UK Consumers' Willingness-to-Accept
(WTA) GM Food

Wanki Moon
Department of Agribusiness Economics
Southern Illinois University
Carbondale IL 62901
Email) wmoon@siu.edu

Arbindra Rimal
Department of Agriculture
Missouri State University
Springfield, MO

Siva K. Balasubramanian
Department of Marketing
Southern Illinois University
Carbondale IL 62901

January 12 2007

Abstract
Our study uses contingent valuation survey data (WTA and WTP) collected in the UK to examine consumers' behavioral intention with regard to GM food. In particular, we characterize respondents who selected 'Don't Know' and 'Protest' options in WTP questions in terms of what they would do when offered discount for GM food.
Key Words: Contingent valuation, WTA, WTP, genetically modified food

Introduction

Controversy over genetically modified (GM) food has entered a new phase when European Union (EU) replaced the moratorium on approving new GM varieties with mandatory traceability and labeling legislation with a 0.9 % tolerance level. The moratorium has been in place since 1998 in response to the largely negative public reception of GM technology in the EU. Apparently, the new labeling and traceability legislation transfers the burden of acceptance/rejection of GM technology from regulatory authority to the market mechanism. Yet, for consumers to ultimately exercise the sovereign power of accepting or rejecting GM technology, food retailers in the EU should be willing to put labeled GM products on the supermarket shelves (Carter and Gruere, 2003; Gaskel et al, 2003). Thus far, they have avoided food products that contain any GM ingredients, in line with the prevailing popular sentiment there against agrobiotechnology. That is, food supply chains in the EU strategically decided to focus on non-GM foods instead of allowing consumers to choose between GM and non-GM foods. Hence, there has been no need to segregate non-GM from GM foods.

Will labeled GM foods appear on European grocery shelves in the foreseeable future? The answer hinges on whether European food industry interprets the new legislation as a favorable long-term opportunity to market GM foods. Previous research on food preferences of European consumers emphasizes willingness-to-pay (WTP) a premium as a measure of behavioral intention with respect to non-GM foods (e.g., Burton et al, 2001; Moon and Balasubramanian, 2003). While useful in gauging the demand for non-GM foods, this approach offers limited insight in terms of predicting the demand for GM foods. From a forecasting perspective, it appears more appropriate to raise the

1

following questions: Are consumers willing to accept GM foods at some or no discount relative to the price of non-GM foods? To what extent are GM foods considered substitutes for non-GM versions?

Whether consumers would be willing to accept (WTA) discount for purchase of GM food products is a useful concept that sheds light on both consumers' preference for GM foods and their perceptions regarding the substitutability between GM and non-GM food versions. Using data collected in UK, this paper analyzes consumers' willingness-to-accept (WTA) discount for GM food products. This study builds on Moon, Balasubramanian, and Rimal (2007) who compared mean WTA discount for GM food products and mean WTP premium for nonGM version and regressed the difference between them against risk and benefit perceptions in an effort to identify factors driving the divergence between WTA and WTP. Yet, their analysis had to exclude the segment of respondents who were not willing to buy GM food at any discount. This paper attempts to extend their analysis and develop regression models incorporating two groups of consumers: (i) who are not likely to be participating in GM food markets at any discount, and (ii) who are willing to consume GM food at some or no discount. This analysis is expected to provide additional insights into predicting the demand for GM food in Europe.

Survey Design and Administration

We use survey data that were collected in the UK in 2002 using the web-panel of UK households maintained by Harris Interactive, a consulting firm that specializes in public polls and opinion surveys. Questionnaires were emailed to a sub-sample of 2500 participants of this panel that was representative of the UK population. 1,090 consumers

completed the online survey within seven days, accounting for an impressive 44%
response rate.

The first part of the survey tapped respondents' attitudes toward genetic
engineering applications involving food production and medicine, and self-rated
knowledge/perceptions about negative and positive attributes of agrobiotechnology. The
second part focused on WTA and WTP measures in two contexts (see Table 1 for exact
question wording) : (i) a box of breakfast cereals made of non-GM and GM ingredients
(base price of £ 2.80), and (ii) weekly expenditure on foods with non-GM and GM
characteristics (actual expenditure in £). Note that a box of breakfast cereals represents a
very small part of the typical household budget. Therefore, the second question
encompasses a much bigger share of this budget because it represents all weekly food
purchases. Asking WTA and WTP questions for both these contexts facilitated a check
for consistency in responses.

The contingent-valuation (CV) questions were structured in the payment card
response format that has gained popularity in recent years, as a compromise between the
open-ended and closed-ended formats (Cameron and Huppert, 1989). CV questions in
the form of payment card contain an ordered set of threshold values. In the payment card
approach, consumers are asked simply to go over the range of values and to circle the
highest amount of premium they would be willing to pay, or the lowest amount of
discount they would be willing to accept.

For a box of breakfast cereals made of non-GM crops (base price £2.80), the WTP
payment card included a range of premiums from £0.00 to £2.10. For the question on
weekly food expenditures, the payment card ranged from 0 % to 75 %, with suitable

increments that were consistent with those used for breakfast cereal. The payment cards also included a "Don't know" category. Moreover, a follow-up question was presented to respondents who selected zero as the maximum premium. The goal was to identify true zeros (i.e., no preference between non-GM and GM foods) from zeros that protested against paying premium for conventional non-GM foods (Boyle, 2003, page 143).

An identical range of discounts was used for willingness-to-accept (WTA) measures along with "Don't Know" category. Yet, the payment card for WTA differed from that of WTP in two respects. First, the follow-up question is not relevant in the WTA context because zero values here imply that respondents do not consider GM foods inferior to non-GM version (i.e., no preference between GM and non-GM foods). Second, a new response category was added to the WTA payment card in order to capture respondents who will not buy GM food at any discount. These differences render the design of WTP and WTA questions somewhat asymmetric. Another reason for this asymmetry is that, for some respondents, GM food may be a "bad" rather than a "good" (i.e., GM foods are worse than simply being inferior to non-GM foods). We further note that this bad involves a product where safety remains the utmost concern for most consumers (unlike public goods such as clean air for which consumers are generally willing to live with lower quality, if adequately compensated for).

Data Analysis

Table 2 presents the distribution of responses to the WTA and WTP questions. About 12 % from both product categories did not need any discount to buy GM food; i.e., they are truly GM-embracing. Approximately 34 % (breakfast cereals) and 37 % (food expenditure) of respondents are price-conscious group that may potentially buy GM food

if discounts are offered for them. There is a group of respondents (7.5 % and 8.3 % for the two products, respectively) who chose 'Don't Know' category. Lastly, the largest group of 47 % (cereals) and 44 % (food expenditure) indicated that they would never buy GM food products regardless of the amount of discounts.

In sum, four distinctive groups of respondents could be identified from the table: (i) GM-embracing, (ii) Price-conscious; (iii) Unsure, and (iv) Non-participant in GM food market. The presence of such a group may have contributed to the EU food industry's decision thus far not to use GM ingredients in its food market and is not likely to change such decision. Further, the significant size of the non-participant group indicates that Europe is not likely to go through in the future the state of commingled (between GM and nonGM ingredients) grain supply chain that is prevalent in the US. The non-participant group is the main focus of this study and will be further analyzed using regression models.

Regression Models

Using the WTA payment card data, a binary variable was created indicating 1 if respondents select the category of "I'll never buy GM food at any discount" and 0 otherwise (Unsure category was deleted from the analysis). Hence, we have a dependent variable indicating whether or not a respondent is a non-participant in GM food market.

Model specification in this study is based on the following premises: (a) WTA is determined by consumers' attitude (acceptance) toward agrobiotechnology and (b) this attitude is in turn shaped by consumers' perceptions of various attributes associated with agrobiotechnology or GM foods (Ajzen and Fishbein, 1980). We hypothesize that

consumers' perceived risks and benefits, and their trust in government are major determinants of WTA.

Table 5 presents brief descriptions and summary statistics for the variables used in equations (1a) and (1b). Perceived risks were measured with five items: (1) health risks, (2) environmental risks, (3) moral and ethical considerations, (4) image of multinational corporations as primary beneficiaries of biotechnology, and (5) the growing control of multinational corporations over farming. Perceived benefits were measured with items focused around three outcomes associated with GM foods: (1) potential increase in crop yield, (2) reduced use of chemicals in crop production, and (3) potential improvement in nutritional contents of crops. We constructed composite indices of risk (**Risk**) and benefit (**Benefit**) perceptions by aggregating the preceding five and three items, respectively. The regression models also include respondents' opinions about the EU's decision to eliminate moratorium on approving new GM varieties and socio-demographic profiles such as education, age, and gender.

Further, the regression models incorporate UK consumers' responses to the question of willingness-to-pay premium for nonGM food as an independent variable. We divide the responses into four categories of consumers: (i) who are not willing to pay premium for nonGM food because they are indifferent between GM and non-GM food, (ii) who are willing to do so, (iii) who are protesting the notion of paying premium for conventional nonGM food, and (iv) who have no opinions. We hypothesize that the first category will be more likely to be associated with buyers of GM food because they fully embrace GM food; the second and third categories will be less likely to be associated with buyers of GM food; the effect of the fourth category is ambiguous.

We created dummy variables for these four categories and the second category representing respondents who are willing to pay for nonGM food was omitted as a base. This analysis will provide insights useful in assessing consumer preferences about and demand for GM food when one has information only on consumers' willingness-to-pay for nonGM food.

Table 1 presents regression results for both breakfast cereals and food expenditure. The results show that respondents with high risk perception are less likely to be participating in markets for GM food compared with those with low risk perceptions. In contrast, when respondents perceive benefits from agricultural biotechnology, they were more likely to be buyers of GM food. In addition, when respondents agreed that the EU's decision to eliminate moratorium on approving new GM varieties was appropriate, they were more likely to be buyers of GM food. While Education and Gender (male=1) were negatively associated with the likelihood of being non-buyers of GM food, they were not statistically significant. Age was positively associated with the likelihood of being non-buyers of GM food, indicating that older consumers are not likely to be participating in markets for GM food.

As expected, respondents who are not willing to pay premium for nonGM food (i.e., embracing GM technology) are significantly more likely to be participating in markets for GM food when compared to those who were willing to pay. Intriguingly, the category of protest was also positively associated with the likelihood of participating in markets for GM breakfast cereals. The positive association indicates that respondents who protested the notion of paying premium for conventional nonGM food are more likely to be buyers of GM food. Respondents who chose Don't know to WTP questions

were highly significantly less likely to be participating in markets for GM food. This result indicates that those who choose 'don't know' to WTP questions can be considered as not being in favor of GM food.

Summary

This study segmented UK consumers into two groups based on their responses to the questions of willingness-to-accept (WTA) a discount for GM food: (i) non-participant in GM food market, and (ii) potential buyer of GM food. About 47 % (breakfast cereals) and 44 % (weekly food expenditure) of the respondents were identified as a segment of consumers that would never participate in markets for GM food regardless of the amount of discounts. Regression models were developed to identify factors determining UK consumers' status regarding whether or not they would be willing to participate in markets for GM food if they are offered. The result shows that risk and benefit perceptions are strong determinants of such status: i.e., consumers with high risk perceptions are more likely to be not participating in markets for GM food when compared with those with low risk perceptions. Previous study showed that risk and benefit perceptions had a significant effect on the size of discount that consumers would be willing to accept to buy GM food (to forego the opportunity to buy nonGM food) (Moon, Balasubramanian, and Rimal, 2007).

Further, the regression models included UK consumers' responses to the question of willingness-to-pay premium for nonGM food as an independent variable (with four dummy variables). As expected, the results show that consumers who are not willing to pay premium for nonGM food are likely to be participating in markets for GM food, if offered. Contingent valuation questions asking WTP may contain Don't Know option

and researchers usually delete from their analysis consumers who choose this option.

Therefore, it is often difficult to make inferences about such consumers. This study

offers one method: i.e., given that our database has information on both WTA and WTP,

it is possible to identify which option they (who selected Don't Know in WTP question)

chose in response to WTA question. Our result shows that they are not likely to be

participating in markets for GM food. Although they stated unsure opinion in connection

with WTP question, they revealed their purchase intention against GM food through

responses to WTA question. A similar logic can be applied to the group of consumers

who protest the notion of paying premium for nonGM food (in WTP question). We have

little understanding of such consumers regarding what they would do when offered the

opportunity to purchase GM food at some discount. Our study shows that they are likely

to accept the discount associated with GM food.

References

Ajzen, I. and M. Fishbein. 1980. *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice Hall.

Baker, G. A. and T. A. Burnham. Consumer Response to Genetically Modified Foods: Market Segment Analysis and Implications for Producers and Policy Makers. *Journal of Agricultural and Resource Economics*. 26 (2001): 387-403.

Boyle, K. J. "Contingent Valuation in Practice." In A Primer on Nonmarket Good Valuation, Edited by P. A. Champ, K. J. Boyle, and T. C. Brown. The Economics of Nonmarket Goods and Resources. Series editor I. J. Bateman. 2003. Kluwer Academic Publishers. Netherlands

Burton, M., D. Rigby, T. Young, S. James. Consumer Attitudes to Genetically Modified Organisms in Food in the UK. *European Review of Agricultural Economics*. 28 (2001): 479-498.

Cameron, T. A. and D. D. Huppert. OLS versus ML Estimation of Non-market Resource Values with Payment Card Interval Data. *Journal of Environmental Economics and Management,* 17 (1989): 230-246.

Carter, C.A., & Gruère, G.P. Mandatory labeling of genetically modified foods: Does it really provide consumer choice?. *AgBioForum*, *6*(2003): 68-70. Available on the World Wide Web: http://www.agbioforum.org.

Gaskell, G., Allum, N., Bauer, M., Jackson, J., Howard, S., & Lindsey, N. Climate change for biotechnology? UK public opinion 1991-2002. *AgBioForum*, *6*(2003), 55-67. Available on the World Wide Web: http://www.agbioforum.org.

Grimsrud, K. M., J. J. McCluskey, M. L. Loureiro, and T. I. Wahl. Consumer Attitudes to Genetically Modified Food in Norway. *Journal of Agricultural Economics*, 55

(2004): 75-90.

Kalaizandonakes, N. and J. Bijman. Who Is Driving Biotechnology Acceptance? *Nature Biotechnology*. 21 (2003): 366-369.

Kalaizandonakes, N., L. A. Marks, and S. S. Vickner. Media Coverage of Biotech Foods and Influence on Consumer Choice. *American Journal of Agricultural Economics,* 86 (2004): 1238-1246.

Kalaizandonakes, N., L. A. Marks, and S. S. Vickner. Sentiments and Acts towards Genetically Modified Foods. *International Journal of Biotechnology*, Vol 7 (2005): 161-177.

Marks, L. A., N. G. Kalaitzandonakes, and S. S. Vickner. Consumer Purchasing Behavior Towards GM Foods in the Netherlands. In Consumer Acceptance of Genetically Modified Food, ed by R. E. Evenson and V. Santaniello. CAB International. 2004.

Moon, W. and S. K. Balasubramanian. "Willingness-to-pay for Nonbiotech Foods in the US and UK." *Journal of Consumer Affairs*. Vol. 37 (2003): 317-339.

Moon, W. and S. K. Balasubramanian. "Willingness-to-Pay (WTP) a Premium for Non-GM Foods v. Willingness-to-Accept (WTA) a Discount for GM Foods." *Journal of Agricultural and Resource Economics*. In press.

Scholderer, Joachim. "The GM foods debate in Europe: history, regulatory solutions, and consumer response research," *Journal of Public Affairs*, 5, (2005): 263-274.

Table 1. WTP and WTA question wordings

	Willingness-to-pay	Willingness-to-accept
A box of breakfast cereals	Suppose the price of breakfast cereals made from GM crops is £2.80 per box. The price of conventional nonGM breakfast cereals will be higher than £2.80, but is not determined yet. What is the most above the current price of £2.80 you would be willing to pay to purchase a box of conventional non-GM breakfast cereals?]	Suppose the prices of breakfast cereals of both types are identical at £2.80. The grocery store offers a discount to promote the sales of GM breakfast cereals. What is the minimum amount of discount below the current price of £2.80 that would make you want to purchase a box of GM breakfast cereals?
Weekly food expenditure	Suppose that it generally costs more to purchase non-GM foods due to segregation and labeling requirements. What is the maximum percentage increase in your weekly food bill that you are willing to incur to ensure that you do not eat GM foods?	Suppose that the grocery store offers discounts to promote the sales of GM food products. What is the minimum percentage decrease in your weekly food bill that will make you want to purchase GM food products?

Table 2. Distribution of responses to WTP and WTA questions

Products	Breakfast Cereals			Weekly expenditure	
Premium/Discount	WTP	WTA	Increase/Decrease In Weekly food bill	WTP	WTA
£ 0.00	21.2 (%)	12.0 (%)	0 (%)	20.5 (%)	12.0 (%)
£ 0.01~£ 0.07	4	1.7	0.01% ~ 2.5 (%)	5.7	2.1
0.08~0.14	5.1	1.7	2.6 ~ 5	10	3.4
0.15~0.21	8.7	2.2	6 ~ 7.55	2.1	2.0
0.22~0.28	4.8	1.7	7.6 ~ 10	7.7	3.6
0.29~0.35	4.3	2.0	11 ~ 12.5	8.1	3.9
0.36~0.53	7.2	4.1	12.6 ~ 18.9	2.8	2.4
0.54~0.70	6.0	4.9	19 ~ 25	7.6	5.3
0.71~0.88	0.9	1.7	26 ~ 31	2.0	2.4
0.89~1.05	4.6	4.7	32 ~37	0.5	1.4
1.06~1.23	2.1	2.4	38 ~44	0.6	0.6
1.24~1.40	1.5	2.5	45 ~50	2.9	4.5
1.41~1.75	0.9	1.0	51 ~ 62	1.2	1.8
1.76~2.10	0.6	0.8	63 ~ 75	0.6	0.7
2.11 or higher	9.0	3.9	76 or higher	6.6	3.7
Don't know	19.54	7.5	Don't know	20.4	8.3
I'll never buy GM food at any discount	N/A	46.6	I'll never buy GM food at any discount	N/A	43.0
Sum	100 %	100 %		100 %	100 %

13

Table 3. Summary information from WTP and WTA responses

Segment/Response category	Willingness-to-pay		Willingness-to-accept	
	A box of break-fast cereal (£)	Weekly food expenditure (%)	A box of break-fast cereal (£)	Weekly food expenditure (%)
Never consumer GM	N/A	N/A	46.6 %	43.6
Don't know	19.5 %	20.4 %	7.5.0 %	8.3 %
WTP premium	57 %	59 %	N/A	N/A
WTA discount	N/A	N/A	33.9 %	36.7 %
*Do not differentiate between GM and non-GM	12.8 %	13.7 %	12.0 %	12.1 %
*Protest responses	8 %	8 %	N/A	N/A
Sum	100 %	100 %	100 %	100 %

* These categories arise from a follow-up question directed toward respondents who selected $0 as their premium for WTP. The follow-up was intended to decompose these responses into true zeros and protest zeros.

Table 4. Definitions and Descriptive Statistics of Variables Used in the Empirical Model.

Variable	Description	Mean (St. Dev.)
RISK		**19.7 (8.9)**
Health Risks	Biotech foods pose health hazards	3.61 (1.5)
Environmental Risks	Agrobiotechnology poses hazards on eco-system	4.06 (1.44)
Morality	It is morally and ethically wrong to use biotechnology	3.39(1.55)
Multinational Corporations	Multinational corporations are primary beneficiaries of agrobiotechnology, while consumers assume most of the risks	4.54 (1.49)
Control on farming	Multinational corporations are increasingly controlling farming	4.22 (1.29)
BENEFIT		**10.2(3.75)**
Increase in yields	Agrobiotechnology reduces world food shortages by increasing yields	3.92 (1.35)
Reduced Chemical Use	Agrobiotechnology reduces the use of chemical in crop production	3.52 (1.38)
Improved nutrition	Agrobiotechnology enhances nutritional composition	3.17 (1.23)
Opinion_Moratorium	What is your opinion about the recent European Parliament legislation to replace the moratorium on approving new genetically modified crops with mandatory labeling and traceability for GM foods?	2.51 (1.54)

Note: items for RISK, BENEFIT, and Opinion_Moratorium are measured with a seven-point scale ranging from 'Disagree Completely' to 'Agree Completely' to 'Don't Know'. Calculation of mean and st. dev. excludes Don't Know responses. Cronbach's alpha for RISK and BENEFIT are 0.82 and 0822, respectively.

Table 5. Binary Regression Models: Non-buyer vs. Buyer of GM food

Variables	Willingness-to-Accept (WTA)			
	Breakfast Cereals		Weekly Expenditure	
	Estimated Parameter	t-statistic	Estimated Parameter	t-statistics
Constant	-0.5822	-1.3672	-1.1570	-2.6525
Risk	0.0925***	9.0642	0.1073***	10.235
Benefit	-0.1229***	-6.3435	-0.1296***	-6.6274
Op_Morat	-0.1473***	-4.0110	-0.1409***	-3.8368
Education	-0.0107	-0.8141	-0.0096	-0.7193
Age	0.0094**	2.2529	0.0125***	2.9750
Gender	-0.1311	-1.2908	-0.0097	-0.0960
WTP_Embrc	-1.1905***	-4.3980	-1.2683***	-3.9634
WTP_DonKn	1.3363***	8.5816	1.0359***	7.0209
WTP_Protest	-0.3743**	-2.0339	-0.0660	-0.4016
# of observations	1008		999	
R^2	0.45		0.43	
LR test	537 [.000]		518[.000]	
Fraction of Correct Predictions	0.7996		0.8008	

Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.