Income Reminder and the Divergence Between Willingness-to-pay Estimates Associated with Dichotomous Choice and Open-ended Elicitation Formats

by

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Abstract:

This study investigates whether an income reminder can reduce the divergence between the willingness-to-pay (WTP) estimates associated with the open-ended (OE) and dichotomous choice (DC) elicitation formats. Results show that without an income reminder, WTP estimate associated with DC elicitation format is about 1.66 times as large as that associated with OE elicitation format. With an income reminder, the WTP estimate associated with DC format decreased while the WTP estimate associated with OE format increased, and the divergence between the WTP estimates was almost eliminated.

Key words: dichotomous choice, open-ended, income reminder, water quality improvement, willingness-to-pay

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Comparisons of field and laboratory elicitation studies indicate that WTP estimates obtained using DC format typically exceed WTP estimates obtained using OE format (e.g. Johnnesson and Jönsson; Loomis et al.). The divergence between the WTP estimates has caused prolonged debate about the validity of the contingent valuation method. Some researchers suggest that the DC format is the preferred format; while others suggest that failure to demonstrate consistency across value elicitation formats negates the validity of the contingent valuation method (CVM) altogether. More recently, Welsh and Poe think it is premature either to dictate a preferred valuation format or to declare that CVM is unreliable. They called for further investigation of this issue.

Previous studies have provided various explanations why dichotomous choice contingent valuations (DC-CV) tend to yield higher WTP estimates than open-ended contingent valuations (OE-CV). Some researchers think that, in OE-CV studies, respondents who are uncertain about their WTP tend to be cautious and thus approach their reservation price from below. Therefore, the stated WTP is less than the value of their true WTP, which is a value from constrained utility maximization. Others attribute the divergence in WTP estimates to overstatements of WTP in DC-CV studies due to the presence of yea-saying responses associated with the DC elicitation form, a tendency of some respondents to agree with an interviewer's request regardless of their true views.

Both overstatement and understatement of WTP could be reduced by incorporating an income reminder prior to the elicitation question. Schkade and Payne found that without an

income reminder, only 31% of the respondents used income information in their derivation of WTP. Without using income information, a stated WTP is unlikely a result from the solution of a utility maximization subject to an income constraint. An income reminder provides a hint to respondents that they should take their income into consideration in their derivation of WTP. With the use of the essential information of income, the stated WTP of a respondent is closer to his true WTP. Therefore, the tendency of overstatement related to DC format and the tendency of understatement related to the OE format are reduced. As a result, an income reminder may help DC and OE elicitation formats to produce more commensurate estimates of mean WTP, which are closer to the true WTP.

This study examines whether incorporating an income reminder prior to the elicitation questions can substantially reduce the WTP estimate divergence associated with the DC and OE elicitation formats. The objective is accomplished by comparing the corresponding WTP estimates, both with and without an income reminder, obtained from the analyses of data on consumer WTP for water quality improvement.

The Survey, the Data, and the Model

The data were from a telephone survey of Georgia residents on their WTP for water quality improvement resulting from the re-authorization of the Safe Drinking Water Act (SDWA). The re-authorization of SDWA was aimed at increasing the public water systems' incentives to optimize their maintenance and leak detection programs. As a result, the water price will increase, a cost ultimately borne by consumers. Debate on the level of consumer WTP for the resulting quality improvements led to the survey prior to the re-authorization of SDWA.

The survey was conducted by the University of Georgia Survey Research Center between

June 7 and July 3, 1995. The survey instrument was developed after a thorough review of relevant literature and close interaction with survey design experts. It was pretested by administering the instrument to 60 households. After some revisions of the instrument, additional pretesting was conducted . Random Digit Dialing probability sampling method was used to ensure all Georgia adult residents an equal opportunity of being selected for the interview. The survey resulted in a useful sample of 400 observations with a response rate of 58.4%.

A key issue in contingent valuation is respondents' attitude and it is commonly recognized that policy relevance of a CV survey affects respondents' attitude toward the survey (Cummings and Taylor). To avoid frivolous valuation, respondents to the survey were clearly informed that the survey was policy relevant. They were given a brief description of the expected effects of the re-authorization of the SDWA before the valuation question.

Half of the respondents were asked an open-ended WTP question (OE subsample), while the other half were asked a dichotomous choice one (DC subsample). The respondents in the OE subsample were asked to state the maximum amounts they were willing to pay while the respondents in the DC subsample were asked whether they were willing to pay a particular amount (bid value) for the resulting water quality improvement. The bid values were based on a pretest telephone survey of 60 Georgia households. Following Mitchell and Carson, the WTP question in the pretest survey used the open-ended format. A method suggested by Boyle, Welsh, and Bishop (1988) was then used to determine and assign bids to respondents in the actual survey.

Prior to the valuation question, half of the respondents were reminded of their annual household incomes (RM subsample) while the other half were not reminded (NM subsample).

Following the evaluation question, all respondents were requested to provide demographic and economic information, including age, education, average monthly water bill, and annual household income.

For the OE subsample, an estimation model was specified as:

$$WTP_i = a_0 + a_1 AGE_i + a_2 AVT_i + a_3 BIL_i + a_4 CERN_i + a_5 EDU_i + a_6 INC_i + e_i \quad \textbf{(1)}$$

where WTP_i is the amount the i^{th} respondent is willing to pay for the quality improvement; AGE_i is the actual age of the respondent; AVT_i indicates whether the respondent used any method to reduce health risk related to drinking water; BIL_i is the household's average monthly water bill; $CERN_i$ is an indicator of the respondent's opinion about the quality of his drinking water; EDU_i is the respondent's education level; INC_i is the household's annual income in thousand dollars; and ε_i is the disturbance term.

For the DC subsample, the estimation model was specified as:

$$Y_i = b_0 + b_1 AGE_i + b_2 AVT_i + b_3 BIL_i + b_4 CERN_i + b_5 EDU_i + b_6 INC_i + b_b BID_i + e_i \quad \textbf{(2)}$$

where $Y_i = 1$ if the i^{th} respondent is willing to pay a bid amount, and 0 otherwise; BID_i is the bid value presented to the respondent. All other terms are defined as before. Summary statistics of the regression variables used in the OE model and the DC model are provided in Table 1.

Hypothesis Specification

A hypothesis is specified to examine whether income reminder can narrow down the gap between the WTP estimate associated with DC elicitation format and the WTP estimate

associated with the OE elicitation format. The null hypothesis is specified as:

$$WTP_{RMOE} = WTP_{RMDC}$$

$$WTP_{NMOE} = WTP_{NMDC}$$

where WTP_{RMOE} is the mean WTP of the RMOE subsample; WTP_{NMOE} is the mean WTP of the NMOE subsample. WTP_{RMDC} and WTP_{NMDC} are the corresponding mean WTPs of the RMDC and NMDC subsamples. The null hypothesis states that valuation formats do not affect the stated mean WTP both with and without the income reminder. The null hypothesis is to be tested by comparing the corresponding estimated mean WTPs.

For the OE subsample, the mean WTP was calculated as the sum of the products of the mean values of the explanatory variables and their corresponding parameter estimates. Following Boyle et al. (1998), the mean WTP of the DC subsample was computed as:

(3)
$$\text{Mean WTP} = \left| \frac{\sum_{i=0}^{6} \hat{b}_i \overline{X}_i}{\hat{b}_b} \right|$$

where $\hat{\hat{a}}_i$ is the estimate of the i^{th} parameter in equation (2), $\overline{X}_i$ is the mean value of the variable corresponding to $\hat{a}_i$, and $\hat{\hat{a}}_b$ is the parameter estimate for the variable of BID.

Results and Discussions

For the DC subsamples, probit models were estimated using the maximum likelihood method. For the OE subsample, the models were estimated using the ordinary least squares regression method. Table 2 presents the parameter estimates.

Households with high monthly water bills consume more water than households with low

monthly water bills. Consequently, a household with a high monthly water bill benefits more from water quality improvement than a household with a low monthly bill. This is intuitively clear if we consider the benefit of quality improvement to a very big household consuming a large quantity of water and the benefit to a single-person household consuming little water. Therefore, the water bill is expected to have a positive effect on stated WTP because WTP can be considered as the price for water quality improvement for the whole quantity a household consumed in a month. Contrary to the expectation, without the income reminder, the parameter estimate of BILL had a negative sign (statistically insignificant) in both DC and OE models. However, with the income reminder, the water bill did have a statistically significant positive effect on WTP in both the DC and the OE models.

The greater the perceived health risk from the consumption of a necessary good, the more a consumer is willing to pay to improve the quality of the good. Therefore, respondents who had concerns about current water quality are expected to be willing to pay more (OE subsample) or more likely to agree to pay a bid value (DC subsample) for water quality improvement. Surprisingly, without the income reminder, the estimated coefficient on the variable CERN had a negative sign (statistically insignificant) in both the DC and the OE subsamples. But concerns about current water quality did have a statistically significant positive effect on WTP when respondents were reminded of their household income.

Water quality is a normal good. Hence, household income is expected to have a positive effect on WTP for water quality improvement. However, income had a significant positive effect on WTP only when the respondents were reminded of their household income. The income reminder might have helped high income respondents to recognize their full capacity to pay for

water quality improvement.

The results show that the use of averting means had a significant negative effect on WTP when respondents were not reminded of their income. In view of reduced risk, it is reasonable for those who used averting means to be more conservative in their valuation. However, with the quality improvement from the re-authorization of the SDWA, the expenses on averting means are available for the consumption of other goods. It could be that the respondents were led by the income reminder to think in terms of purchasing capacity and opportunity cost, and thus realized that extra amount would be available to pay for water quality improvement from the SDWA re-authorization if they would not have to use those averting means to reduce risk.

The bid value presented to a respondent in the DC model is expected to inversely related to the probability that the respondent is willing to pay the amount because water quality is an ordinary good. The results are consistent with our expectations. But with the income reminder, the magnitude of the negative impact of bid value was less than a half of that without an income reminder. From the view point of policy development, this is an important finding because it appears that the change in the fee for water quality improvements may be of varying magnitude depending on the context in which it is presented to the public. The context, in this study the use of the income reminder, could affect the acceptance of the fee and decide the scope of the water quality improvement program.

It is interesting to notice that with the income reminder, the estimation results are more consistent with our expectations. It could be that the income reminder helped respondents to be more rational in figuring out their WTP. The incorporation of the income reminder also improved the fitness of the models. In both the DC and OE models, more variables are statistically

significant with the income reminder. It is noteworthy that, without the income reminder, only one variable was statistically significant in the OE subsample, but four variables were significant when the income reminder was incorporated.

Hypothesis Tests

Table 3 presents the estimated mean WTPs for both the DC and the OE subsamples. Results from previous empirical studies suggest a systematic and significant difference between values obtained using different elicitation formats. Consistent with previous studies, without the income reminder, the mean WTP elicited using DC format substantially exceeds the mean WTP elicited using OE format. The difference is $7.77 in money value and 66% in percentage. However, with the income reminder, the mean WTP associated with the DC elicitation format exceeds the mean WTP associated with the OE elicitation format only by $0.43, less than 3% higher. Thus, the incorporation of an income reminder almost eliminated the divergence between the mean WTP estimates. Furthermore, with the income reminder, the mean WTP of the OE subsample increased by 34% while the mean WTP of DC subsample decreased by 17%. As stated before, with an income reminder, a stated WTP is closer to the true WTP. In OE-CV studies where understatements of WTP are likely to occur, closer to true WTP implies an increase in stated WTP. In DC-CV studies where yea-saying responses tend to result in overstatement of WTP, an income reminder may serve to remind a respondent that his income is limited and paying the requested amount may violate his income constraint. Hence, income reminder may discourage the tendency of overstatement of WTP in DC-CV studies. The income reminder not only helped the DC and the OE formats to produce more commensurate mean stated WTPs but also helped to reduce the upward bias associated with the DC format and the downward bias associated with the

OE format discussed in previous studies. As a result, with the income reminder, the resulting WTP estimates are closer to true mean WTP and are more reliable.

Concluding remarks

Evidences from empirical studies have provided evidence for the existence of systematic and significant divergence between the WTP estimates associated with the DC and OE elicitation formats. The existence of the divergence between the value estimates of WTP associated with these elicitation formats has caused some researchers to question the reliability of the contingent valuation method (McFadden; Desvousges et al.; Schkade and Payne). Although great efforts have been made to address the issue, little has been accomplished to solve the problem.

According to previous studies, the divergence may be due to the overstatement tendency related to the DC format and the understatement tendency related to the OE format. In both cases, the problem could be mitigated by incorporating an income reminder prior to the elicitation question. Being reminded of their income prior to an elicitation question, a respondent is more likely to take the essential information of income into consideration when he figures out his WTP. This means his stated WTP is likely to be closer to his true WTP, which is theoretically the value from the solution of a constrained utility maximization.

This study provides empirical evidence that the incorporation of an income reminder can effectively mitigate the problem. The income reminder helps the DC and OE formats to produce commensurate WTP estimates by reducing the potential upward WTP estimate bias associated with DC format and the downward bias associated with OE format. The divergence between the WTP estimates associated with these elicitation forms is almost eliminated by the income reminder. We recognize that the results from this single empirical study are not sufficient for a

conclusion that the problem is completely solved. Further investigations should be made into the WTP effects of elicitation methods other than DC and OE formats, and in valuation of less familiar goods. However, this study does show a new way, simple and easy to apply, to address the issue.

Appendix

1: Elicitation question for the reminded open-ended subsample.

"Before I ask you the next question, I want you to think of your household's total income, your current water quality, your current water bill, and any expected problems you may have with your water in the future. And remember that any answer you give is fine with me. I'm neutral. Let me know when you are ready for the next question."

"Now, keeping all these things in mind, suppose that the water system would send you a higher water bill due to the adoption of the amendments. Remember that you are free to support or not support these amendments. What would be the maximum (the most) that you would be willing to pay EVERY MONTH (and for the rest of your life) ABOVE your current MONTHLY bill to support the amendments of the Safe Drinking Water Act?"

2: Elicitation question for the reminded dichotomous choice subsample.

"Before I ask you the next question, I want you to think of your household's total income, your current water quality, your current water bill, and any expected problems you may have with your water in the future. And remember that any answer you give is fine with me. I'm neutral. Let me know when you are ready for the next question."

"Now, keeping all these things in mind, suppose the water system would send you a higher water bill due to the adoption of the amendments. Remember that you are free to support or not support these amendments. Suppose the water system would increase your MONTHLY water bill by (bid) dollars. Would you be willing to pay this amount EVERY MONTH (and for the rest of your life) to support the amendments of the Safe Drinking Water Act?"

3: For the not-reminded subsamples, everything is the same as above except that the respondents were not reminded of their household's total income.

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Table 1. Summary Statistics of the Explanatory Variables.

Variables	Dichotomous Choice Model				Open Ended Model			
	With Income Reminder		Without Income Reminder		With Income Reminder		Without Income Reminder	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
AGE	47.00	16.00	40.10	12.27	43.10	16.67	45.31	15.05
AVT	0.46	0.50	0.65	0.48	0.53	0.50	0.54	0.50
BILL	20.31	15.66	25.23	16.31	21.73	17.63	28.33	19.61
CERN	0.40	0.50	0.39	0.49	0.36	0.48	0.42	0.50
EDU	0.65	0.49	0.51	0.50	0.52	0.50	0.54	0.50
INC	0.36	0.48	0.28	0.45	0.37	0.49	0.35	0.48
BID	15.32	9.94	15.28	9.38				

AGE	Age of respondent in years
AVT	AVT=1 if respondent used either bottled water, or filters, or boiled tap water to avert health risk; 0 otherwise.
BILL	Respondent's average monthly water bill in dollars.
CERN	CERN=1 if respondent had concerns about water quality; 0 otherwise.
EDU	EDU=1 if respondent had at least some college education; 0 otherwise.
INC	Respondent's annual household income in thousand dollars.
BID	Dollar amount respondents were asked to pay for water quality improvement.

Table 2. Parameter Estimates for the Willingness to Pay for Water Quality Improvement.

Variables	Dichotomous Choice Model				Open Ended Model			
	With Income Reminder		Without Income Reminder		With Income Reminder		Without Income Reminder	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Intercept	1.0289	1.24	3.2579	3.02**	17.2822	2.41**	27.1979	2.30**
AGE	-0.0125	-1.11	-0.0069	-0.44	-0.2317	-2.45**	-0.3390	-1.76*
AVT	-0.0534	-0.16	-0.7724	-1.65*	-0.4057	-0.13	5.1072	0.87
BILL	0.0191	1.90*	-0.0067	-0.48	0.1913	2.02**	-0.1487	-1.06
CERN	0.7052	2.11**	-0.2190	-0.46	7.6920	2.34**	-0.5682	-0.10
EDU	-0.0872	-0.24	0.1937	0.44	-1.4851	-1.47	6.4932	1.15
INC	-0.3474	-1.01	-0.4563	-0.95	6.9401	1.73*	-5.3618	-1.00
BID	-0.0557	-3.14***	-0.1185	-4.56***				
R^2					0.25		0.14	
R^2_M	0.19		0.36					

Note: R^2_M is the Pseudo R^2 calculated using McFadden's formula.

* denotes statistically significant at 10% level.

** denotes statistically significant at 5% level.

*** denotes statistically significant at 1% level.

Table 3. Estimated Mean Willingness to Pay for Water Quality Improvement.

	DC Subsample	OE Subsample
	Constructed Using Estimation Results	Constructed Using Estimation Results
With Income Reminder	16.23	15.80
Without Income Reminder	19.55	11.78