Actual Media Reports on GM Foods and Chinese Consumers' Willingness to Pay for GM Soybean Oil

Wuyang Hu, Funing Zhong, and Yulian Ding

Information has been proven to have significant impacts on consumers' behavior and willingness to pay (WTP). In this study, information on GM soybean oil is given in the form of real-life cases involving GM food. These cases are recorded from actual media reports. Using a hybrid of the double-bounded and payment card elicitation approaches, Chinese consumers' WTP for soybean oil is examined both before and after these cases are presented to them. Results indicate that media reports on positive cases do not increase consumers' WTP significantly, while reports on negative cases drastically lower their WTP.

Key words: Chinese consumers, double-bounded, soybean oil, willingness to pay

Introduction

Over the past decade, genetic modification (GM) has become a considerably controversial yet widely applied technique in agricultural production. One striking characteristic associated with GM food is the presence of credence attributes with uncertain quality, and consumers often attach risks to the consumption of GM food (Lusk and Coble, 2005). Due to these uncertainties, information becomes crucial. Information may be reflected by labels, claims, or other types of verbal or nonverbal communication, and plays an important role in guiding the market. In economics, the role of information on consumers' acceptance and purchasing intentions for GM food, and consequently on the potential market, has emerged as one of the most focused current research areas (Noussair, Robin, and Ruffleux, 2004; Rousu et al., 2004; Huffman et al., 2003, 2004; Hu, Chen, and Yoshida, 2006). In most of these studies, product information is generally synthesized by the researchers and then given in an abstract form. Although the language is often adjusted to suit the general public, statements on GM are usually presented in a plain-fact manner as most often seen in scientific reports. However, this may not be the most comfortable and common way consumers acquire information about GM food.

In the most popular media—such as TV, the internet, newspapers, radio, and magazines—consumers are likely to learn GM-related information through many real-life cases involving GM food. Unlike information printed on a product label, these real-life reports often involve stories or summaries of cases that have occurred around the world,

offering a wide variety of content or background. These cases may trigger either positive or negative reactions by consumers toward GM food. From the psychological perspective of decision making, information must be assimilated and processed by consumers, allowing the resulting perceptions or attitudes formed by consumers to determine their choices. This perspective implies that witnessing actual real-life examples might be just as relevant as "plain facts" in consumers' decision-making processes (Manski, 2000). In terms of product marketing, relevant information spreads much faster through the popular media than through product labels.

The approach of this study differs from previous research by introducing real-life cases involving GM food to consumers in a format that can be seen or heard in the popular media. Accordingly, we seek to capture practical implications associated with understanding how consumers respond to real-life cases.

Soybean oil is chosen as the target product for this analysis due to its popularity among Chinese consumers. Prior to this study, soybean oil explicitly labeled as GM has not been sold in the Chinese market. Therefore, bidding experiments are used to elicit consumers' willingness to pay (WTP) for oil that may be produced from GM oilseeds [e.g., see McCluskey et al. (2005) for the case of tested beef in Japan].[1] Consumers' WTP is obtained both before and after they are exposed to real-life case reports recorded from the media. Since these cases may generate either positive or negative reactions by consumers, they are grouped and presented separately to experiment participants. The results suggest that consumers do behave differently under these two types of cases, depending on their personal characteristics. The effects of different cases, however, are quite asymmetric. To proceed, the WTP elicitation method used in this study is first introduced.

WTP Elicitation Method

The WTP elicitation method adopted for this analysis is a hybrid of the double-bounded approach and the payment card approach. The double-bounded approach belongs to the closed-ended category, and has its associated advantages. If the two stages of a double-bounded question are examined separately, both stages can be viewed as a single bounded question in that a value associated with the product is assigned by the researcher through prior analysis of the possible range of respondents' WTP (Hanemann and Kanninen, 2002). Depending on their answers, respondents' WTP is believed to fall between the value they accept and the value they cannot accept. Consequently, if a respondent accepts the highest value, it is assumed that the respondent is willing to pay more than this highest value. Likewise, if a respondent does not accept the lowest value, the WTP is considered to be between zero and the lowest value offered.

Regardless of whether the internal consistency holds between the two stages (McFadden, 1994; Calia and Strazzera, 2000), an obvious problem arises with the standard double-bounded approach in the treatment of the lower-end extreme observations. If a respondent does not accept the minimum value associated with the product as given in the question, the respondent's WTP is assumed to be somewhere between zero and the minimum value. It is likely that some respondents may not be willing to pay

---

[1] A compulsory labeling regulation on GM food (and primarily effective on GM oil) was put in force in July 2003, after the survey for this research was conducted.

anything for the product, and therefore their true WTP is equal to zero. Treating the WTP as positive in this instance will clearly overestimate the overall WTP. A set of statistical models has been developed to correct for this problem by modifying the underlying WTP distribution function (Kristrom, 1997; Werner, 1999; Brox, Kumar, and Stollery, 2003). There are very few earlier studies linking this approach to an examination of private goods, such as the product of interest here—GM soybean oil [for one notable exception, see Hu (2006)]. By using the approach described in this paper, we show that the zero-bid problem can be properly addressed through the design of the survey rather than by adjusting the empirical models.

In our survey, the basic two-stage structure of the double-bounded approach is maintained, while a payment card approach is adopted for the second stage. In particular, rather than assign a bid amount to respondents and ask whether they would accept the amount, a choice is offered. For example, in the first stage, the following question is asked of all respondents: "If both GM and non-GM soybean oils are available to you in the market at 40 RMB[2] a bottle, will you consider buying the GM oil?"[3]

If a respondent answers "no" to the first-stage question, then he or she will be asked the follow-up question: "If the price of the GM oil is lower, will you consider buying it?" If the answer is again "no," then we know the respondent is not willing to buy GM oil even when the price is lower, and this respondent will be directed to the next section of the survey.

If the individual answers "yes" to the follow-up question, then a series of options is presented to the respondent where each option features a price interval representing the price decrease the respondent may consider acceptable. The intervals start from a value equal to the price specified in the first stage and continue to decrease in the following options. By this process, the respondent can then indicate the minimum *price decrease* necessary before he or she would consider buying GM oil. In this sense, instead of a single bounded question, the second stage is indeed a payment card approach, and provides an opportunity for respondents to state whether their WTP is truly zero or some value between zero and the minimum value given in the survey.

Correspondingly, if a respondent's answer to the first-stage question ("If both GM and non-GM soybean oils are available to you in the market at 40 RMB a bottle, will you consider buying the GM oil?") is "yes," then he or she will also be asked the follow-up question: "If the price of the GM oil is higher, will you consider buying it?" If the answer is "no," the respondent will be directed to the next section of the survey. If the answer is "yes," a series of options is then presented, with each option featuring a price interval representing the *price increase* the respondent considers acceptable. The intervals start from a value equal to the amount in the first stage and continue to increase from one option to the next. The respondent can then indicate the maximum amount of price increase he or she would be willing to accept.

As shown by the flowchart presented in figure 1, rather than the typical answers following a double-bounded approach given as "yes/yes," "yes/no," "no/yes," and "no/no," the method adopted in this study maintains the answer "yes/no" in the double-bounded framework but further breaks down the answers "yes/yes" and "no/yes" into several

---

[2] RMB (Ren Min Bi) is the Chinese currency unit. Over the time of this study, 1 Yuan (¥) RMB is equal to $0.12 U.S.

[3] This question is a simplified version of the actual question asked in the survey. For the complete set of survey questions, see the appendix.
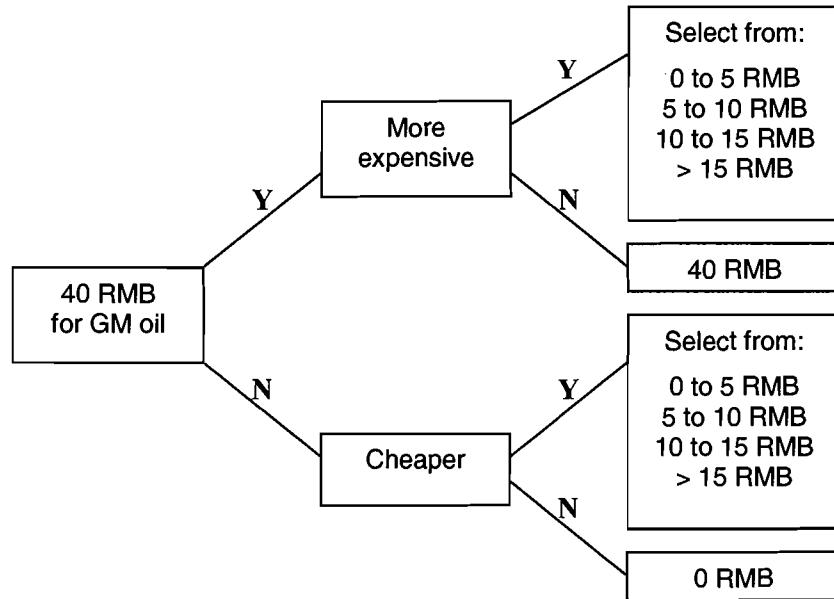
Figure 1. WTP question flowchart

possible levels—thereby enabling the answer "no/no" to truly represent those respondents whose WTP is zero. This approach will eventually still yield the same four types of answer combinations as in a conventional double-bounded context. In addition to the ease of handling zero bids, this new approach has an advantage in reducing the size of the sample needed due to the design of the second stage of the question.[4]

WTP Estimation Approach

The model used in this study is based on random utility theory. Assume individual i's utility associated with purchasing a 5-liter bottle of GM oil can be written as:

$$(1) \qquad\qquad U_i = f(\mathbf{X}_i) + \varepsilon_i \,,$$

where $\mathbf{X}_i$ is a vector of explanatory variables including the money term for the underlying WTP. The error term ε_i represents the uncertainties associated with the utility. Now suppose individual i's true WTP_i is unknown to the researcher, and the lowest payment card value individual i uses to express his/her WTP is P_i^0 (which is zero, meaning

---

[4] As noted earlier, a potential serious bias associated with a conventional double-bounded approach is the inconsistency between the underlying "bidding" behavior under the two stages. Researchers have formulated methods to alleviate this bias, such as the one-and-a-half bounded approach (Cooper, Hanemann, and Signorello, 2002); the descending-only follow-ups approach (DeShazo, 2002); and/or more elaborate empirical models (Flachaire and Hollard, 2006). Although characterized as a double-bounded approach, the method used here does not directly address behavioral inconsistency such as caused by the surprise effect noted by Cooper, Hanemann, and Signorello (2002) in the conventional double-bounded approach. This is because in the second stage, respondents are not asked to compare their true WTP with another value, but simply to *state* it by selecting a corresponding payment card. In this way, the second stage does not require the respondent to make another "decision." Hence, the true WTP each respondent uses in the first stage may be better preserved, which in turn reduces inconsistency.

the individual will refuse to purchase the GM oil at any price discount). Following Hanemann and Kanninen (1999) and assuming a linear utility function in (1), the probability of the true WTP_i being at least as great as P_i^0 can be written as:

$$(2) \qquad \Pr\left(WTP_i \geq P_i^0 = 0\right) = 1 - G(\mathbf{X}_i\beta)_i^0,$$

where $\mathbf{X}_i$ includes the payment card value P_i^0, G is a continuous cumulative distribution function, and β is a vector of unknown parameters.

Proper assumptions for the distribution of the error term in (1) will give a specific form for the distribution function G. If ε_i is assumed to have a Gumbel distribution,[5] (2) can be explicitly written as:

$$(3) \qquad \Pr\left(WTP_i \geq P_i^0 = 0\right) = 1 - LGT_i^0,$$

where LGT is a logistic distribution function with the form:

$$(4) \qquad LGT_i = \frac{1}{1 + \exp(\mathbf{X}_i\beta)}.$$

Based on similar procedures, the probability of WTP_i falling in other payment card intervals can be derived as follows:

$$(5) \qquad \Pr\left(P_i^{j+1} \geq WTP_i \geq P_i^j\right) = LGT_i^{j+1} - LGT_i^j \quad (j = 1, ..., M-1),$$

$$(6) \qquad \Pr\left(WTP_i \geq P_i^M\right) = 1 - LGT_i^M,$$

where P_i^M is the highest payment card value individual i may use to express WTP_i. The corresponding log-likelihood function can be expressed as:

$$(7) \qquad LL = \sum_{i=1}^{N}\left[d_0\ln\left(LGT_i^0\right) + \sum_{j=1}^{J-2} d_j\ln\left(LGT_i^{j+1} - LGT_i^j\right) + d_M\ln\left(1 - LGT_i^M\right)\right],$$

where d_0, d_M, and d_j are dummy variables respectively indicating whether an individual accepted zero, accepted the maximum, or a payment card lies between these values.

Based on these specifications, the mean and median WTP are given by the following:

$$(8) \qquad WTP_{mean-i} = \frac{\ln\left(1 + \exp\left(\sum \mathbf{X}_i\beta\right)\right)}{\beta_P}$$

$$(9) \qquad WTP_{median-i} = \frac{\sum \mathbf{X}_i\beta}{\beta_P}.$$

---

[5] Hu (2006) demonstrates that the estimated coefficient and WTP for the two most commonly used distributions (logistic and normal) are very similar. Therefore, we expect the WTP distribution function to behave similarly.

It is important to report both the mean and median WTP measures because, although these measures can be very close, depending on specific situations, they also can be quite different. If these two measures are different, a common rule of thumb in the related literature is to use the median as the true measure since the mean may be considerably affected by extreme observations in the WTP distribution (Hanemann and Kanninen, 2002). The median also reflects the voting nature of the valuation question in that it represents the cutoff point where 50% of the consumers will purchase the oil and the remaining 50% will not.

Survey Design and Data

The target product selected for this analysis is soybean oil. Soybean oil, together with rapeseed oil and peanut oil, are the three most widely consumed oils in Chinese households. The choice of soybean oil will therefore help to ensure that survey respondents are familiar with the product in question. In addition, soybean oil, given its mild flavor and extremely low cholesterol content, is usually considered by Chinese consumers to be high quality (Eating in China, 2004).

Data used in this study were collected in Nanjing, a major mid-east Chinese city located in the Yangzi Delta with a population of 6.4 million. In 2003, potential respondents were contacted through a telephone survey. The local telephone company in Nanjing does not normally release the list of registered phone numbers and their associated residences. Nevertheless, the first two digits of the seven-digit phone numbers reveal the sub-area of the city where the number is assigned. Twenty numbers were randomly generated for each sub-area based on the first two digits. If a selected number was not in use or was not a residence phone, the next closest number was substituted in place of the original number. To account for the potential sampling biases associated with telephone surveys (such as "not at home" or "weekdays only"), phone calls were made on three selected days of the week: Tuesday, Wednesday, and Saturday. In each day, calls were placed in three fixed time slots: 10am–11am, 3pm–4pm, and 7pm–8pm.[6]

A total of 523 individuals agreed to participate and answered at least some portions of the survey. Of these 523 responses, 449 were considered acceptable after accounting for data input errors and the exclusion of respondents who did not answer the key WTP questions. Table 1 reports the demographic characteristics of the 449 respondents in the final sample, as well as China's national average for comparison. The sample reflects the nationwide statistics well in categories of sex ratio, number of children in the household, income, and household size. Although the mean age of the sample (39) is noticeably higher than the national average (32), this finding is not unexpected, as only adults (at least 18 years of age) were sampled in the survey. The national average for education is 7.95 years, which includes the entire Chinese population older than six years of age. At a mean of 13.19 years, the survey sample has a higher average education level, again because only adults aged 18 and above were included. Overall, it can be concluded that the demographic characteristics of the sample are reasonably representative of the Chinese population.

---

[6] An inherent limitation with telephone surveys is that families who do not own a telephone may not enter the sample. However, one has to trade off this drawback against the benefits associated with a telephone survey, such as the interactive nature and high response rate. As can be seen from table 1, the sample is reasonably representative of the Chinese population, and we therefore conclude that the bias caused by this limitation is unlikely to be significant.

Table 1. Demographic Characteristics of Survey Sample, 2003 (*N* = 449)

Variable	Definition	Mean	Standard Deviation	National Average
MALE	Dummy variable = 1 if the respondent is male	0.503	0.501	0.517
AGE	Continuous variable for respondent's age (years)	39.018	13.844	32.260
EDUCATION	Continuous variable for respondent's years of schooling	13.192	3.336	7.952
CHILDREN	Continuous variable for number of children in household	0.472	0.586	0.649
INCOME	Continuous variable for household annual income (1 ¥ RMB)	31,247.19	16,346.90	30,182.96
HSIZE	Continuous variable for household size	3.290	1.014	3.360

The survey contains four sections and takes approximately 20 minutes to complete over the phone. The final design of the survey reflects input gleaned through several focus group discussions held on the campus of Nanjing Agricultural University. More importantly, the current survey is built upon the knowledge and experience gathered in a similar earlier survey conducted in 2002 (Zhong et al., 2002).

The first survey section contains questions on respondents' general perceptions about food safety and quality issues. The WTP questions are found in the second section of the survey. (The exact wording of the WTP and follow-up payment card questions are given in the appendix.) The initial WTP questions are first preceded by a general discussion of the definition of genetic modification. Responses to these questions form the respondent's WTP prior to receiving any specific real-life case information (positive or negative) about genetic modification.

In the third section, survey participants were randomly assigned to two scenarios containing real-life cases that may generate different personal reactions about GM food. Because consumers would be more likely to hear about cases regarding general GM food from different media sources, the survey examples in these two scenarios did not specifically include cases involving GM soybean oil. One five-case scenario was designed to provide cases which were expected to offer support for the application of GM technology. These cases involved actual quotes or examples that had occurred recently in China or elsewhere around the globe. The alternative scenario consisted of five cases that were expected to cast doubts on GM technology, potentially generating negative feelings toward GM soybean oil.

Table 2 details the cases for each of the two scenarios presented to respondents in the survey. Following the reading of each case description over the phone, respondents were asked about their purchasing intentions for GM oil. These questions were intended to explore only qualitative intentions, grouped as "may choose to buy," "may not choose to buy," and "do not know." The direct reason for eliciting these responses was to ensure that participants were actually paying attention to the cases read to them. Under both scenarios, the sequence of the five cases was randomly selected to minimize the ordering effects. After all five cases were read, respondents were asked once again the same WTP questions to which they had previously responded, with the format of these questions remaining identical to their earlier presentation. The final section of the survey collected information on personal characteristics of the participants.

Table 2. GM Food Cases Presented to Respondents Before Asking the Second WTP Question

Scenarios		Cases
Positive Cases (N = 208)	1	Since the first appearance of GM food in the market, there are about 200 million people in the world who have consumed GM food. Up to now, there is no report on any health accident discovered as the result of consuming GM food.
	2	Vitamin A deficiency causes 0.5 million children to become blind and 1 million people die every year worldwide. Using gene techniques, scientists have cultivated "golden rice" which is rich in vitamin A. This type of rice may greatly help to reduce the result of vitamin A deficiency.
	3	Hepatitis B is a severe disease of the liver that claims thousands of lives a year worldwide. Scientists have discovered a method for inserting genes of Hepatitis B antibodies into tomatoes so that individuals consuming the tomatoes will receive benefits similar to an actual injection of these antibodies.
	4	To test the safety of genetically modified animals on human health, scientists have used a species of genetically modified fish to feed lab mice. These GM fish grow much faster than they would naturally. Results show that no difference can be found between the mice fed this fish and the control group.
	5	It is a concern that the residuals of pesticide in vegetables and fruits may pose threats to human health. GM techniques have created new types of plants that are pest resistant and therefore require only a minimal amount of pesticide in their growing cycle.
Negative Cases (N = 241)	1	Scientists from the Chinese Academy of Science in Biology note that the commercialization of GM food has occurred only relatively recently. Yet the impacts of GM foods on human health and the environment may take 10 or 20 years or even longer to identify. Before extensive testing and experimenting have been completed, there will be risks associated with consuming GM foods.
	2	In the fall of 1998, a British scientist announced his research results on TV, stating that after feeding lab mice with GM potato leaves, he discovered that the internal organs of some of those mice have been malfunctioning and their immune systems have deteriorated.
	3	According to a public polling in 2003, only 14% and 34% of consumers in the UK and France, respectively, are willing to accept GM food. Some farmers have even dumped vegetables and fruits in front of some fast food restaurants to protest that these establishments sell food with GM ingredients.
	4	In 2000, a GM corn variety called "Starlink Corn," regulated only for animal feed, was detected in some taco shells sold for human consumption in the U.S. The U.S. government fined the producer of these taco shells.
	5	A major dairy products manufacturer has promised not to use milk containing GM trace in their milk production in many other foreign markets—but not in China. Mothers of young babies have expressed their concerns that their babies might have been used unknowingly as test subjects for these products with GM ingredients.

Before analyzing the impacts from the actual media reports on consumers' WTP, it is important to identify the potential effects of any preexisting perceptions respondents may have before they were presented with the additional real-life case information. If respondents have formed no preconceptions about GM oil beforehand, it would be appropriate to directly assess the impacts of the media reports. However, if respondents hold prior positive or negative attitudes on GM oil, the distribution of these respondents across the two subsamples (subject to positive or negative cases) may greatly affect the WTP estimates. To account for this possibility, the survey asked respondents several perception questions before any media reports were given.

Table 3. Respondents' Preexisting GM Perceptions in the Two Subsamples

Response Category	Subsample Given Positive Cases (N = 208)		Subsample Given Negative Cases (N = 241)	
	Number of Respondents	Percentage (%)	Number of Respondents	Percentage (%)
Heard about GM	81	38.94	109	45.23
GM is safe to eat	32	15.38	38	15.77
GM is *NOT* safe to eat	23	11.06	34	14.11

Note: The response category of "don't know if GM food is safe to eat" is omitted from both subsamples.

Table 3 provides both the number and the percentage of respondents who reported they have heard about GM food, as well as information on the number and percentage of individuals who feel GM food is safe to eat or not safe to eat (with the category of "do not know" omitted) within the two subsamples. As observed from table 3, the distribution of individuals who hold certain views (either positive or negative) on GM food is fairly similar across the two subsamples. This in turn reveals two results. First, the number of respondents who do not have any preexisting perceptions about GM food is high—a fact consistent with findings of previous studies on Chinese consumers (Li et al., 2002; Hu and Chen, 2004). Second, although there are some respondents who view GM food as either safe or not safe to eat, their impacts on the WTP estimates from the two subsamples are expected to be similar given their close resemblance in distribution across the two subsamples.

Results

In order to gain a preliminary knowledge of what respondents' answers to the two WTP questions may imply, table 4 presents the number of respondents in each WTP interval suggested by the payment cards both before and after the real-life cases are presented. The first column of the table shows the lower and upper bounds of the payment cards (0 and 55, respectively) as well as the mid-point of each interval. Before any real-life cases were reported, approximately 46% (205) of the 449 survey participants would pay zero for GM oil; i.e., they would not purchase GM oil and would not likely change their opinion based on any price discount. For the remaining respondents, 113 (about 25%) would pay 42.5 RMB, which is 2.5 RMB more than the current market price for GM oil. This small premium for GM oil clearly supports the general finding that some consumers are slightly supportive toward GM products, especially consumers in developing countries (Li et al., 2002; Curtis, McCluskey, and Wahl, 2004; Hu and Chen, 2004). Explanations for this support might be that consumers did prefer the positive attributes offered by the GM oil (such as higher productivity or less pesticide application), or they were seeking a different variety of product.

Next, the five positive real-life cases (table 2) were presented to a subset of 208 randomly selected respondents. Only 64 (31%) of these respondents indicated they would not purchase GM oil at any price discount. A total of 71 (34%) would pay 2.5 RMB above the normal market price of 40 RMB, and about 21% would pay as high as 7.5 RMB over this price (table 4). The total percentage of respondents whose maximum payment card value was less than 40 RMB was low (about 10% altogether).

Table 4. Distribution of Consumers' Intention to Pay for GM Soybean Oil Before and After Presentation of Specific Real-Life Cases

Payment Card Value (in RMBs)[a]	Before Any Case Information Is Presented		After Presentation of Positive Cases		After Presentation of Negative Cases	
	Observed (No.)	Frequency (%)	Observed (No.)	Frequency (%)	Observed (No.)	Frequency (%)
0	205	45.66	64	30.77	193	80.08
18.5	5	1.11	1	0.48	1	0.41
22.5	1	0.22	1	0.48	1	0.41
27.5	23	5.12	4	1.92	5	2.07
32.5	26	5.79	2	0.96	5	2.07
37.5	15	3.34	13	6.25	2	0.83
42.5	113	25.17	71	34.13	16	6.64
47.5	51	11.36	43	20.67	14	5.81
52.5	4	0.89	5	2.40	0	0.00
55 and above	6	1.34	4	1.92	4	1.66
Sum	449	100%	208	100%	241	100%

[a] RMB is the Chinese currency unit, where 1 ¥ RMB = $0.12 U.S. over the time of this study. The normal market price for GM soybean oil = 40 RMB/5-liter bottle.

In contrast, from the second subset of 241 respondents who received negative case reports on GM products, 193, or more than 80%, would refuse to buy GM oil at any price discount. A χ^2 test reveals this percentage is significantly higher than the percentage under either the positive cases scenario (31%) or respondents' WTP before their exposure to any real-life case reports (46%). Interestingly, even under the negative cases scenario, 13% of respondents still reported they would be willing to pay more than the 40 RMB normal market price for a 5-liter bottle of GM soybean oil.

While the implications from the above analysis are clear, the results do not offer a statistical basis for our conclusions, nor do they provide explanations for the factors that contribute to a consumer's WTP. Table 5 presents the estimation results for the WTP equations as a function of respondents' demographic characteristics and the price of the GM oil.[7] These effects are discussed below.

Male consumers have a marginally significantly higher likelihood of paying for GM oil after negative cases are reported. Older consumers are less likely to pay for GM oil, but this effect is only significant when no real-life information is provided about GM food. Consumers with more education are less likely to pay for GM oil in situations where no real-life information is presented as well as in situations when only positive cases are presented. Families with children, when given no additional case report information, are more likely to pay for GM oil. This finding contradicts other studies where the presence of children in the household has been found to have an insignificant or slightly negative effect. The possibility of multicollinearity across the explanatory

---

[7] Before any additional information in the form of real-life case reports was given, the entire sample of 449 individuals was analyzed in one pooled model. A dummy variable was added to test whether there is a difference in parameters between models of those who were later assigned to positive cases and those who were assigned to negative cases. The results show, as expected, that the dummy variable was not significant, which means the sample can be pooled together.

Table 5. Coefficient Estimates of the WTP Distribution Function

Variable	Before Any Case Information Is Presented		After Presentation of Positive Cases		After Presentation of Negative Cases	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Constant	2.476***	0.415	3.688***	0.642	0.401***	0.361
MALE	0.216	0.141	0.346	0.226	0.194*	0.102
AGE	−0.015***	0.005	−0.013	0.008	−0.005	0.004
EDUCATION	−0.159*	0.088	−0.377***	0.139	−0.070	0.097
CHILDREN	0.293**	0.135	0.191	0.182	0.022	0.088
INCOME	−0.101	0.089	−0.065	0.121	−0.127*	0.074
PRICE	−0.021***	0.002	−0.024***	0.003	−0.015***	0.004
No. of Respondents	449		208		241	
Log-Likelihood	−575.169		−235.536		−276.842	
Adjusted R^2	0.1082		0.099		0.081	

Notes: Single, double, and triple asterisks (*) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

variables might explain this result. However, multicollinearity does not affect the WTP estimates presented next. Income is only marginally significant under the negative cases scenario, indicating higher-income consumers were less likely to pay for GM oil in this situation. Finally, the price variable is significant and negative throughout the three scenarios.

Table 6 reports both the mean and median WTP estimates before and after the real-life case additional information was presented to respondents. The confidence interval for each estimate was obtained by bootstrapping with 5,000 repetitions. It can be observed that the mean WTP estimates are consistently greater than the median WTP values in all three scenarios, indicating the underlying WTP distributions under all three scenarios are skewed to the right. Given the previous discussion about the relationship between the mean and median WTP and the convention in the literature, we will refer only to the median WTP in the following discussion.

Before any real-life cases were presented, an average consumer would be willing to pay 34.47 RMB for a 5-liter bottle of GM oil, compared with the average market price of 40 RMB at the time of the survey, leading to a 14% price discount. The finding that consumers on average do not prefer GM foods is almost unanimous for earlier studies conducted in different countries with different foods as the target product (Lusk et al., 2005). According to Lusk et al., the price discount for GM food, or conversely, the price premium for the non-GM food, generally has been found to range from 10% to 70%, depending on various situations. Notably, however, the conclusion that consumers had negative attitudes toward GM foods and demanded a price discount is only true based on an average level. Indeed, studies have reported a great deal of heterogeneity among consumers' WTP toward GM food. While the majority of consumers are negative, there are also some individuals who are relatively neutral and may be even slightly supportive. These heterogeneities may be explained by social, economic, psychological, or other institutional factors. Although the focus of this investigation is not to explain differences among individual consumers, heterogeneity remains an important issue.

Table 6. Mean and Median WTP Estimates Before and After Case Presentation

Description	Before Any Case Information Is Presented	After Presentation of Positive Cases	After Presentation of Negative Cases
Sample Size	$N = 449$	$N = 208$	$N = 241$
Absolute Mean WTP (in RMBs)[a]	48.92 (33.79, 65.32)	54.31 (34.73, 75.96)	14.94 (7.44, 23.30)
Percentage Mean WTP Based on 40 RMB	22.30%	35.78%	−62.65%
Absolute Median WTP (in RMBs)[a]	34.47 (24.29, 44.93)	34.24 (23.23, 46.28)	13.42 (7.03, 20.51)
Percentage Median WTP Based on 40 RMB	−13.83%	−14.40%	−66.45%

[a] Values reported in parentheses are the 95% confidence intervals, based on 5,000 bootstrap repetitions.

After positive cases were presented, consumers' WTP for GM oil was 34 RMB, representing a price discount of approximately 14% (table 6). The confidence interval for this estimate overlaps with the confidence interval for consumers' median WTP calculated before the real-life cases were presented, suggesting the two WTP estimates are not statistically different from each other. In other words, the positive real-life stories did not have a significant impact on consumers' WTP. In dramatic contrast, when negative real-life cases were presented, consumers' WTP dropped to 13 RMB, which is a 66% discount from the market price. The confidence interval of the median WTP estimate in this scenario does not overlap with those under the other two scenarios. This finding suggests that the median WTP is statistically different (lower) than the WTP under the other two scenarios. Thus, the negative cases presented to the survey respondents in this study clearly had a strong negative impact on their WTP.

The important finding of the asymmetric impact of positive or negative information on consumers' choices and WTP is supported by earlier studies—not only in economics, but also in the disciplines of psychology and sociology. Attribution theory (Mizerski, 1982) generalizes the empirical evidence by arguing that individuals do have the tendency to place more weight on negative information than on positive information. Therefore, the same volume of these two types of information may have very different degrees of impacts on individuals' behavior. Prospect theory, as advanced by Kahneman and Tversky (1979), can also be used to explain this type of finding. Empirical studies applying prospect theory report that there may exist an asymmetric effect of risk and benefit perceptions on public acceptance or purchasing of GM food (Moon and Balasubramanian, 2004; Hu, Adamowicz, and Veeman, 2006). The information associated with the actual media reports may likely serve as a covariate in the formulation of consumers' risk and benefit perceptions.

Conclusion and Implications

This study has examined the impacts of real-life case reports describing GM food on Chinese consumers' WTP for vegetable oil made from GM oilseeds. The elicitation approach adopted is a hybrid of the double-bounded and the payment card methods. This procedure, while taking the structural advantage of the double-bounded approach, avoids some of the potential problems associated with the conventional double-bounded

design. A particular advantage of the method used in this study is its ability to address the issue of the lower-end bid problem.

WTP is elicited under three information conditions: (a) no information regarding GM food, (b) only actual real-life cases that may generate positive attitudes, and (c) only actual real-life cases likely to generate negative attitudes. The results clearly reveal that individual characteristics are important factors explaining WTP. When only positive cases are presented, consumers' WTP increases, and when only negative cases are presented, WTP drops sharply. Findings also show that in terms of the absolute magnitude, negative information has a much greater impact on consumers' WTP than positive information.

The results of this study could be case-sensitive. Both the positive and negative cases are recorded from either newspapers or TV programs. The survey did not provide the original sources for these reports (e.g., the government, producers, consumer groups, etc.). Due to the complexity of this issue, the source of information was not included as a focus of this analysis. However, this factor may be an important element in consumers' decision making (e.g., Hu, Chen, and Yoshida, 2006). Similarly, reports on cases of a different nature or varying magnitude of effects may very likely affect the WTP estimates as well. It is possible that a report on an extreme case (either extremely positive or extremely negative) may cause a significant structural change in consumers' WTP. Nevertheless, the cases used in the current study represent typical examples to which consumers would most likely be exposed. Consumers who are simultaneously exposed to both positive and negative case reports may exhibit different behavior altogether. The combination of positive and negative case reports may vary across individual, time, and location—thus requiring extensive survey data collection.

Rather than focusing on the specific value of WTP, the intent of this study was to provide answers to three general questions:

■ How can we analyze the impact of real-life case reports on consumers?

■ Do these real-life case GM reports have an effect on consumers' WTP?

■ Do these reports on positive and negative cases generate different responses?

An understanding of these issues may also prove to be useful for analyzing other food production and marketing situations with large public involvement and social welfare implications.

References

Brox, J. A., R. C. Kumar, and K. R. Stollery. "Estimating Willingness to Pay for Improved Water Quality in the Presence of Item Nonresponse Bias." *Amer. J. Agr. Econ.* 85,2(2003):414–428.

Calia, P., and E. Strazzera. "Bias and Efficiency of Single versus Double-Bound Models for Contingent Valuation Studies: A Monte Carlo Analysis." *Appl. Econ.* 32(2000):1329–1336.

Cooper, J., W. M. Hanemann, and G. Signorello. "One-and-One-Half Bound Dichotomous Choice Contingent Valuation." *Rev. Econ. and Statis.* 84(2002):742–750.

Curtis, K. R., J. J. McCluskey, and T. I. Wahl. "Consumer Acceptance of Genetically Modified Food Products in the Developing World." *AgBioForum* 7,1&2(2004):70–75.

DeShazo, J. R. "Designing Transactions Without Framing Effects in Iterative Question Formats." *J. Environ. Econ. and Mgmt.* 43(2002):360–385.

Eating in China. Online. Available at http://www.eatingchina.com/articles/art-soystory.html#oil, 2004. [Retrieved June 18, 2005.]

Flachaire, E., and G. Hollard. "Controlling Starting-Point Bias in Double-Bounded Contingent Valuation Surveys." *Land Econ.* 82,1(2006):103–111.

Hanemann, M., and B. Kanninen. "The Statistical Analysis of Discrete Response CV Data." In *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries*, eds., I. Bateman and K. Willies, pp. 392–442. New York/London: Oxford University Press, 2002.

Hu, W. "Use of Spike Models in Measuring Consumers' Willingness to Pay for Non-GM Oil." *J. Agr. and Appl. Econ.* (2006, forthcoming).

Hu, W., W. L. Adamowicz, and M. M. Veeman. "Labeling Context and Reference Point Effects in Models of Food Attribute Demand." *Amer. J. Agr. Econ.* (2006, forthcoming).

Hu, W., and K. Chen. "Can Chinese Consumers Be Persuaded? Case of Genetically Modified Vegetable Oil." *AgBioForum* 7,3(2004):124–132.

Hu, W., K. Chen, and K. Yoshida. "Japanese Consumers' Perceptions and Willingness to Pay for Credence Attributes Associated with Canola Oil." *J. Agr. and Appl. Econ.* 38,1(2006):91–103.

Huffman W. E., M. Rousu, J. F. Shogren, and A. Tegene. "Consumers' Resistance to Genetically Modified Foods: The Role of Information in an Uncertain Environment." *J. Agr. and Food Industrial Org.* 2(2004):1–13.

Huffman, W. E., J. F. Shogren, M. Rousu, and A. Tegene. "Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions." *J. Agr. and Resour. Econ.* 28,3(2003):481–502.

Kahneman, D., and A. Tversky. "Prospect Theory: An Analysis of Decision Under Risk." *Econometrica* 47(1979):263–291.

Kristrom, B. "Spike Models in Contingent Valuation." *Amer. J. Agr. Econ.* 79,3(1997):1013–1023.

Li, Q., K. R. Curtis, J. J. McCluskey, and T. I. Wahl. "Consumer Attitudes Toward Genetically Modified Foods in Beijing, China." *AgBioForum* 5(2002):145–152.

Lusk, J. L., and K. H. Coble. "Risk Perceptions, Risk Preference, and Acceptance of Risky Food." *Amer. J. Agr. Econ.* 87,2(2005):393–405.

Lusk, J. L., M. Jamal, L. Kurlander, M. Roucan, and L. Taulman. "A Meta-Analysis of Genetically Modified Food Valuation Studies." *J. Agr. and Resour. Econ.* 30,1(2005):28–45.

Manski, C. F. "Economic Analysis of Social Interactions." *J. Econ. Perspectives* 14,3(2000):115–136.

McCluskey, J. J., K. M. Grimsrud, H. Ouchi, and T. I. Wahl. "Bovine Spongiform Encephalopathy in Japan: Consumers' Food Safety Perceptions and Willingness to Pay for Tested Beef." *Austral. J. Agr. and Resour. Econ.* 49(2005):197–209.

McFadden, D. "Contingent Valuation and Social Choice." *Amer. J. Agr. Econ.* 76(1994):689–708.

Mizerski, R. "An Attribution Explanation of the Disproportionate Influence of Unfavorable Information." *J. Consumer Res.* 9(1982):301–310.

Moon, W., and S. K. Balasubramanian. "Public Attitudes Toward Agrobiotechnology: The Mediating Role of Risk Perceptions on the Impact of Trust, Awareness, and Outrage." *Rev. Agr. Econ.* 26(2004): 186–208.

Noussair, C., S. Robin, and B. Ruffleux. "Do Consumers Really Refuse to Buy Genetically Modified Foods?" *Economics J.* 114(2004):102–120.

Rousu, M., W. E. Huffman, J. F. Shogren, and A. Tegene. "Estimating the Public Value of Conflicting Information: The Case of Genetically Modified Food." *Land Econ.* 80,1(2004):125–135.

Werner, M. "Allowing for Zeros in Dichotomous-Choice Contingent-Valuation Models." *J. Bus. and Econ. Statis.* 17,4(1999):479–486.

Zhong, F., M. A. Marchant, Y. Ding, and K. Lu. "GM Foods: A Nanjing Case Study of Chinese Consumers' Awareness and Potential Attitudes." *AgBioForum* 5,4(2002):136–144.

Appendix:
Willingness-to-Pay Questions Asked in the Survey

Suppose there are two types of soybean oil for sale in a grocery superstore: one is labeled as containing GM ingredients and the other is labeled as containing no GM ingredients. The two oils are equivalent in all other qualities. Suppose the selling price of both these oils is 40 RMB per 5-liter bottle. Which type of oil would you buy?

- (a)   GM oil
- (b)   Non-GM oil
- (c)   Don't know or not sure

If the answer to the above question is (a), then ask the following questions:

Would you still consider buying the GM oil if it is more expensive than the non-GM oil?

- (1)   Yes
- (2)   No
- (3)   Don't know or not sure

If the answer is (1), then ask the following question:

For the GM oil, how much of an increase in price would you be willing to accept?
- (i)   Lower than 5 RMB
- (ii)   Between 5 RMB (inclusive) and 10 RMB
- (iii)   Between 10 RMB 10 (inclusive) and 15 RMB
- (iv)   Above 15 RMB

If the answer to the above question is (b), then ask the following questions:

Would you still consider the non-GM oil if the price of the GM oil is cheaper?

- (1)   Yes
- (2)   No
- (3)   Don't know or not sure

If the answer is (1), then ask the following question:

At least how much cheaper should the GM oil be before you would consider buying it?

- (i)   Less than 5 RMB
- (ii)   Between 5 RMB (inclusive) and 10 RMB
- (iii)   Between 10 RMB (inclusive) and 15 RMB
- (iv)   Above 15 RMB

If the answer to the above question is (c), then stop the WTP questioning.

■ ■ ■ ■ ■