Some Problems in Estimating Willingness to Pay
with Contingent Valuation Surveys:
Case for Consumer Acceptance of Genetically Modified Food

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Abstract:

This paper reports results from a U.S. national telephone survey on genetically modified foods.   The objectives of this paper are to determine the effect of "indifference" response on the estimate of willingness to pay and to test the assumption of common marginal utility of money among respondents.

Keywords: Genetically modified foods, contingent valuation, willingness to pay

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Introduction

        Modern food technology has produced foodstuffs that possess ambiguous qualities. Genetically modified (GM) foods are a case in point.   Some consider GM foods to be unwanted products that impose all the risks on consumers without tangible benefits while others regard GM foods as an innovation that allows environmentally sounder farming practices (Fernandez-Cornejo and McBride, 2002).   It is true that the first-generation GM foods lack direct consumer benefits, but some consumers may still appreciate environmental benefits.

        Many researchers have been investigating consumer acceptance of GM foods in various countries (Lusk et al., 2005).   The methods used by these researchers widely differ, and the direct comparison is difficult, but several observations are shared by these studies. One of the strongest tendencies is that consumers' acceptance is dependent on risk perception. However, it is important to note that consumers tend to overestimate small risks, especially when they are unfamiliar with the risks (Slovic, 1987).   Consumers do not usually weigh the benefits and risks involved in a particular food choice; instead, they trust the food retailers to assure at least a minimum level of food safety.   Therefore, the researcher needs to be careful not to amplify consumers' risk perception when conducting a survey.

        Another common theme is that most consumers are not informed very well about GM foods, let alone the technology that makes them possible.   Under this condition, the researcher faces a dilemma: if she does not inform the consumer-respondents about the GM foods, then the survey research will fail to observe consumers' informed choice, but if she provides the information (about risks, especially), then it may send an uncalled-for signal that may dominate the respondents decision.   The researcher must be extremely sensitive about the content and wording of the information.

        As many consumers are uninformed about GM foods, it is unlikely that they have strong attitudes toward GM foods.   In that case, they may find it difficult to choose between

the non-GM and GM foods.   Since the choice between the non-GM and GM foods is a

discrete decision, the respondent may feel impossible to accurately map their preference into

the dichotomous choice options.   We do not know how the respondents will answer to the

question if neither option seems quite appropriate to them.   It is one of the purposes of the

paper to demonstrate that indifference between the non-GM and GM alternatives is a

legitimate answer option.

As the presence or absence of GM ingredients in a foodstuff is a credence attribute,

the difference between the non-GM and GM alternatives should depend on the consumer's

perception.   There is some evidence that the GM acceptance differs among segments of

consumers (Baker and Burnham, 2001).   Some consumers are unwilling to buy GM foods

while others do not really care about the presence of GM ingredients.   This means that the

willingness of consumers to trade off an additional (perceived) risk for money may be

significantly different.   Yet most valuation studies on consumer acceptance of GM foods

assume that the marginal utility of income (MUI) is the same for the entire sample.   This can

allow a small proportion of consumers with extreme views to exert an excessively large

influence in the estimation of willingness to pay of the entire sample.   The second purpose

of the paper is to demonstrate that this is of great concern for empirical studies.

The objectives of this paper are to determine the effect of "indifference" response on

the estimate of willingness to pay and to test the assumption of common marginal utility of

income (MUI) among respondents.   We first estimate a multinomial logit model and find

that the "indifference" response is a legitimate answer choice in contingent valuation question

and that omitting it may distort the willingness-to-pay estimate.   We next estimate binary

probit models and test the equality of MUI.   We find that the non-GM choosers have a

statistically different MUI and demonstrate that the assumption of common MUI will lead to

overestimate of willingness to pay for non-GM foods.   The paper concludes with discussion

of our findings.

Method

In order to elicit consumers' willingness to pay a premium for the non-GM alternative, we consider the paired choice between the non-GM and GM alternatives, rather than explicitly offering a premium (in dollars or in percentages) and asking the respondents a yes-no question.   We initially ask a paired choice question without a price difference. Since the two alternatives are the same except the presence or absence of GM ingredients, what differentiates the two is the respondent's perception of GM ingredients.   If the use of GM ingredients does not affect the utility of the respondent, the two alternatives will yield the same utility, and the respondent should be indifferent.   Recognizing this, we provide five answer options: (1) non-GM, (2) GM, (3) indifferent, (4) neither, and (5) don't know.   We will estimate a multinomial logit model with only individual characteristic (and not product attribute) variables as explanatory variables.

After the initial question with no price difference, we add a price difference to the initial paired choice question.   To analyze the paired choice with price difference, we invoke the random utility maximization framework (Haab and McConnell, 2002).   Let y denote the income, x a vector of respondent i's characteristics, and P the posted price of the product. Then, consumer preferences are represented by the indirect utility function as follows:

$$U_i^j = \beta_0^j + \beta_1^{j\prime} x_i + \beta_2 (y_i - P_i^j) + \varepsilon_i^j,$$

where subscript i indexes respondent and $j = $ NG or GM.   For now, we assume a common MUI so that there is no superscript on β_2.   Respondent i chooses the non-GM alternative if

$U_i^{NG} > U_i^{GM}$.   Let $\Delta U_i = U_i^{NG} - U_i^{GM}$.   Then, $\Delta U_i = \beta_0 + \beta_1' x_i - \beta_2 \Delta P_i + \varepsilon_i$, where

$\beta_0 = \beta_0^{NG} - \beta_0^{GM}$, $\beta_1 = \beta_1^{NG} - \beta_1^{GM}$, $\Delta P_i = P_i^{NG} - P_i^{GM}$, and $\varepsilon_i = \varepsilon_i^{NG} - \varepsilon_i^{GM}$.   We assume

that ε_i are independently and identically distributed as normal with mean zero and variance σ^2.

Then the probability of choosing the non-GM alternative is expressed as

$$\Pr(\text{Choose NG}) = \Pr(\Delta U_i > 0)$$

$$= \Pr\left(\frac{\varepsilon}{\sigma} < \frac{\beta_0 + \beta_1' x_i - \beta_2 \Delta P_i}{\sigma}\right)$$

$$= \Phi(\beta_0^* + \beta_1^* x + \beta_2^* \Delta P_i),$$

where $\beta_0^* = \beta_0 / \sigma$, $\beta_1^* = \beta_1 / \sigma$, and $\beta_2^* = -\beta_2 / \sigma$. For the present analysis, the

parameters with asterisks are estimated and reported.[1] The expected non-GM premium has

the following form:

$$E[WTP_i \mid x_i] = -(\beta_0^* + \beta_1^{*'} x_i) / \beta_2^*.$$

To relax the assumption of common MUI, we include the interaction terms ΔP^*NG and

ΔP^*GM as additional explanatory variables, where NG and GM are dummy variables that

indicate that the respondent prefers the non-GM and GM alternatives, respectively, given

both having the same price. If $NG = GM = 0$, then the respondent feels that the non-GM and

GM alternatives are equally good. No special change is required either in the estimation or

in the computation of the willingness to pay in order to incorporate the slope dummies; only

the formula for the expected non-GM premium is affected, which is now expressed as

$$E[WTP_i \mid x_i] = -(\beta_0^* + \beta_1^{*'} x_i) / (\beta_2^* + \alpha_1 NG_i + \alpha_2 GM_i),$$

where α_1 and α_2 are coefficients on the slope dummies.

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[1] The asterisked parameters are scalar multiples of corresponding nonasterisked paremeters. Since the willingness-to-pay value can be expressed fully in terms of the asterisked parameters, and we are not particularly interested in the nonasterisked ones, we do not recover the latter from the former.

Data

The data are drawn from a U.S. national telephone survey that was conducted in 2003. Telephone interviews were conducted with the random-digit dialing method on 1,014 food shoppers of age 18 or older in the contiguous 48 states of the United States. The respondents answered questions about their knowledge, perception, and attitudes on GM foods. They then answered a series of contingent valuation (CV) questions (first without and second with price difference) about the choice between non-GM and GM alternative food products (vegetable oil, cornflakes, and salmon).[2] The respondents were randomly asked either about vegetable oil and cornflakes or about salmon only. The size of the vegetable oil sample is 622, of which 481 provided responses usable to the econometric analysis.[3] After the CV questions, the respondents answered questions about their socio-economic background.

The price difference given in the follow-up CV question was distributed among the respondents according to a random design. For those who chose the non-GM or GM alternative, either the price of the forgone alternative was discounted or the price of the chosen alternative was raised. The rate of price discount was 10%, 30%, 50%, or 70% while the rate of price increase was 10%, 30%, or 50%. The respondent received one of the above seven treatments randomly. The random distribution of treatments was facilitated by the software used for the computer-assisted telephone interviews. For those who indicated indifference between the non-GM and GM alternatives, we used the same randomization

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[2] In the present analysis, only the vegetable oil data are used.
[3] Of the 622 respondents, twenty-nine refused to answer the CV question altogether. Eighty respondents refused to choose either one of the alternatives. The remaining 513 respondents chose either the non-GM or GM alternative (or both) in the initial screening question, but thirty-two of them did not answer the follow-up question. Although the eighty respondents who chose neither alternative are somewhat older than the remaining sample, simply dropping them does not affect the conclusions of the paper.

scheme of price discount and price increase, but with an additional piece of randomization: the half was treated as if they had chosen the non-GM alternative, and the other as if they had chosen the GM alternative.   In the second CV choice question with a price difference, we allowed only two substantive choice options: (1) non-GM or (2) GM.   The binary choice data obtained this way are used to estimate probit models.

Results

Effect of Indifference

Table 1 lists the individual characteristics variables of interest with their definitions and descriptive statistics according to the response to the initial paired choice.   By looking down the numbers for each of the column heads from "Non-GM" to "Don't Know," we can roughly sketch the profiles of the five groups.

(1) Non-GM group: This group is very much unwilling to consume GM foods, but it consists of a number of respondents who are somewhat willing to consume GM foods. Demographically speaking, this group is characterized by highest educational achievement and highest income.   This group has the second-lowest level of subjective knowledge, next only the "Don't Know" group, which is consistent with House et al. (2004).   The lack of confidence in knowledge is supported by the relatively low level of objective knowledge.   The highest educational achievement seems to promote precautionary behaviors rather than acceptance of GM foods.   For instance, this group has a relatively low level of confidence in the government and high level of risk perception.   The high concentration of women also supports the group's cautious attitude.

(2) GM group: This group has a very large proportions of "extremely willing" and "somewhat willing" respondents, and very small proportions of "somewhat unwilling"

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and "extremely unwilling" respondents.   This group has a relatively high level of risk perception; roughly half of the respondents in the GM group consider GM foods to be at least somewhat risky, and yet they chose the GM alternative.   This group has a relatively high level of subjective knowledge although its objective knowledge is of about the same level as the non-GM group.   Thus, this group is quite self-confident and bold with regard to the choice between the non-GM and GM foods.   This group is also characterized by lower educational achievement and lower income, in sharp contrast with the non-GM group.   The proportion of male is higher than for the non-GM group.

(3) Indifference group: The profile of indifferent respondents bears some similarity to that of GM choosers, but there are important differences.   This group is characterized by the lowest level of risk perception, which is matched by high subjective and objective knowledge.   Both the educational achievement and income level are the second-highest, next to the non-GM group.   This group also has the highest proportion of male respondents.   Thus, there is a population of relatively well-educated and wealthy consumers who are not reluctant to accept GM foods.

(4) Neither group: This group is characterized by the highest concentration of those who are extremely unwilling to consume GM foods.   This group has a high subjective knowledge but a low objective knowledge.   The confidence in the government is also very low, which may be why the group chose "neither" since what is available on the market is what is approved by the government.   Although the most frequently cited reason for belonging to this group was that the respondents do not buy vegetable oil, 17.5% opposes to the use of GM technology in food production, so the group shares cautious attitude with the non-GM group.   The important distinction is, however, that this group is not in the market while the non-GM group is.

(5) Don't-Know group: The proportion of positive and negative sentiments is more or less

balanced in this group; those who hold positive and negative views are equally likely to say "don't know." It is notable that the profile of the entire sample is quite similar to that of the "don't know" group. This is so because positive and negative views tend to cancel out when they are aggregated. This group is characterized by the lowest knowledge (both subjective and objective) and the lowest educational achievement. These factors usually contribute to inability to optimally choose substantive option and hence the choice of don't-know option in survey research. Notice the difference between this group and the indifference group; indifference is definitely not the same as "don't know."

By comparing and contrasting the five groups above, we find that the indifference group stands alone and cannot be subsumed under any other group.

Table 2 presents the results of a multinomial logit model to account for the multinomial choice when the respondents are presented a choice between non-GM and GM alternative oils. We provide only the marginal effects of the explanatory variables on the probability that the answer option is chosen. As is evident, the non-GM and indifference options have more significant variables than others. These two options draw a sharp contrast in many ways. For instance, "extremely willing" respondents are more likely to choose the indifference option and less likely to choose the non-GM option. They are also more likely to choose the GM option, but the marginal effect is larger for the indifference option than for the GM option. "Extremely unwilling" and "somewhat unwilling" respondents are more likely to choose the non-GM alternative and less likely to choose the indifference or GM option. The marginal effect in absolute terms is once again larger for the indifference option than for the GM option. These results tell us that indifference is the opposite of choosing the non-GM alternative, more so than choosing the GM alternative. Thus, the indifference option deserves the status of substantive answer option. It is also

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important to note that merely observing the revealed choice behavior never identifies indifference because indifference reveals itself as either a non-GM or GM choice.

Since we did not have a split-ballot design with and without the indifference option, it is impossible to formally test the effect of including the indifference option. There are three possibilities when the indifferent respondents are not given an indifference option: (1) choose the non-GM alternative; (2) choose the GM alternative; or (3) answer "don't know." If 50% of the indifferent respondents choose (1) and the remaining 50% choose (2), then the willingness-to-pay estimate will not severely distorted, but if the split is not 50-50, distortion depends on the split. If the prevailing option is (3), then the willingness-to-pay estimate will be biased because a group of respondents with distinctive characteristics are systematically excluded from the sample.

Effect of Common MUI

It is revealing to study willingness-to-pay values for non-GM, GM, and indifferent groups. To sum up, we note that the choice behavior of the non-GM group is more or less dominated by perception and attitude variables, but those in the GM and indifference groups make their choice primarily on the basis of price. Figure 1 exhibits the price sensitivity of different groups. Panel (a) of Figure 1 presents the responses to the second CV question of those who chose the non-GM and GM alternatives in the screening question. The right half of the panel indicates the proportions of non-GM and GM choice by the non-GM choosers at alternative price differences.[4] As is evident, nearly 80% of non-GM choosers still choose the non-GM alternative even though the GM price was lowered by 70%, i.e., at the largest

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[4] The price difference is computed by subtracting the GM price from the non-GM price. Although there are seven random treatments for the follow-up question, the distinction between price increase and price discount is lost when taking the price difference. Thus, the diagram looks as if there were only four random treatments for both the non-GM and GM choosers when in fact the two groups each receive seven treatments.

price difference of $1.40.[5]   When this price-insensitive response pattern is linearly

extrapolated, the distribution of non-GM premium should have a fat upper tail and many

individuals in the extremely high value range.   On the other hand, the GM choosers are

more inclined to switch to the cheaper non-GM alternative, as nearly 35% switched to the

non-GM oil as its price was reduced by 70% or at the price difference of negative $1.40.

Panel (b) of Figure 1 presents the indifferent respondents' responses to the alternative price

differences.   Although the non-GM proportion is not monotonically decreasing (as it should

be in theory), the indifferent respondents indicate a much higher sensitivity to price

incentives with only 5% choosing the non-GM oil when it is $1.40 more expensive than the

GM oil.

We estimated five binary probit models (see Kaneko and Chern, 2006 for details).

The first three models are estimated with subsamples (i.e., the non-GM, GM, and indifference

groups).   For the last two models, we pooled the above subsamples with and without

common MUI assumption (model 1 and model 2, respectively, in Table 2 of Kaneko and

Chern, 2006).   The results indicate that naïve pooling (model 1) retains statistical

significance of explanatory variables with improvement on the significance of MUI (i.e.,

coefficient on ΔP).   The significance of MUI is somewhat deceptive if we consider the fact

that the non-GM choosers are quite insensitive to the price incentives, which is immediately

apparent with a casual inspection of Figure 1.   To illustrate the problem, we estimated a

pooled model with slope dummies (coefficients on $\Delta P*NG$ and $\Delta P*GM$).   We observe that

variable $\Delta P*NG$ significantly affects the choice between the non-GM and GM alternatives,

and the two-sided t-test rejects at the 5% level of significance the hypothesis that the non-GM

segment has the same MUI as the indifferent respondents.   The coefficient on $\Delta P*NG$ is

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[5] For the non-GM choosers, the largest price difference is a 70% discount on the GM
alternative.   In this case, the non-GM price is held fixed at $2.00, and the GM price is
discounted by 70% to obtain $0.60.   The price difference is computed by subtracting the
latter from the former.

positive, which means that the MUI for the non-GM segment is small in absolute value.

This implies that the non-GM segment's choice behavior is affected so much by factors other

than price, unlike the GM segment's or indifferent respondents'. On the other hand, the

coefficient on ΔP^*GM is not significant, which implies that the GM choosers have the same

MUI as the indifferent respondents.[6] Thus, the non-GM choosers stand out from the rest of

the sample as they are unwilling to switch alternatives, given the price incentives.

To further illustrate the problem of the common MUI assumption, we provide

histograms, or empirical distributions of non-GM premiums estimated by alternative models.

Panel (a) of Figure 2 is the distribution based on the separate estimation while panel (b) is

that based on pooled model with the common MUI assumption. As is obvious, the

distribution in panel (a) is far more dispersed than that in panel (b). Moreover, panel (b) has

a more clearly bimodal distribution than panel (a), with the upper tail truncated abruptly at

around $3.00. This shape is mainly attributable to the assumption of common MUI. When

the three respondent segments are pooled and the assumption of common MUI is imposed,

the MUI (in absolute value) is overestimated for the non-GM segment while underestimated

for the GM and indifference segments. Since the MUI appears in the denominator of the

formula for the non-GM premium, the non-GM segment's premium is underestimated while

the GM and indifference segments' are overestimated, which causes the premium distribution

to shrink toward the middle. Hence, the distribution in panel (b) of Figure 2 is clearly

distorted. Panel (c) presents the premium distribution derived from model 2. Since the

common MUI assumption is relaxed, there is no shrinkage as found in panel (b). In fact, the

distribution in panel (c) reproduces that in panel (a) with remarkable accuracy: high peaks

around $0.00 and lower peaks from around $1.60 to around $5.60. With the use of slope

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[6] We note that the insignificance of the coefficient on ΔP^*GM may be due to the small size
of the GM segment. Even so, the absolute value of the coefficient on ΔP^*GM is smaller
than that of the coefficient on ΔP^*NG.

dummies, we predict that there are a significant number of respondents who have very high non-GM premiums while the common MUI assumption artificially truncates the premium distribution at a relatively low level.

Conclusions

In this paper, we estimated a multinomial logit model to account for the multinomial choice faced by consumers when the non-GM and GM foods are provided side by side. We also estimated probit models with alternative specifications, using different combinations of samples. We found that the indifference response is definitely not the same as the don't know response; it reflects the optimal mapping of consumers' preferences into the answer options. Although the effect of omitting the indifference option could not be tested formally, we argue that contingent valuation studies will benefit from considering including the option (if it is natural to the CV scenario such as ours). We also found that the researcher should consider the segment effect on the estimation of willingness to pay. In our case, the marginal utility of income (MUI) is a measure of how much consumers are willing to trade off an additional (perceived) risk for a price discount, the assumption of common MUI may be unrealistic, given the diverse consumer preferences.

We used a contingent valuation survey with a screening question that allowed the researcher to identify segments of respondents according to their willingness to pay a premium for a non-GM product vis-à-vis the GM counterpart. The information on the identified segments was used in econometric analysis to derive the sample distribution of willingness to pay a non-GM premium. When a separate probit model was estimated for each segment, the distribution of premium was somewhat bimodal and quite widespread with a large proportion of respondents in the very high price range and a cluster of respondents at around zero. However, when the segments are pooled with the assumption of common MUI,

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the distribution of premium was more clearly bimodal with the upper tail truncated at around

$3.00.   Another pooled-sample probit model was estimated with the assumption of common

MUI relaxed by including slope dummies.   We found evidence that the respondents in the

non-GM segment have a different marginal utility of income from the rest of the sample.

There are two interpretations for the above result.   If the non-GM segment's

response to the price incentives is genuine, it follows that the non-GM segment has an

extremely large non-GM premium.   On the other hand, if the response is not genuine, the

assumption of common MUI for the entire sample may be sustained.   We generally cannot

tell the difference just by examining the survey responses.   One lesson to be learned from

this study is that the identification of segments is extremely important as it has a direct

implication on the distribution of welfare measure.   In our application of GM food, we saw

that the distribution of non-GM premium had a bimodal distribution.   The screening

question allowed us to obtain a bimodal distribution using only a simple probit model and

segment dummies.   Without such information, econometrically more involved model must

be used, and estimation would be more difficult (e.g., Hu et al. 2004).

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Table 1. *Definition of variables and sample means and standard deviations*

Variable	Definition	Non-GM	GM	Indifferent	Neither	Don't Know	All
Will1	1 if one is extremely willing to	0.011	0.151	0.187	0.050	0.034	0.084
	consume GM foods; 0 otherwise	(0.106)	(0.361)	(0.391)	(0.219)	(0.186)	(0.277)
Will2	1 if one is somewhat willing to	0.288	0.547	0.503	0.250	0.345	0.375
	consume GM foods; 0 otherwise	(0.454)	(0.503)	(0.501)	(0.436)	(0.484)	(0.484)
Will3	1 if one is neither willing nor unwilling	0.161	0.132	0.187	0.138	0.138	0.162
	to consume GM foods; 0 otherwise. (Dropped.)	(0.368)	(0.342)	(0.391)	(0.347)	(0.351)	(0.369)
Will4	1 if one is somewhat unwilling to	0.303	0.057	0.083	0.213	0.172	0.196
	consume GM foods; 0 otherwise	(0.461)	(0.233)	(0.276)	(0.412)	(0.384)	(0.397)
Will5	1 if one is extremely unwilling to	0.213	0.075	0.031	0.300	0.103	0.151
	consume GM foods; 0 otherwise	(0.411)	(0.267)	(0.174)	(0.461)	(0.310)	(0.358)
Risky	1 if one considers GM foods to be extremely	0.625	0.509	0.311	0.575	0.310	0.497
	or somewhat risky to human health; 0 otherwise.	(0.485)	(0.505)	(0.464)	(0.497)	(0.471)	(0.500)
S_Know	1 if one considers oneself very well or somewhat	0.566	0.623	0.622	0.613	0.483	0.590
	informed about GM foods; 0 otherwise.	(0.497)	(0.489)	(0.486)	(0.490)	(0.509)	(0.492)
O_Know	Number of correct answers to three	1.588	1.585	1.819	1.488	1.034	1.621
	true or false questions.	(1.001)	(1.046)	(1.017)	(0.968)	(1.085)	(1.022)
Govt	1 if one grades the government's food safety	0.472	0.566	0.611	0.375	0.310	0.503
	policies as excellent or good; 0 otherwise.	(0.500)	(0.500)	(0.489)	(0.487)	(0.471)	(0.500)
Kids	1 if one lives with kids under age 18;	0.442	0.415	0.430	0.375	0.414	0.426
	0 otherwise.	(0.498)	(0.497)	(0.496)	(0.487)	(0.501)	(0.495)
College	1 if one attains bachelor's degree or higher;	0.416	0.245	0.399	0.388	0.207	0.383
	0 otherwise.	(0.494)	(0.434)	(0.491)	(0.490)	(0.412)	(0.486)
Age	One's age as of 2003 divided by 100.	0.450	0.454	0.458	0.528	0.509	0.466
		(0.154)	(0.162)	(0.164)	(0.162)	(0.147)	(0.160)
Male	1 if male; 0 if female.	0.258	0.264	0.321	0.250	0.241	0.277
		(0.439)	(0.445)	(0.468)	(0.436)	(0.435)	(0.448)
TV	1 if one uses TV or radio most often to obtain	0.109	0.226	0.124	0.163	0.276	0.138
	information on food; 0 otherwise.	(0.312)	(0.423)	(0.331)	(0.371)	(0.455)	(0.345)
Shop1	1 if one goes grocery shopping several times	0.333	0.340	0.316	0.525	0.379	0.355
	a week; 0 otherwise.	(0.472)	(0.478)	(0.466)	(0.503)	(0.494)	(0.479)
Shop2	1 if one goes grocery shopping once a week;	0.476	0.509	0.503	0.300	0.379	0.460
	0 otherwise.	(0.500)	(0.505)	(0.501)	(0.461)	(0.494)	(0.499)
Shop3	1 if one goes grocery shopping less frequently than	0.187	0.151	0.176	0.163	0.241	0.180
	Once a week; 0 otherwise. (Dropped.)	(0.391)	(0.361)	(0.382)	(0.371)	(0.435)	(0.385)
Recyc1	1 if one always recycles paper, cans, and	0.502	0.415	0.466	0.500	0.414	0.479
	bottles; 0 otherwise.	(0.501)	(0.497)	(0.500)	(0.503)	(0.501)	(0.500)
Recyc2	1 if one often recycles paper, cans, and	0.161	0.132	0.119	0.113	0.069	0.135
	bottles; 0 otherwise.	(0.368)	(0.342)	(0.325)	(0.318)	(0.258)	(0.342)
Recyc3	1 if one never, rarely, or sometimes recycles paper,	0.337	0.453	0.399	0.388	0.517	0.381
	cans, and bottles; 0 otherwise. (Dropped.)	(0.474)	(0.503)	(0.491)	(0.490)	(0.509)	(0.486)
Info1	1 if one actively search for information about	0.367	0.321	0.332	0.438	0.310	0.359
	food safety and nutrition; 0 otherwise.	(0.483)	(0.471)	(0.472)	(0.499)	(0.471)	(0.480)
Info2	1 if one gets information about food safety and	0.375	0.358	0.383	0.338	0.448	0.375
	nutrition occasionally; 0 othewise.	(0.485)	(0.484)	(0.487)	(0.476)	(0.506)	(0.484)
Info3	1 if one rarely gets information about food safety	0.251	0.302	0.285	0.225	0.241	0.262
	and nutrition; 0 otherwise. (Dropped.)	(0.434)	(0.463)	(0.453)	(0.420)	(0.435)	(0.440)
Inc	Annual household income in dollars divided	7.390	6.284	6.893	6.459	4.541	6.899
	by 10,000.	(7.185)	(5.728)	(5.054)	(6.390)	(3.465)	(6.244)
N	Number of respondents.	267	53	193	80	29	622

[a] Nonparenthesized numbers are sample mean values except those for variable *N*, which are the sample sizes.

[b] Parenthesized numbers are sample standard deviations.

[c] Numbers in brackets are numbers of respondents whose income is known.

Sources: Primary survey data.

Table 2.   Multinomial Choice for the Initial CV Question[a]

	Non-GM	GM	Indifferent	Neither	Don't Know
Will1	-0.561***	0.145***	0.417***	0.024	-0.024
	(0.158)	(0.047)	(0.105)	(0.078)	(0.033)
Will2	-0.046	0.043	0.077	-0.051	-0.023
	(0.061)	(0.030)	(0.053)	(0.044)	(0.015)
Will4	0.301***	-0.093**	-0.205***	0.022	-0.024
	(0.073)	(0.047)	(0.072)	(0.047)	(0.018)
Will5	0.289***	-0.037	-0.350***	0.115**	-0.017
	(0.087)	(0.046)	(0.097)	(0.048)	(0.022)
Risky	0.109**	0.034	-0.101**	-0.007	-0.035**
	(0.049)	(0.023)	(0.045)	(0.033)	(0.014)
S_Know	-0.094*	0.030	0.073*	-0.007	-0.002
	(0.048)	(0.023)	(0.044)	(0.032)	(0.013)
O_Know	0.026	-0.006	0.010	-0.010	-0.020***
	(0.024)	(0.012)	(0.022)	(0.016)	(0.007)
Govt	-0.044	0.019	0.111***	-0.053*	-0.033**
	(0.046)	(0.022)	(0.042)	(0.030)	(0.013)
Kids	0.032	-0.008	-0.002	-0.028	0.006
	(0.046)	(0.022)	(0.042)	(0.030)	(0.012)
College	0.061	-0.048*	0.005	-0.003	-0.015
	(0.048)	(0.025)	(0.044)	(0.032)	(0.015)
Age	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.003	-0.005	0.002	-0.007	0.007
	(0.052)	(0.025)	(0.047)	(0.034)	(0.014)
TV	-0.110	0.045	-0.003	0.041	0.026*
	(0.070)	(0.028)	(0.063)	(0.042)	(0.015)
Shop1	-0.070	0.018	0.001	0.056	-0.004
	(0.066)	(0.034)	(0.061)	(0.041)	(0.016)
Shop2	-0.012	0.023	0.053	-0.052	-0.011
	(0.062)	(0.032)	(0.057)	(0.043)	(0.016)
Recyc1	0.119*	-0.024	-0.072	-0.010	-0.013
	(0.051)	(0.024)	(0.046)	(0.033)	(0.013)
Recyc2	0.152**	-0.018	-0.076	-0.035	-0.023
	(0.071)	(0.035)	(0.067)	(0.050)	(0.024)
Info1	-0.002	-0.025	-0.046	0.052	0.020
	(0.061)	(0.029)	(0.056)	(0.040)	(0.018)
Info2	0.005	-0.026	-0.025	0.025	0.022
	(0.058)	(0.027)	(0.052)	(0.040)	(0.016)

[a]Numbers in parentheses are estimated standard errors.   Symbols ***, **, * indicate that the variable is significant at the 1%, 5%, and 10% levels, respectively.
[b] N is the number of respondents in each subsample.
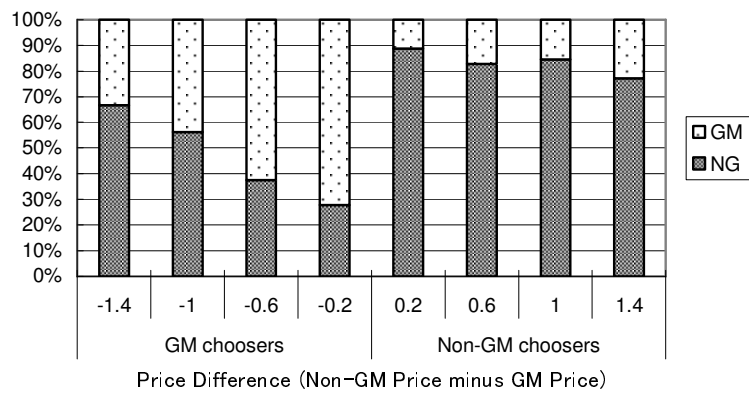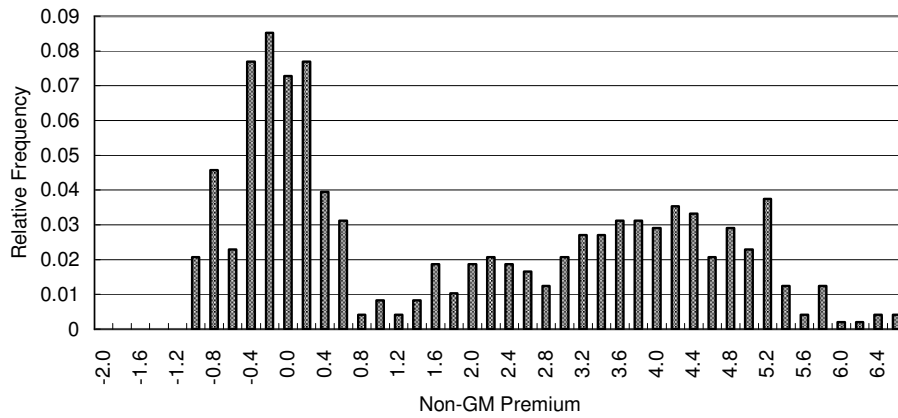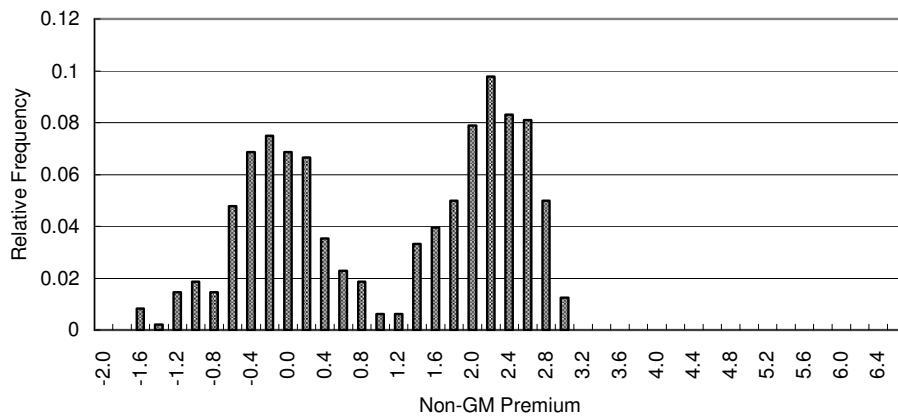
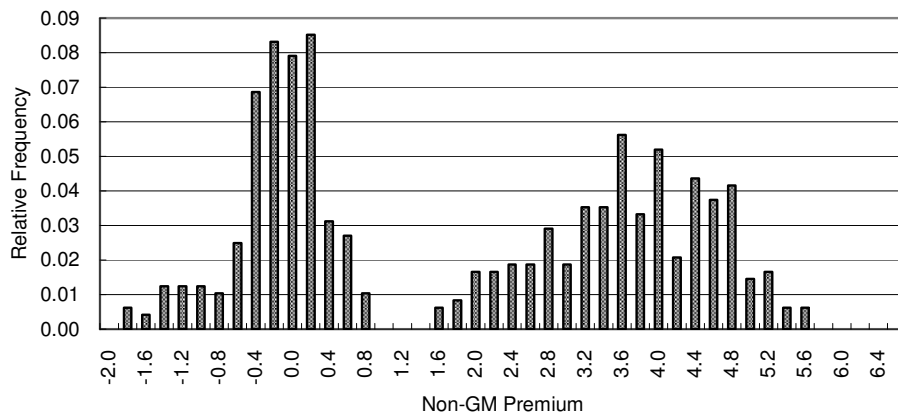(a) Non-GM and GM choosers
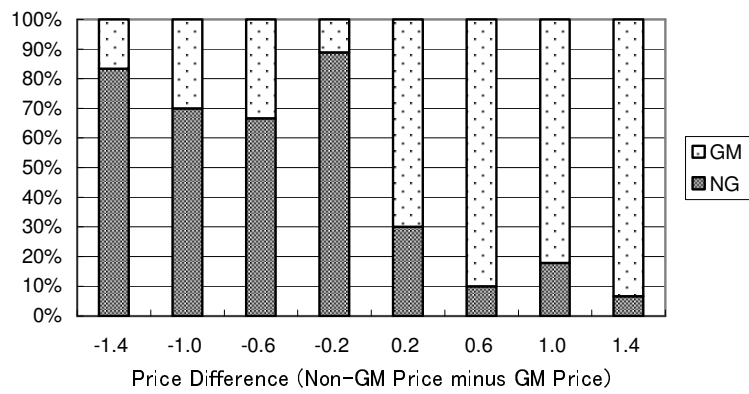
(b) Indifferent respondents

Fig. 1. *Response to paired choice question with price difference*

(a) *Separate estimations (non-GM, GM, and indifferent)*

(b) *Pooled estimation without slope dummies (Model 1)*

(c) *Pooled estimation with slope dummies (Model 2)*

Fig. 2. *Distribution of non-GM premiums from alternative estimation results*