing to give up each year in exchange for the provision of the old growth forest protection program. Of the 97 individuals who selected DK in response to the referendum question, 3 did not respond to the alternative payment question, and 3 individuals' responses could not be used because of item nonresponse. Of the remaining 91 individuals, 21 also answered DK to this question, and 3 did not indicate specific amounts they would be willing to give up (listed as option 9 on the survey). Therefore, 67 individuals who gave DK responses to the referendum question selected specific amounts that they would be willing to give up.[9]

Of the 67 DK respondents who gave specific answers to the quasi–open-ended payment question, 7 stated that they were willing to give up amounts exceeding the tax level that they were requested to vote on. If these amounts accurately reflect their WTP, it suggests that these individuals should have responded Yes to the referendum question. The other 60 individuals were willing to give up amounts that were below the tax level on which they were asked to vote. Since the intervals included in the options for stating how much the household was willing to give up are quite broad, especially at the higher end, for 5 of the 60 individuals it was not possible to tell if they were being inconsistent.[10] However, if the other 55 individuals' responses regarding their WTP were to be considered consistent, they should have voted No in response to the referendum. Therefore, in total, 62 DK responses were recoded.

A number of reasons might explain why some individuals answered DK to the referendum but specified amounts that they were willing to give up. First, they may simply be answering the survey with little thought, and therefore neither answer reflects their true preferences. Another possibility is that the preamble to the alternative payment question provided the respondents with sufficient information to resolve their preference uncertainties. Given the responses to the debriefing questions, it is also possible that some individuals perceived the alternative payment mechanism to be more realistic than the referendum payment scheme. Polasky, Gainutdinova, and Kervliet (1996) mention that some individuals will respond differently to what they perceive as a hypothetical question compared with one that they perceive as more real. They also note that "there is less incentive for individuals to acquire information in a hypothetical than a real setting. As a result, responses to hypothetical questions may be uninformed or poorly thought through" (p. 106).

As noted above, many more of the DK responses were recoded to No (55) than Yes (7). A DK re-

Table 5. Demographic Differences between Yes, No, and DK Respondents

Variable	Yes Respondents	No Respondents	DK Respondents
Tax	72.73	88.30	82.98
Income (000's)	49.35	48.70	42.54
Gender (proportion of males)	0.50	0.52	0.36
Age	40.11	42.73	39.32
Household size	2.85	2.84	2.93
Association membership	0.12	0.046	0.053
Education level	5.48	5.43	5.29
Camping and hiking activity	0.67	0.70	0.55
Fishing or hunting license	0.37	0.33	0.32

sponse to the referendum question that the alternative payment question suggests should have been a No response may also indicate a reluctance to say No to the referendum question. It is possible that, if the DK option had not been provided, these individuals might have answered Yes and in effect become "yea-sayers," especially in light of Polasky, Gainutdinova, and Kervliet's (1996) suggestion that "respondents who are were initially 'undecided' may be particularly prone to such behavior since they do not have strong views on the issue to anchor their response" (p. 114).[11]

Based on the comparison of responses to alternative payment questions, the referendum DK responses were recoded to Yes or No where individuals' responses to the other WTP question suggested that they should have responded a certain way. Models were also estimated using the two most common treatments of DK responses.[12] The logit models estimated used all the available demographic variables except for View because, as mentioned earlier, it varied very little across the sample.[13] Model 1 does not include any of the DK responses and simply consists of a logit model of the remaining Yes and No responses with the exception of those that had to be excluded because of item nonresponse. Model 2 represents the conservative method whereby the DK responses are included with the No responses, and model 3 represents the recoding procedure outlined above. The median WTP for the representative individual was also computed for each model.[14] The results of the three models are shown in Table 6.[15]

As expected, the welfare measure computed using model 2 is lower than that computed using model 1. The median WTP estimate using model 3 is between these two values. All models are significant[16] and show that tax level and association membership are important determinants of the decision to respond Yes. However, the coefficient on age is significant in models 1 and 3 but not in model 2. Although the percentage correctly predicted is approximately the same for the three models, the adjusted McFadden R^2 and chi-squared statistic suggest that model 3 is superior.

Another important factor to note when compar-

Table 6. Binary Logit Models Estimated with Alternative Treatments of DK Responses

	Model 1: Yes and No Only		Model 2: DK Coded as No		Model 3: DK Coded as Yes or No Based on Open-Ended Responses	
Variable	Coefficient	Mean	Coefficient	Mean	Coefficient	Mean
Constant	**1.8290		0.6795		**1.2999	
	[0.6175]		[0.5345]		[0.5689]	
Tax	**–0.0089	79.18	**–0.0076	79.87	**–0.0097	79.74
	[0.0024]		[0.0021]		[0.0022]	
Income	0.0017	49.08	0.005	47.9	0.0053	48.07
	[0.0042]		[0.0038]		[0.0040]	
Gender	–0.0258	0.5082	0.1489	0.4817	0.0712	0.4908
	[0.2084]		[0.1842]		[0.1922]	
Age	**–0.0156	41.19	–0.0091	40.85	*–0.0122	40.79
	[0.0074]		[0.0066]		[0.0069]	
Household size	–0.0321	2.848	–0.0614	2.864	–0.086	2.869
	[0.0827]		[0.0730]		[0.0773]	
Education	0.0032	5.459	0.0064	5.428	0.0001	5.439
	[0.0650]		[0.0561]		[0.0588]	
Association	**1.1706	0.0894	**1.0449	0.0829	**1.1810	0.0821
	[0.4268]		[0.3565]		[0.3923]	
Camping/hiking	–0.3751	0.6824	–0.1279	0.659	–0.1466	0.6674
	[0.2295]		[0.2003]		[0.2085]	
License	0.1539	0.3506	0.1436	0.3449	0.1495	0.345
	[0.2251]		[0.1980]		[0.2080]	
Observations	425		519		487	
Median WTP	$121.64		$69.39		$89.94	
Statistics						
% correctly predicted	60.7		60.1		60.8	
Chi-squared	28.52		27.61		35.26	
Adjusted McFadden R^2	0.0312		0.0233		0.035	

NOTES: The values in parentheses below the coefficients are standard errors.
The degrees of freedom for all chi-squared values is 9.
*Statistically significant at 90%. **Statistically significant at 95%.

ing the models is that the means of the explanatory variables, although similar, are not identical. This suggests that the characteristics of the DK respondents not included in model 1 are systematically (although perhaps not significantly) different from the Yes and No respondents that are included. Similarly, the mean values for the explanatory variables suggest that a slightly different mix of individuals is included in the various estimations. Considering the differing demographic characteristics of Yes, No, and DK respondents, this is not surprising.[17]

These results suggest that the recoding procedure we employ provides a viable and useful alternative to other methods of dealing with DK responses. It is less conservative than recoding all DK responses as Nos. It also uses more of the sample information than the complete removal of DK responses, and therefore its parameter estimates are more representative of the individuals in the sample. Consequently, if the means of the explanatory variables are used in the calculation of a welfare measure for the representative individual, the estimate will be more representative.

Conclusions

As noted above, the literature offers many different reasons why an individual might provide a DK response to a question designed to elicit WTP in a referendum format. This analysis found that several individual-specific attributes significantly affect the probability of selecting a DK response in this survey, and not all of these attributes are the same as those that are significant determinants of the selection of either the Yes or No option. This suggests that for this data set the estimation of median WTP would be biased if the DK respondents were simply thrown out or recoded as Nos. For these reasons, an alternative recoding using individuals' responses to an alternative payment mechanism for the same program was used to estimate the median WTP. Although it is questionable whether such a procedure introduces additional bias, the procedure appears to be viable in this case. Further study should examine whether such a procedure is appropriate for use on other data sets.

This procedure is relatively simple to use if the survey includes other information regarding the respondents' preferences for the same good. However, if this information is not available, then the DK responses could be analyzed using a multinomial logit model or other type of framework to determine how best to deal with DK responses without introducing undue bias.

The results presented in this paper are also relevant to the design of referendum surveys, since they suggest that including a question or questions that provide preference information using an alternative payment mechanism may be useful. Of course, the inclusion of additional questions must be weighed against the possible increase in the incidence of survey fatigue and other problems. If these issues are kept in mind, the procedure outlined in this paper may represent an alternative to other methods of dealing with DK responses.

There are many other issues related to DK responses in referendum surveys that may be worthy of investigation. More information is needed on the determinants of DK response selection, including the possibility of strategic behavior or preference uncertainty. Identifying the demographic characteristics of these individuals may assist in explaining DK responses. Analysis of responses to debriefing questions may also be useful in assessing the motivation for response selection.

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Notes

1. "Yea-saying" refers to the "the tendency of some respondents to agree with an interviewer's request regardless of their true values" (Holmes and Kramer 1995, pp. 240–41).
2. Carson et al. (1995) treat the voluntary reporting of "not sure" and "would not vote" as equivalent.
3. It should be noted that this model is interpreted slightly differently than a conditional logit model. In this case, the alternative believed to yield the most utility is chosen; however, the probability equations cannot be interpreted as indirect utility function because of the absence of choice specific attributes. Instead, the probability equations simply illustrate the relationship between the individual specific attributes and the probability of choosing a particular alternative or being in a particular mutually exclusive category.
4. As noted by an anonymous referee, the survey results should ideally be adjusted to account for nonresponse, but unfortunately the information required for such an adjustment was not available.
5. Respondents could answer Yes to more than one of these questions.
6. In order to try to determine whether these uncertain and indifferent individuals were systematically different from certain respondents who answered Yes or No, initially a binomial logit model with tax amount, income level, gender, age, household size, education level, association membership, camping and hiking activity, and fishing or hunting license ownership as the explanatory variables was estimated for the two groups. Since there was little variation in the response to the question regarding wildlife viewing, the variable view was not included. The model had low predicative ability and a low measure of fit; therefore, it is not a very reliable tool for examining the differences between certain and uncertain respondents. Carson et al. (1995) estimated a similar model and also found that the model had a limited ability to explain responses. This prompted Carson et al. to estimate a three-outcome multinomial logit model.
7. These results bear some similarity to a comparison conducted by Champ et al. (1995) between individuals who answered a dichotomous choice CV question inconsistently with their revealed WTP. Inconsistent respondents were more likely to be female and had lower education and income levels than those who answered consistently. There may be some similarity between inconsistent respondents and DK respondents.
8. A likelihood ratio test that the coefficients on DK and No are jointly equal results in a chi-square statistic of 45.35 which exceeds the critical chi-square value for 95% confidence and 10 degrees of freedom which is 18.31.
9. One could simply use the quasi–open-ended responses to provide a value for the environmental good; however, as discussed above, this approach does not have the incentive compatibility properties associated with referendum approaches.
10. For example, one individual answered DK to a tax level of $55 but stated that his/her household was willing to give up the equivalent of $50. Since the next level that could have been selected as the amount he/she was willing to give up was $100, it is not possible to know if the individual really was indifferent at $55 or if the true WTP was between $50 and $55 (suggesting that a No response should have been provided to the referendum question) or between $55 and $100 (suggesting that a Yes response should have been provided to the referendum question).
11. The responses of individuals who answered Yes or No to the referendum question were also compared with their responses to the quasi–open-ended WTP question. The results were quite interesting. About 40% of Yes respondents stated that they were willing to give up an amount that was less than the tax level for which they voted. Although the reason for the inconsistency among Yes

respondents is not obvious, there are a number of possibilities. First, responses to the alternative payment mechanism may suffer from some form of bias, such as starting point or anchoring bias (Holmes and Kramer 1995). It is also possible that some individuals have very unstable preferences and they changed their minds after answering the referendum question, especially considering that this was a mail survey and the questions could have been answered over a period of several days to a week. Polasky, Gainutdinova, and Kervliet (1996) note that Magelby (1989) reports a fall in Yes responses and a rise in the proportion of No responses as the election comes closer in about three of every four real referenda. These results support the possibility that an individual's preferences may change over a relatively short period of time. There is also a chance that some respondents incorrectly interpreted the second WTP question and thought that the amount they stated they would be willing to give up was in addition to the tax level for which they voted. Finally, there is a possibility that inconsistency is the result of yea-saying. Perhaps respondents felt compelled to show their support for the protection program despite the fact the tax level exceeded their true WTP.

A binomial logit model of consistent versus inconsistent respondents was estimated. The results show that tax level, age, and education level are significant determinants of the probability of being an inconsistent respondent. As the tax level increases, and age and education level decrease, the probability of being an inconsistent respondent increases. A binomial logit of just inconsistent versus consistent Yes respondents was also estimated and shows similar results except that age is no longer a significant determinant. However, in this case, income level has a significant effect on the probability of being an inconsistent Yes respondent; the probability of being an inconsistent Yes respondent increases with decreasing income. The welfare measure that would result from recoding these Yes responses to Nos was also calculated and found to be $33.25.

12. A linear form of the utility function is used because the fit, significance, and percentage correctly predicted of the models was not improved when the assumption of a diminishing marginal utility of income was imposed.

13. It should be noted that in order to keep as many observations as possible in the analysis, nonresponses to the age, income, and household size questions were replaced with the mean values of these variables. This was also done to try to offset any systematic bias that might be introduced since a higher proportion of these nonresponses was in the No and DK categories. It is hoped that this procedure prevented more bias in the results than it may have introduced.

14. The mean values of the explanatory variables were used in this calculation.

15. For a logit model with a linear utility function, Hanemann (1984) demonstrates that the median WTP for the representative individual, C^*, can be expressed as:

$$C^* = -\alpha/\beta,$$

where α represents the sum of the products of the estimated coefficients and the corresponding mean value of the demographic variable and β represents the coefficient on tax level (marginal utility of money).

16. Based on a likelihood ratio test that the slope coefficients are jointly equal to zero (see chi-squared value in table 6).

17. Under the suggestion of an anonymous reviewer, model 2 was estimated using the observations that make up the sample used to estimate model 3. In other words, all respondents who answered DK to the referendum but provided a numerical response to the quasi–open-ended question were recoded as No responses. The coefficient estimates and the welfare measure that result are similar to those that result from the initial estimation of model 3. This shows that changing the sample size even when recoding all DK responses as No makes a significant difference to the welfare measure derived and the model estimated. This suggests that the demographics of the sample have changed significantly. It can be argued that the demographic profile of this sample is more representative of individuals who have determinable preferences over the good being valued characteristics (the only individuals excluded are those who answered DK to both questions and whose preferences therefore cannot be determined). When individuals who answered DK to both questions are included in the sample and their referendum responses are recoded to No (model 2), the demographics of the sample are altered. Therefore, a comparison of responses to the two question forms at least allows the elimination from the sample of individuals who do not have determinable preferences even if all DK responses from the remaining sample are recoded as Nos. However, since the comparison needs to be made to eliminate these individuals with preferences that are not determinable, it seems prudent to appropriately recode the other DK responses as Yes or No. Although in this case it does not make much difference, since only 7 warrant recoding to Yes, this situation is not

likely to occur in all cases. Considering the results of the multinomial model, which suggests that DK respondents are not the same as No respondents, it seems inappropriate to treat all DK respondents as No respondents.

Appendix

Old Growth Ecosystem Preservation Program

In Alberta, as well as around the world, conflicts often arise between forestry and wilderness preservation, particularly when it comes to old growth forests and the preservation of threatened and endangered species. What follows is an overview of how this issue affects Alberta. Please read this overview before proceeding to the next survey questions.

What Is an Old Growth Forest?

Old growth forests are a valuable source of timber, which generates employment, revenue, and economic stability. As well, old growth forests supply watershed protection, recreation opportunities, and unique breeding and feeding habitats for many wildlife species. Features of old growth forests include large diameter trees, fallen logs, snags, deep layer mosses, and lichens.

What Species Are Dependent on Old Growth Forests in Alberta?

Many species, such as the woodland caribou, the marten, and the boreal owl, are dependent on old growth forests. The woodland caribo is considered endangered under the Wildlife Act of Alberta and threatened by the Policy for the Management of Threatened Wildlife in Alberta. If caribou, a wide-ranging species, dependent on old growth forests, can maintain a viable population, this may act as an indicator of a healthy old growth ecosystem.

Caribou Populations in Alberta

There are two types of woodland caribou in Alberta, forest-dwelling woodland caribou and mountain-dwelling woodland caribou. Current estimates suggest that there are approximately 400 mountain-dwelling caribou and 1500 forest-dwelling caribou, althoug these numbers are somewhat uncertain. The mountain-dwelling caribou live along the west-central border of Alberta, in the mountain and foothill regions near Grande Cache. The forest-dwelling caribou have a wider range, and herds exist in the mature conifer forests along the western border of Alberta as well as through northern Alberta (see enclosed Map).

Caribou herds have been in decline for a number of reasons, including hunting (illegal and unintentional), natural predators, oil and gas activity, roadkill, and parasites. Also, a combination of activities may play a role in affecting caribou populations. Forestry activity may increase the moose populations (by providing an increased food source), which increase wolf populations. The increased wolf population then contributes to the decline in the caribou population.

An Old Growth Forest Preservation Program
(A Hypothetical Proposal)

One method that may generate an increase in caribou populations is the development of an old growth preservation area within existing mature forest stands. No forestry activity or oil and gas developments would be allowed in the preservation area. As well, no hunting or fishing would be allowed and no off-road vehicles or helicopters would be allowed. Horses and overnight camping would be allowed only in designated areas. Caribou management programs would be instituted, including the rehabilitation of habitat that historically was caribou range. It is estimated that a caribou density of about 1 caribou per 1235 acres (500 hectares) achieves a balance between caribou and their predators. Therefore, in order to achieve the target population of 600 mountain caribou, 741,000 acres (300,000 hectares) of preservation area are required. About half of this area is already in existing restricted use regions: Jasper National Park and the Willmore Wilderness Area. Thus, about 370,500 additional acres (150,000 hectares) of existing forest landbase are required.

A Balance between Old Growth Forest Preservation and Commercial Forest Usage

This land use issue involves a tradeoff between preservation of old growth forests (which would provide habitat for caribou and other old growth species) and revenues and employment generated from the forestry, oil and gas, and tourism sectors of Alberta's economy. The maintenance of an old growth ecosystem and compensation for lost industrial activity rights would likely require an increase in taxes for residents of Alberta. As well, habitat created from timber cutting that is ideal for wildlife species such as moose and wolf would be reduced.

Please think about your position regarding old growth forest preservation. Below, hypothetical options will be presented to you in response to this issue.

Option Set 1: A Referendum on Old Growth Forest Preservation

1. Suppose the decision of implementing the Old Growth Forest Preservation Program was to be based on a vote or referendum. If the majority of Albertans were in favor of the program, it would be approved and become law. If you were asked to vote on the old growth preservation program, and it cost each Alberta household $_____ per year in increased income taxes to fund the program, would you vote yes or no? (*Choose one only below*)

☐$_1$ YES (*Please go to question #1a.*)

☐$_2$ NO (*Please go to question #1b.*)

☐$_3$ I DON'T KNOW (*Please go to question #1c.*)

1a. If you chose YES: Why did you vote for the Old Growth Forest Preservation Program? (*You may choose more than one*)

☐$_1$ I believe that old growth forests are valuable and should be preserved.

☐$_2$ I do not really have to pay this amount but I still support old growth preservation.

☐$_3$ I do not really think that forestry firms will suffer.

☐$_4$ I do not think this is too much to pay for the benefits I receive.

☐$_5$ Other (*please specify*) _____

Please proceed to the next page . . .

1b. If you chose NO: Why did you vote against the Old Growth Forest Preservation Program? (*You may choose more than one*)

☐$_1$ I think this is an important issue but I feel that the funding should come from the existing taxbase.

☐$_2$ I do not believe that the old growth forests are worth that much.

☐$_3$ I do not think that the preservation proposal will be successful.

☐$_4$ I cannot afford it.

☐$_5$ I do not really believe that the old growth ecosystem is threatened.

☐$_6$ I think that this proposal will adversely affect the forest industry/local communities.

☐$_7$ I think that industry should take the initiative and responsibility in conservation and environmental issues.

☐$_8$ I think payment should be on a voluntary basis (for example, donations to an environmental organization that supports old growth habitat and wildlife conservation).

☐$_9$ Other (*please specify*) _____

Please proceed to the next page . . .

1c. If you chose I DON'T KNOW: Why did you choose this cateogy? (*You may choose more than one*)

☐$_1$ I need more information to make such a decision.

☐$_2$ I think this question is morally offensive.

☐$_3$ I think the situation presented is too hypothetical.

☐$_4$ Other (*please specify*) _____

Option Set 2: What Should Households In Alberta Give Up to Conserve Old Growth Forests?

Implementing the Old Growth Forest Preservation Program will probably have financial implications on Albertans. If taxes rise, there will not be as much income to spend on other things. If industrial regulations are changed, prices of goods and services will be affected. We are interested in knowing what Albertans would be willing to give up to preserve old growth forests.

Please examine the dollar amount categories presented below. Which one of the categories do you feel best corresponds to what your household would be willing to give up, annually, to implement the old growth forest preservation program described above? The item that your household is willing to give up must be something that you intended to purchase. Some examples of items are provided. Check the dollar amount that relates to the value of an item that your household would be willing to give up (whatever that item may be if not included in the example).

2. Every year my household would be willing to give up (*choose one dollar amount category only*):

☐$_1$ Nothing. (*Please go to question #3.*)

☐$_2$ An item or items worth $5.

Examples: Two movie rentals from a video store; a one-day pass to a fitness facility; dessert and coffee from a coffee shop.

☐$_3$ An item or items worth $10.

Examples: A bottle of wine; a new cassette tape; a paperback novel.

☐$_4$ An item or items worth $15.

Examples: A new compact disc; breakfast or brunch at a restaurant; a dozen cans of beer.

☐$_5$ An item or items worth $25.

Examples: An annual subscription to a magazine; a night out at the movies; a month of cable television.

☐$_6$ An item or items worth $50.

Examples: A dinner for two at a restaurant; a new shirt or blouse; two tickets to a sporting event.

☐$_7$ An item or items worth $100.

Examples: Two tickets to theatre or a concert; a portable Walkman; sporting goods equipment.

☐$_8$ An item or items worth $300.

Examples: A color television; a weekend trip to a favorite getaway; a bicycle.

☐$_9$ An item or items worth another amount. (*Please state the item and amount.*)

_____

☐$_{10}$ I don't know. (*Please go to question #4.*)

3. If you chose NOTHING: Why did you not want to give up any item? (*Choose as many as apply.*)

☐$_1$ I do not believe that old growth forests are worth that much.

☐$_2$ I do not think that the preservation proposal will be successful

☐$_3$ I do not really believe that the old growth forests are threatened.

☐$_4$ I think that this proposal will adversely affect the forest industry/local communities.

☐$_5$ I cannot afford it.

Please proceed to the next section . . .

4. If you chose I DON'T KNOW: Why did you choose this cateogy? (*Choose as many as apply.*)

☐$_1$ I need more information to make such a decision.

☐$_2$ I think this question is morally offensive.

☐$_3$ I think the situation presented is too hypothetical.

☐$_4$ Other (*please specify*) _____

_____