

**The Effects of Irrational Responses in Contingent Valuation Survey  
And the Appropriate Treatment**

by

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**Abstract:**

This paper investigates the effects of irrational responses on stated willingness-to-pay (WTP) in a contingent valuation study. A significant portion of the respondents stated that they were willing to pay a higher price for irradiated beef which they would avoid consuming due to their concerns about the side effects of irradiation. Such responses may not reflect true WTP and may cause bias in WTP estimate. Excluding these responses from estimation may result in sample selection bias. Whereas setting the bid values presented to these responses close to zero both helped to improve the estimation model and to reduce the potential bias in WTP estimate.

**Key words:** beef irradiation, irrational response, willingness-to-pay.

## **The Effects of Irrational Responses in Contingent Valuation Survey**

### **And the Appropriate Treatment**

The use of contingent valuation (CV) in policy analysis and academic research has grown rapidly over the past two decades because this method can provide valuable information about goods not presently traded in the market. With the use of the contingent valuation method (CVM) becoming more and more popular, it is increasingly important to assess the validity of the instrument. Many studies have addressed the validity issue of the CVM and there is currently a debate about whether or not CVM can measure individual maximum willingness-to-pay (WTP) accurately because the method has failed in many validity tests.

Earlier studies assessing the validity of CVM focused on such aspects as anchoring effects, temporal effects, embedding effects, ordering effects, effects of elicitation formats, and effects of strategic responses. More recently, the issue of rationality of responses in CV survey has caught researchers' attention and several studies have provided evidence of "economically irrational" responses in CV studies.

In their testing for consistency in a willingness-to-pay experiment, Ryan and Miguel found that about 30% of the respondents stated that they were willing to pay more for a less preferred alternative of medical treatment and thus violated the assumption of consistency. The authors attributed the inconsistency of WTP responses to cost-based valuation, where consumers tend to figure out their WTP according to the perceived cost of the goods under valuation. The cost-based valuation is a choice behavior consistent with the 'fair price' explanation for WTP responses, where consumers do not want to exploit others by paying less than what they perceive the commodity would cost. In the cost-based valuation, respondents benefit from the

consumption of the less preferred commodity and they want to pay a “fair price.” A question to ask is whether respondents could be so irrational that they are willing to pay for something they consider to be harmful and would avoid. And if such irrational responses occur in a CV survey, what is the cause of such response? Do they have a significant effect on the estimated mean WTP? If they do, what should we do to mitigate the problem?

The main objective of this study is to examine the effects of irrational responses on WTP estimate in a contingent valuation survey and to find an appropriate way to treat such responses. The goal is accomplished by comparing the estimation results of three econometric models: one in which the irrational responses were included in the estimation (inclusive model), one in which the irrational responses were excluded from the estimation (exclusive model), and one in which the bid values presented to the irrational respondents were set close to zero (adjusted model). Criteria set by earlier studies addressing the validity issue of the CVM are used to identify which of these models perform best.

### **The Data and the Survey**

The data were collected from a nationwide telephone survey of 740 households on meat consumption. The survey was conducted by the University of Georgia Survey Research Center in December 1999 and January 2000. The survey instruments were developed, after a thorough review of the relevant literature, by a group of agricultural economists and survey design experts.

In order to enhance the reliability of the information obtained from the survey, primary grocery shoppers of the households were requested to answer the survey questions. Vegetarians were excluded from the survey and more than 99% of the respondents ate meat at least once a week and about 93% had the experience of purchasing beef at grocery stores.

The main purpose of the survey was to gain insights about consumers' perceptions of food irradiation and their attitudes toward irradiated beef. Food irradiation has been proved to be able to kill harmful microorganisms such as parasites and insects in food, and hence can help to enhance the safety level and freshness of food. In response to the outbreaks of food poisoning due to E-coli in beef, the Food and Drug Administration (FDA) of the United States approved in 1997 the use of the irradiation process to treat beef in order to enhance the safety level of beef products. Although many authoritative organizations such as World Health Organization (WHO) and FDA have approved food irradiation to be both safe and effective when the treatment is conducted properly and at authorized radioactivity level, previous studies have provided evidence that the majority of US consumers are resistant to food irradiation due to their perceived side effects of the use of radioactivity. Consumer concern about the side effects of food irradiation is mainly due to ignorance of the food process technique and its effects on food. To help respondents to be more informative about food irradiation, a short paragraph is included in the survey to give a brief description about the food treatment process and its effects.

Three sets of questions were specially designed to obtain information about consumers' perspectives of beef irradiation and their WTP for irradiated beef. After a brief introduction about food irradiation, the respondents were requested to answer a set of questions regarding their opinions about the effects of beef irradiation on environment, the health of consumers, and on the health of the workers conducting beef irradiation. Surprisingly, in spite of the emphasis of the safety of food irradiation prior to the questions, more than 33% of the respondents thought that food irradiation would adversely affect the health of the workers who conduct beef irradiation. Although food irradiation is considered to be more environment friendly than many other food

processing techniques such as chemical sanitizing procedures (Corry et al.; Farkas), as high as 36% of the respondents showed their concerns about environment pollution by beef irradiation. Further, despite the overwhelming scientific evidence to the safety of consuming irradiated food, more than 18% of the respondents even thought that consumption of irradiated beef would increase the risk of suffering from cancers.

A question, designed to gain information about consumers' perception of the adequacy and enforcement effectiveness of food safety regulations, is also included in the first set of questions because perception about food safety regulation may affect food consumption. About 6% of the respondents thought that the food regulations are neither adequate nor effectively enforced.

In the second set of questions, the respondents were asked how they would react to a label indicating that the beef is irradiated. More than 30% of the respondents said they would consider it as a symbol of warning and avoid the product although they were clearly told that food irradiation had been approved by the Food and Drug Administration and the World Health Organization as both effective and safe. Less than 21% of them would consider it as an assurance of quality and safety and would buy the product while the rest were either neutral or uncertain about their attitude toward irradiated beef.

The respondents were then asked whether they would purchase irradiated beef at the current market price of non-irradiated beef. About 55% of the respondents indicated that they would buy irradiated beef at current market price. Those who would buy irradiated beef at current market price were then asked whether they were willing to pay a higher price for irradiated beef. About 30% of the whole sample stated that they were willing to pay a higher

price. To our surprise, about 15% of those who had previously considered label of irradiation as a symbol of warning and would avoid irradiated beef also said they were willing to pay a higher price for it. Those who were willing to pay a higher price were then asked whether they would pay certain amount (first bid amount) for beef irradiation. If a respondent was willing to pay the first bid amount, then he was asked whether he was willing to pay a higher amount (second bid amount.) If a respondent was not willing to pay the first bid amount, then he was offered a lower amount (second bid amount) and asked whether he was willing to pay it.

### **Models**

There is no well established economic theory for the occurrence of such irrational responses in a contingent survey. Sen demonstrated that there may be economically rational reasons for inconsistent choices, but his argument does not provide a convincing reason for the existence of such irrational responses. Although the issue of irrational response in this study represents a specific type of choice inconsistency, it differs from the general topic of choice inconsistency in that the respondents would pay for something perceived to be worthless or even potentially harmful to them. If they consider label of irradiation as symbol of warning and would avoid the product, then they should not be willing to pay a higher price for irradiated beef. Further, since they would avoid irradiated beef when they actually do grocery shopping, it makes no sense for them to pay higher price for it.

Likewise, there exists no unanimous agreements about how to treat such responses in empirical estimations. Some researchers (e.g. Ryan and Miguel) think that those who give an irrational response might have misunderstood the questions. As a result, the irrational responses were excluded from WTP estimation in their study. However, in our study, it is unlikely that the

respondents misunderstood the relevant questions because the questions were very simple and straightforward.

If there are economically rational reasons for such irrational responses, then they should be included in empirical estimation, otherwise it may cause sample selection bias. On the other hand, if there are no rational reasons for such responses, then, including them in empirical estimation may result in biased WTP estimate. If the irrational responses are due to misunderstanding of the relevant questions, then, excluding such responses from empirical estimation may not cause serious problem because the true mean WTP of those who misunderstand the questions may not significantly differ from that of the rest of the sample. If respondents understand the questions well and would avoid irradiated beef when they do grocery shopping, then excluding such responses from estimation may result in biased WTP estimate because the true mean WTP of this group is likely to be different than that of the rest of the sample. Specifically, the true value of their WTPs should be zero because, practically, there is no chance for their WTPs for beef irradiation to be materialized since they will not consume irradiated beef.

Taking the above points into consideration, we believe that the irrational responses should be included in empirical estimation with their mean WTPs set to zero. This can be implemented by setting the bid values presented to the irrational respondents to be close to zero. However, for the purpose of comparison, all the three models described before were estimated. The estimation results from these models are compared to see whether the estimated mean WTPs associated with these models differ from each other. Further, criteria set by earlier studies addressing the validity issue of CVM are used to identify which of these models perform best.

Table 1 provides a detailed description and summary statistics of the variables used in the



estimation. It is worth mentioning that 71% of the respondents are females. However, this does not imply a sample selection bias. It is because primary grocery shoppers of the households were requested to answer the questions in the survey and, in the United States, the majority of main meal planners are females. Main meal planners are likely to be primary grocery shoppers, hence, the majority of the respondents are females.

## **Results and Discussion**

Table 2 presents the parameter estimates and the corresponding t-values of the three models. The results show that education have a positive effect on WTP in the inclusive model and the adjusted model. Earlier studies recognized the importance of cognitive cost in information acquisition. People with cognitive advantages are more likely to obtain information from cognitively demanding sources. It could be that more educated people are better informed about food irradiation because scientific evidence and authoritative attestation to the safety, the wholesomeness, and effectiveness of food irradiation are usually publicized in professional journals or magazines which are cognitively more demanding than such information sources as TV. Better informed with correct knowledge about the processing, more educated respondents might be more confident about the benefits of food irradiation, and hence are willing to pay more for beef irradiation than less educated respondents.

Ippolito and Mathios think that income may indicate human capital beyond that given by formal education. Based on this assumption, Nayga expected income to have a positive impact on the probability that a consumer would consider new food processing technology to be safe. If a respondent with higher income is more likely to consider beef irradiation to be safe, then, for a particular bid value, he is more likely to be willing to pay the amount for irradiated beef. In this

study, the parameter estimate of the income variable bears the expected sign, but the effect is statistically significant only in the exclusive model.

Older consumers are generally more risk averse to food safety issues than younger consumers (Grossman; Nayga). Despite the overwhelming body of scientific evidence attesting to the safety of food irradiation at approved levels, many consumers remain concerned about the use of radiation in food processing due to the lack of knowledge on the wholesomeness of irradiated food (Farkas; Bruhn; Resurreccion et al.). Being more risk averse to food safety issues, older consumers maybe more reluctant in accepting irradiated food. Hence, age is expected to have a negative effect on WTP for beef irradiation. Although the parameter estimate of the age variable bears a negative sign in all the three models, the age effect is statistically insignificant.

Respondents' negative perceptions of beef irradiation are expected to have a negative impact on their WTP. However, in the inclusive model, two of the three variables representing consumer negative perceptions have unexpected signs. All the three variables bear expected signs in the adjusted model and the exclusive model, but only concerns about environment pollution has a significant effect on WTP in the exclusive model. Earlier studies have also reported consumer concerns about environment pollution by food irradiation. For example, Bruhn found that people have concerns about product safety, nutritional quality, and potential danger from living near an irradiation facility, and they want information on the effect of irradiation on environmental safety.

Bid value is theoretically expected to have a statistically significant negative effect on consumer WTP. Information on the parameter estimate of bid value is used in earlier studies as a criteria of validity valuation. In the inclusive model, the coefficient on the bid variable had a positive sign, thus, the model did not pass even the simplest theoretical test according to the

criteria. In the exclusive model, the coefficient on the bid variable bears the correct sign, but is statistically insignificant. Therefore, the theoretical validity of the model is also questionable. In the adjusted model, the bid variable bears the correct sign and its effect on WTP is statistically significant. Hence, the adjusted model is theoretically valid while the inclusive model and the exclusive model are not.

The value of pseudo  $R^2$  (McFadden  $R^2$ ) is usually reported as a valuation criteria for the fitness of probit models. The value of pseudo  $R^2$  of the adjusted model is substantially higher than those of the inclusive model and the exclusive model, implying that the adjusted model is more appropriate than the other two.

The estimated mean WTPs associated with the three models differ substantially from each other. The adjusted model yielded a WTP estimate less than half of that resulted from the inclusive model. The difference maybe due to the upward bias of WTP estimate of the inclusive model because the irrational responses are overstatements of WTP, thus, including them in the WTP estimation would result in an upward biased estimate. On the other hand, the estimated mean WTP of the adjusted model is more than double of that of the exclusive model. The exclusive model imposes a strong assumption that the true mean WTP of the irrational respondents is not significantly different than that of the rest of the sample, otherwise excluding these responses may cause sample selection bias. As stated before, the true WTP of the irrational respondents should be zero because these respondents consider beef irradiation to be harmful and would not buy irradiated beef. Hence, the assumption cannot hold. As a result, the WTP estimate of the exclusive model is very likely biased. If the WTP estimate of the adjusted model is closer to the true mean WTP than the WTP estimates of the other models, then, the direction of

the estimate bias of the exclusive model is assuredly downward.

### **Concluding Remarks**

Respondents in a contingent valuation survey can be so irrational that they say they are willing to pay a positive amount for something they would avoid consuming because they consider it to be harmful. Such responses may be due to the yea-saying tendency in contingent valuation survey, a tendency of some respondents' to agree with an interviewer's request regardless of their true views. As Blamey pointed out, such respondents subordinate outcome based or true economic preferences in favor of expressive motivations when responding to CVM questions. The problem of such irrational responses is likely to be more serious when respondents know that their benefits are unlikely to be affected by the materialization of the policy related to survey.

Since such irrational responses do not reflect consumers' true value of WTP, they may cause bias in WTP estimate. However, this problem is largely neglected in previous contingent valuation studies. Neither adequate efforts have been made to detect such responses nor an effective method has been established to prevent such responses in a contingent valuation survey.

The problem can be mitigated in empirical estimation by setting the bid values presented to the irrational respondents close to zero because the true WTPs of such respondents should be zero. By adjusting the bid values presented to such respondents, we can avoid the potential upward bias associated with using the original data and the possible sample selection bias resulting from excluding such responses from empirical estimation. Although the results of this study show that the method of adjusting the bid values can effectively mitigate the problem, we recognize that there are other alternatives to address the issue.

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Table 1. Description and summary statistics of the variables used in estimation

Variables	Description	Inclusive Model	Adjusted Model	Exclusive Model
		Mean	Mean	Mean
Age	Actual age of respondents.	46.88	46.88	48.73
Gender	Female = 1, Male = 0.	0.71	0.71	0.71
Education	1 = less than high school, 2 = high school graduate, 3 = some college, 4 = college level, 5 = post graduate or professional.	3.08	3.08	3.09
Income	1 = if annual household is \$75,000 or more, 0 otherwise.	0.17	0.17	0.19
Safety	1 = if a respondent thought that the food regulations are neither adequate nor effectively enforced, 0 otherwise.	0.06	0.06	0.06
Worker	1 = if a respondent thought that the health of the workers conducting food irradiation may be affected by radiation, 0 otherwise.	0.33	0.33	0.30
Pollution	1 = if a respondent thought that food irradiation may cause environment pollution, 0 otherwise.	0.36	0.36	0.28
Cancer	1 = if a respondent thought that consumption of irradiated beef may increase the risk of suffering cancer, 0 otherwise.	0.18	0.18	0.14
Bid	The amount a respondent is asked whether he is willing to pay for beef irradiation.	11.20	8.21	10.93

Table 2. Parameter Estimates of the inclusive model, adjusted model, and exclusive model.

Variables	Inclusive Model	Adjusted Model	Exclusive Model
Constant	0.0008 (0.01)	0.5335 (1.29)	-0.3957 (-0.83)
Age	-0.0069 (-1.34)	-0.0017 (-0.31)	-0.0003 (-0.05)
Gender	0.1447 (0.77)	0.1071 (0.54)	0.1558 (0.71)
Education	0.1444 (1.63)*	0.1788 (1.92)*	0.1539 (1.50)
Income	0.1262 (0.51)	0.3312 (1.24)	0.4988 (1.76)*
Safety	0.1131 (0.30)	0.0184 (0.05)	0.2219 (0.52)
Worker	-0.1997 (-0.92)	-0.1445 (-0.63)	-0.0722 (-0.27)
Pollution	0.0077 (0.04)	-0.2273 (-1.01)	-0.5756 (-2.07)**
Cancer	0.0433 (0.18)	-0.0901 (-0.35)	-0.3294 (-1.05)
Bid	0.0066 (0.43)	-0.0828 (-5.54)***	-0.0119 (-0.63)
Mean WTP	29.3 (9.1)	11.9 (3.7)	4.48 (1.1)
Pseudo R <sup>2</sup>	0.024	0.131	0.081

Note: T-ratios are in parentheses.

\* denotes significant at 0.1 level, \*\* denotes significant at 0.05 level, \*\*\* denotes significant at 0.01 level.