

## 3 Survey

### Questionnaire Design

A multi-country comparative analysis of consumers' acceptance of GMO was conducted in United States, Taiwan, Japan and Norway. A revision of Chern *et al.* (2002) questionnaire was designed to have its lexical and idiomatic usage revamped to fit the customers in Taiwan. The questionnaire is composed of three major parts. The first part measures personal knowledge, understanding and perception with regards to genetically modified foods. Part two consists of a series of contingent valuation questions involving vegetable oil, tofu and salmon, and the final part mainly concerns with socioeconomic, demographic and other profiles of respondents.

The telephone survey was administrated in August 2003 with computer-assisted telephone interview (CATI) system. Stratified systematic sampling method was adopted. At the first stage, 25 cities (including Penghu, Lienchiang, and Kinmen county) in Taiwan are treated as strata. Required numbers of respondents in each stratum are calculated by multiplying required sample size, 1000 in this research, by the proportion<sup>2</sup> of respective stratum. Random-digit dialing method was then applied to determine which household to be interviewed in each city. A total of 1004 respondents completed this telephone interview.<sup>3</sup>

Table 1 itemizes the definitions, sample proportions, and standard deviations of those key variables collected from part 1 and 3 of the survey. A noteworthy point is that about 42% of the respondents considered themselves more or less know genetically modified produce while 32% said genetically modified food were detrimental to human health. Albeit these two self-reported questions reflect subjective knowledge and perception, we believe that what counts is not objective measure of understanding but their subjective reception. Compared with Kaneko and Chern (2005), which indicates that U.S. consumers have lower subjective knowledge and considered genetically modified foods risky, the figures seem to show that the consumers in Taiwan are more "adventurous", they do not hold a negative attitude toward genetically modified foods and are willing to consume them.

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<sup>2</sup>The relevant information is extracted from Ministry of Interior, Executive Yuan, Taiwan.

<sup>3</sup>401 of 1004 are assigned to answer their WTPP for salmon in section 2 and the rest are assigned to answer tofu and vegetable oil.

Table 2: Variable Definition and Summary Statistics

Variable	Description	Sample Proportion or Mean
Risk Perception		
UNDPR	Binary Response 1: if very well/somewhat informed about GMO or GM foods 0: Otherwise.	0.4281 (0.0269)
HEAPR	Binary Response 1: If one thinks GM food is extremely/somewhat detrimental to human health 0: Otherwise.	0.3263 (0.0256)
Consumption Characteristic		
LABEL	Binary Response 1: If one thinks it is very/somewhat important to impose a mandatory labeling regulation on GM foods 0: Otherwise	0.9011 (0.0163)
PUR	Binary Response 1: If one had ever purchased salmon in the previous year; 0: Otherwise	0.7634 (0.0230)
Socioeconomic Variables		
SEX	Binary Response 1: Male; 0: Female	0.7333 (0.0237)
EDU	School years	11.568 (3.572)
I-EDU	Binary Response 1: High school and above; 0: Below high school	0.3293 (0.0255)
AGE	Age of the respondent	43.431 (12.209)

<sup>a</sup> Sample size  $n = 334$ .

<sup>b</sup> In the parentheses are standard error of sample mean or sample proportion.

## Willingness to Pay Elicitation

Before introducing the willingness to pay elicitation in more detail, it would be helpful to know how the willingness to pay inquiry mechanism is designed. Basically, such questionnaire design doesn't allow us to investigate the individual price of GM and Non-GM simultaneously. Because the respondent tells us which product he/she is about to purchase under a specific price level, we can't infer how he/she thinks of the other one. For example, if a respondent choose Non-GM when  $P_{GM} = P_{GM}^*$  and  $P_{Non-GM} = P_{Non-GM}^*$ , we could only infer that the respondent is willing to pay more than  $P_{Non-GM}^0$  to buy Non-GM but we can't determine how he/she thinks of GM.

To overcome this shortcoming, rather than solving a two-dimensional perplexity, we concentrate on a one-dimensional problem, the price difference  $\Delta P = P_{Non-GM} - P_{GM}$ , instead.

Observing how respondents make their choice at various levels of price differences, we could apprehend what amount of payment they will pay for the risk premium. In the beginning, each respondent is asked to answer the following question first:

*Question 160: Suppose there are two kinds of farmed salmon, their appearance, smell and nutrition component are identical. The only difference is that one of which is fed by soybean derivative which is of GM variety, while the other one is fed by conventional non-genetically modified soybean derivative. If the price for these two sorts of salmons are both NT\$150 per 600 grams, which of the following options will you choose:*

- (1) Salmons fed with Non-GM derivative*
- (2) Salmons fed with GM powder derivative*
- (3) These two are indifferent*
- (4) Neither one*

The base price \$150 we used reflected prices found for the non-GM products in marketplace. Followed by question 160, usual double-bounded CVM questions are then presented to the respondents. In step one, each respondent is asked to decide either Non-GM or GM to consume but offered price increase for the commodity he/she choose or reduction for the commodity he/she didn't choose. Moreover, one of three price increasing(reducing) scenarios, 10%, 30%, and, 50% are randomly assigned.

In step two, the respondent is given the same choices as in step 1 but the price adjustment is half of the price adjustment he received in step 1.

In the following, we will go through all possible choices that the respondents might choose and specify their willingness to pay for premium accordingly.

### Case 1:

For those respondents who choose GM at the initial stage, at which the price difference is zero, the following graph illustrates how the price inquiry strategy is conducted.

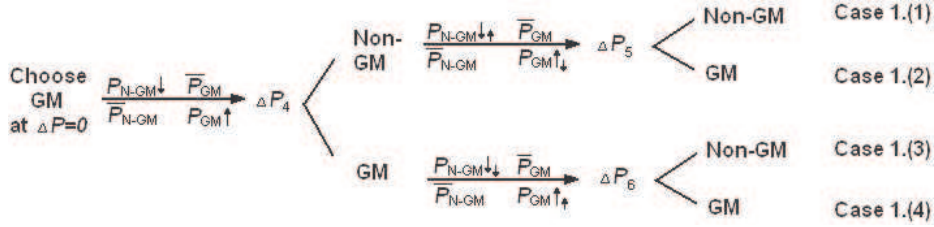


Figure 1: Choose GM at initial price \$150

The symbol  $P. \downarrow (\uparrow)$  means that the price for respective product is about to be lowered(raised),  $\bar{P}$  means the price is held constant, and the symbol  $P. \downarrow \uparrow (\uparrow \downarrow)$  means that the price is lowered in the first price adjustment and raised in the second.

According to Figure 1, the first price difference adjustment is either raising  $P_{GM}$  or lowering  $P_{Non-GM}$ . Denote the price difference at this step as  $\Delta P_4$  where  $\Delta P_4 < 0$ . Subsequent CVM questions are then proposed just as what we have discussed in the previous chapter. Specifically, if a respondent choose to purchase Non-GM at  $\Delta P_4$ , the follow-up question is to ask he/she which product he/she will choose if the price difference is  $\Delta P_5$  where  $\Delta P_4 < \Delta P_5 < 0$ .

Summarizing the responses that a participant answers at each stage, we could determine their censoring intervals for these 4 cases as shown in the following table. Recall that respondents are randomly assigned to one of the three different price increasing(reducing) scenarios. Therefore, for each case, there will be three different censoring intervals.

	Response	Censoring Interval for WTPP
Case1.(1)	(Non-GM , Non-GM )	(-38,0)
		(-22,0)
		(-8,0)
Case 1.(2)	(Non-GM , GM)	(-75,-37)
		(-45,-22)
		(-15,-8)
Case 1.(3)	(GM , Non-GM)	(-113,-75)
		(-67,-45)
		(-22,-15)
Case 1.(4)	(GM , GM)	(-C,-113)
		(-C,-67)
		(-C,-22)

A notable point is that the censoring range in Case1.(4) is  $(-C, \Delta P_6)$ , where  $-C$  is an artificial lower bound that we impose on WTPp. The reason why we impose such a lower bound is that we assume the price for GM product should not be higher

than that of the Non-GM counter part too greatly albeit we do allow the possibility that the price for GM could be higher.

**Case 2:** Similarly, we could illustrate the price inquiry strategy for those respondents who choose Non-GM at the initial price as Figure 2

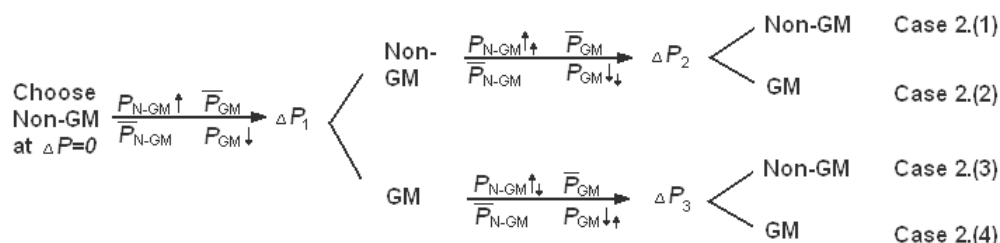


Figure 2: Choose Non-GM at initial price \$150

Summarize censoring range for these 4 cases as following table

	Response	Censoring Interval for WTPP
Case 2.(1)	(Non-GM , Non-GM)	113+
		67+
		22+
Case 2.(2)	(Non-GM , GM)	(75,113)
		(45,67)
		(15,22)
Case 2.(3)	(GM , Non-GM)	(37,75)
		(22,45)
		(8,15)
Case 2.(4)	(GM , GM)	(0,38)
		(0,22)
		(0,8)

<sup>a</sup> The symbol 113(67/22)+ means that the WTPP is greater than the respective value.

**Case 3:** The following graph is the price inquiry strategy for those respondents who choose Indifference at the initial price

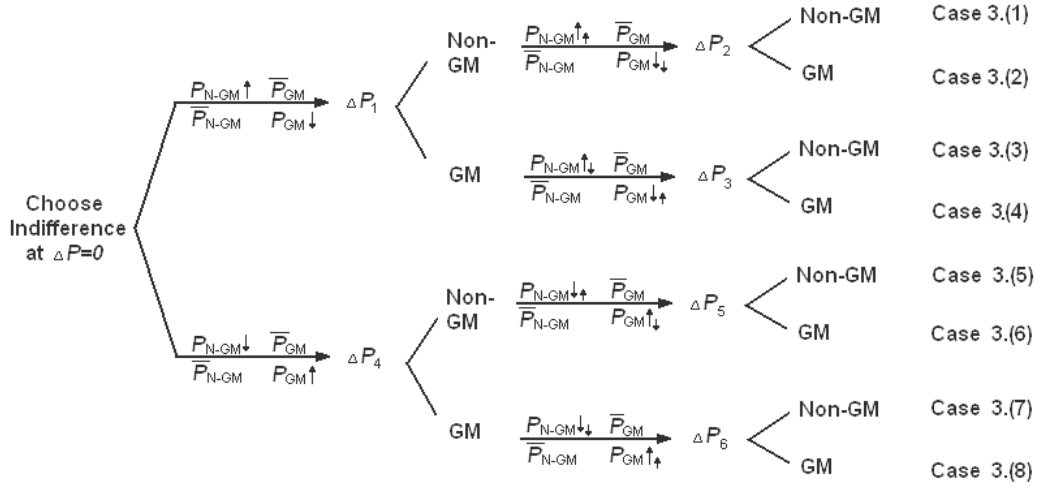


Figure 3: Choose Indifference at initial price \$150

Censoring range for these 8 cases are summarized in the following table

Response	Censoring Interval for WTPP
Case 3.(1) (Non-GM , Non-GM)	113+ 67+ 22+
Case 3.(2) (Non-GM , GM)	(75,113) (45,67) (15,22)
Case 3.(3) (GM , Non-GM)	(37,75) (22,45) (8,15)
Case 3.(4) (GM , GM)	(0,38) (0,22) (0,8)
Case 3.(5) (Non-GM , Non-GM)	(-38,0) (-22,0) (-8,0)
Case 3.(6) (Non-GM , GM)	(-75,-37) (-45,-22) (-22,-15)
Case 3.(7) (GM , Non-GM)	(-113,-75) (-67,-45) (-22,-15)
Case 3.(8) (GM , GM)	(-C,-113) (-C,-67) (-C,-22)

## Preference Analysis

Thanks to the recent advancement in biotechnology, the application of genetically modification technology ranges from the orchid that we grow in the greenhouse to the salmon that we eat in diner. Gallup’s survey in 2002 indicates that consumers are more willing to purchase genetically modified plants, such as orchid and soybean, than genetically modified living organism, such as salmon. Since consumers’ preferences differ from product to product, we should keep in mind that the concept “genetically modified product” is too general and vague. To avoid ambiguity, we had better investigate public preference product by product.

In this research, we are interested in figuring out with what traits a consumer will prefer to purchase Non-GM, GM, or either one. By specifying proper preference groups, we could solve another perplexity arising in willingness to pay analysis, the phenomenon that a certain percentage of the population is willing to purchase the commodity no matter how high the price is. In our study, the willingness to pay for premium is likely overestimated if those Non-GM consumers manifest their invariable resolution. To deal with this issue, we assume the willingness to pay for premium is measurable as long as the respondent is willing to purchase either product rather than GM or Non-GM favorer.

Question 218 and 219 best meet what we need for performing preference analysis. These two questions are as follow

*Q218(219): Under general situation, how is your inclination to purchase “Salmon fed with Non-GM soybean derivative”(Salmon fed with GM soybean derivative)*

*(1) Highly Likely*

*(2) Likely*

*(3) Not Sure*

*(4) Unlikely*

*(5) Extremely Unlikely*

According to these two questions, we could classify the respondents into the following table. Only if a respondent choose *(5) Extremely Unlikely* that we will considered him/her impossible to purchase the respective product, otherwise he/she is deemed as a possible buyer

		<i>Non-GM</i>	
		Possible	Impossible
<i>GM</i>	Possible	$n_{11}$	$n_{12}$
	Impossible	$n_{21}$	—

By the above table, our three preference groups are defined as: subjects who purchase Non-GM product only, subjects who purchase GM product only, and subjects who purchase either GM or Non-GM product. In general, we would not expect the number of subjects in group 2,  $n_{12}$ , to be too large since such option is unusual in our cognition. On the other hand, we do expect the number of subjects in group 3,  $n_{11}$ , to be reasonably large as they are the respondents that we are of interest the most.