Labeling Genetically Modified Food Products: Attitudes among the consumers in the United States and United Kingdom

Arbindra Rimal*
Assistant Professor
Department of Agriculture-Agribusiness
Southwest Missouri State University

Wanki Moon
Assistant Professor
Department of Agribusiness Economics
Southern Illinois University

Siva Balasubramanian
Department of Marketing
Southern Illinois University

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Abstract: Eight perceived attributes of agro-biotechnology were identified to be associated with consumers' attitude toward existing practices of GM food labeling. The perceived negative attributes, particularly health risk from GM food, played a dominant role in shaping the overall attitude toward GM labeling. Female and older respondents were more likely to be concerned about the existing GM labeling practices than male and younger respondents. Consumers with college education were less likely to be concerned about existing GM labeling practices than those without college degree.

* Contact information: E-Mail: arr412f@smsu.edu; Tel: (417) 836 5094; Department of Agriculture-Agribusiness, Southwest Missouri State University, 206 Karls Hall, 901 South National Avenue, Springfield, MO 65810.

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Introduction:

Government policies toward genetically modified (GM) food labeling are undergoing significant development in several countries including the US and Europe. For example, in the US, HR3377 and S 2080-"the genetically engineered Food Right to Know Act"-were introduced into the US House of Representatives and Senate, respectively (Teisl, et al., 2003). In July 2003, the European Union (EU) agreed on a new legislative framework for the labeling of the food containing ingredients derived from GM crops and set a new threshold at 0.9 percent (European Commission, 2003). While Australia and New Zealand have adopted a mandatory GM labeling, Canada has decided to not to include mandatory labeling of GM food products as part of its regulatory control of GM food.

According to Caswell (2000), labeling choices made by countries fall into two broad camps: voluntary and mandatory. European Union countries, Japan, Australia, and New Zealand are pursuing mandatory labeling programs for GM food products, while the US is pursuing voluntary labeling as its main strategy. Irrespective of the choices made by the countries, it is important to consider consumers' concern and attitude toward the labeling of GM foods. Consumer concerns regarding direct and indirect consumption of GM food may have led to a large percentage of consumers wanting mandatory labeling of beef from cattle fed of GM crops (Roosen et al., 2003). Past studies have generally suggested that food labels have impact on consumers' food selection (Kim, et al., 2001; Rayner and Boaz, 2001). In a study using experimental data among adult consumers, Huffman (2003) showed that GM labels affected consumers' willingness to pay for GM products in the market. When GM labels were introduced

consumers discounted GM labeled foods by approximately 14% compared to the traditionally labeled food. The influence of perceived benefits and risks of GM technology on consumers' attitude toward labeling of GM products has remained relatively unexplored. It is likely that each factor plays an important role in shaping consumers' concern and attitude towards labeling of GM foods. Findings from this study will help food policy makers and marketers alike in determining the role of perceived positive and negative attributes of GM technology in shaping the attitude of consumers' in the UK and the US toward GM food labeling. In addition, it will also highlight key socio-demographic factors influencing the attitudes toward GM food labels.

Materials and Methods

Data Collection

A survey instrument was designed to measure concern and attitude toward the labeling of GM food products. The surveys were administered in December 2000 by mail survey in the United States (US) and online survey in the United Kingdom (UK) using household panels maintained by the National Panel Diary (NPD) group, a marketing consulting firm specializing research on consumer behavior and food marketing. Survey methods that use an established panel are called "permission-based surveys" and are increasingly used in exploring various aspects of consumer behavior for academic or commercial purposes (Moon et al., 2003). Questionnaires were distributed to 5,200 households (a sub-sample of NPD panel), selected across the United States by random sampling. About 3,060 households returned completed questionnaires, yielding a response rate of nearly 58 percent. The US sample was stratified by geographic regions, head of household age, education level, and income level, consistent with the US census for adults. The same instrument was administered to consumers in the United

Kingdom using online methods. Questionnaires were sent to about 9,000 participants of the online panel via emails, and 2,568 consumers completed the online survey within the next seven days.

The data were analyzed in two ways. First, means of the variables for US, UK, and ALL samples were computed. ALL samples included both US and UK observations. Mean tests were conducted using Tukey procedure (SAS, 2003). Second, the association of perceived negative and positive attributes of agro-biotechnology with the attitude toward GM food labeling was analyzed using a regression analysis. Two empirical models were estimated using maximum likelihood procedures. In the first model, independent variables included only negative and positive attributes of agro-biotechnology. In the second model, socio-economic variables were added to the set of independent variables.

Results

USA, UK, and ALL sample sets included 969, 1331, and 2294 usable observations, respectively. Summary statistics including the description of the variables and sample means are given in Table 1. Tukey tests showed that mean differences were statistically significant (**"**=.05) between US and UK consumers across all variables except the variable representing the perceived belief among consumers that application of biotechnology is morally wrong.

Although the overall sample has a balanced gender representation, the US sample included slightly more women than men and UK sample included slightly less women than men. UK respondents were younger; less educated, and had less average income than the US respondents. Interestingly, 20 percent of the UK respondents had college degree in the field of science compared to only 11 percent in the US. The disparity was expected to have important effect on the attitude toward GM labeling.

Labeling of GMO food products

Respondents were asked, “How do you feel about the facts that conventional foods are currently not labeled differently than genetically modified foods in the grocery stores?” More than 60 percent of the ALL sample respondents were concerned by the fact that conventional foods in the grocery stores were not differently labeled than GM foods. There was, however, a statistically significant difference between UK and US consumers (Table 2). Only 60 percent US consumers were extremely concerned compared to more than 75 percent of the UK consumers. Further, only 3% of the UK consumers did not have a definite opinion about the labeling issue compared to 16 percent of the US consumers who were unaware of the issue, or were not in a position to offer opinion. In a separate study, a low level of awareness about GM foods among US consumers was found by Teisl (2002).

Risks and Benefits of Agro-biotechnology

Those who have generally opposed the application of biotechnology in food production have argued that using this technology in crop production has significant negative consequences. They fear that inserted genes could be allergenic or harmful to human health (Moon and Balasubramanian, 2003; Hensen, 2001). Examples of such fear included a possibility of new genes inadvertently causing plants to produce toxins at higher levels than are present naturally, which could create long-term negative health consequences. Further, genes from genetically modified plants may escape into the environment through cross-fertilization, posing risks to the natural ecosystem (Caplan, 2001). In addition to perceived negative impact on human health, other negative aspects of GM technology included moral and economic issues. Moral issues about biotechnology focus on the belief that it is immoral to alter God’s creations using genetic

engineering techniques. Others have pointed to the inequitable distribution of the economic benefits of agro-biotechnology (Wohl, 1998). For example, many believe that multinational biotech corporations are the main beneficiaries of agro-biotechnology while consumers assume most of the risks involved. Further, increasing control of multinational corporations over small-scale family farming and gradual disappearance of small farms are some of the negative attributes of agro-biotechnology.

Supporters of agro-biotechnology argue that the application of biotechnology to crop production will bring substantial benefits to societies while revolutionizing the way crops are produced (Moon and Balasubramanian, 2003). Some of the specific benefits of agro-biotechnology include improved environmental quality (e.g., less soil erosion and infertility) by reducing the use of pesticides and herbicides in crop production (Magnusson and Hursti, 2002; Pinstrup-Anderson, 2000) and improved nutritional value of foods (e.g., rice with improved quantities of Vitamin A; soybeans with fatty acid). More importantly, supporters of biotechnology believe that biotechnology will mitigate food shortages in developing nations by increasing yields with crops resistant to various pests, insects or drought (Moon and Balasubramanian, 2003).

Based on the above discussions, respondents were asked eight questions dealing with perceived risks and benefits of the application of biotechnology in crop production. The five questions related to perceived risks of GM technology dealt with (1) health risks, (2) environmental risks, (3) moral considerations, (4) image of multinational corporations as the primary beneficiaries of biotechnology, and (5) growing control of multinational corporations over farming. The three questions relating to benefits of GM technology dealt with (1) reduced use of chemicals in crop production, (2) improved nutritional content, and (3) increased yields.

Table 3 presents the distribution of responses to the eight questions dealing with perceived negative and positive attributes of application of biotechnology in crop production. Overall, respondents in the UK showed a greater level of consensus about the negative as well as positive attributes of application of biotechnology than those in the US. More US consumers (24.4%) reported, “Don’t know” about moral issues regarding the application of biotechnology than UK consumers (8.1%). It seems UK consumers were more certain about moral issues than US consumers and more of them disagreed that application of biotechnology was morally wrong. Also, greater percentage of UK consumers agreed that the application of biotechnology in crop production resulted in higher yield rate than USA consumers; more of them also agreed that the technology was hazardous to health and environment. About 65% of UK respondents were concerned about adverse environmental effects resulting from agro-biotechnology.

The beneficiaries of biotechnology also determined the consumer acceptance of biotechnology. If there were only commercial interests but no obvious benefits to the consumers the acceptability was low among the European consumers (Grov-White et al., 1997). In the current study, 71% of UK respondents perceived multinational corporations as being the primary beneficiaries of biotechnology with consumers assuming most of the risks. Multinational corporations were seen increasingly to control farming. There was also a divergence in the percentage of respondents across the US and UK who selected "Don't Know." The US consumers were much more predisposed to choose the "Don't know" option than UK consumers across all questions (25%-50% in the US vs. 8%-28% in the UK).

A regression analysis to evaluate the factors influencing the attitude toward labeling of GM food products

Determinants of Consumer Attitude towards Labeling of GM foods

A general attitude towards labeling of GM foods is determined by the perception of positive and negative attributes of application of biotechnology in food production. Hoban (1999) explained that the strengths of consumer's beliefs about potential risks and benefits from agro-biotechnology are the result of consumers' knowledge and more general attitudes (e.g., attitude towards technology, trust in government and food system), which have roots in socio-economic and demographic characteristics. A multiattribute model represents a valuable approach in examining the factors that shape consumers' attitude towards an object. Several multi-attribute frameworks have been developed and explained in previous studies including those by Fishbein (1963) and more recently by Mowen and Minor (2000). The frameworks explain how consumers may combine their beliefs about product attributes to form attitudes about various products. Mowen and Minor (2000) call their framework "the attitude-toward-the object model", which suggests that three factors influence attitude formation: 1) the salient attributes, 2) the extent to which consumers believe that the object possesses the attributes, and 3) the manner in which the attributes are evaluated. Symbolically, the model can be written as

$$A_0 = \sum_{i=1}^{n} \beta_i X_i \qquad (1)$$

where A_o is the overall attitude toward a product; X_i is the strength of the belief that the product has attribute *i*; β_i is the evaluation of attribute *i*; and *n* is the number of salient attributes. The

model therefore proposes that attitudes toward a given object are based on the summed set of beliefs about the object's attributes weighted by the evaluation of these attributes.

The multi-attribute model described above suggests that attitude toward labeling of GM foods will be determined by the strength of consumer beliefs about various attributes of biotechnology applied in food production. As stated earlier, the use of biotechnology in crop production is controversial due to its association with a number of negative attributes. At the same time, it promises to provide revolutionary benefits to the public. Thus, it is important to evaluate the association of both positive and negative attributes of agro-biotechnology with the attitude toward GM labeling.

Regression Models

The evaluations ($\$_i$) and the belief ($X_i$) in equation (1) are obtained from survey responses, and used for the calculation of the overall attitude toward a product. The X_i component, representing how strongly a consumer believes that the product possesses a particular attribute is, typically, measured using a scale variable, for example from "agree strongly" to "disagree strongly." Ideally, the information on the evaluation of the attributes is also collected using a similar type of scale variable. However, studies have found that respondents often have difficulties in distinguishing between the existence of the attribute and the evaluation of the attribute for low-involvement products like food (Wadel and Steenkamp, 1991). The situation can be handled by treating (1) as a stochastic regression equation, and statistically measuring the evaluation of attributes ($\$_i$). The following is the modified equation representing the stochastic multiattribute regression models using risk and benefits attributes, and demographic variables (Wadel and Steenkamp, 1991):

(2) $$A_0 = \sum_{i=1}^{n} \beta_i X_{it} + \varepsilon_t \qquad i = 1,\ldots,4; \quad t = 1,\ldots,T$$

where X_{it} is the ith attribute of agrobiotechnology reported by the tth respondent, **$** is the vector of unknown parameters representing the evaluation of the attributes, and demographic variables, and **g**$_t$ is the independently and identically normally distributed error term. The survey data used in this study provide information on consumers' attitudes toward the labeling of GM foods and their statements for eight attributes of agro-biotechnology. Respondents expressed the existence of the eight attributes using a 6-point scale ranging from disagree completely to agree completely. "Don't Know" responses were deleted.

An ordered probit regression model was selected as the appropriate empirical model given that the attitude variable was measured using a scale that allowed for the ranking of the outcomes. The general model is defined as

(3) $$Y^*_t = \$ \mathbb{N} X_t + ,_t$$

where Y^*_t is an unobserved concern that conventional foods were currently not labeled differently than genetically modified foods in the grocery stores; X_t is a vector independent variables relating to consumers perceived positive and negative attributes of agro-biotechnology and socio-demographic variables hypothesized to affect the degree of concern; **$** is the vector of unknown parameters and **,**$_t$ is the independently and identically normally distributed error term. While Y^*_t is unobserved, respondents actually reported concern by selecting one of the six categories (Y_t) representing from not bothered that conventional foods were currently not labeled differently than genetically modified foods to extremely bothered. Values for Y_t are 1,2,3,4,5 and 6 where 1 represents not bothered (NB) to the statement "How do you feel about the fact that

conventional foods are currently not labeled differently than genetically modified foods in the grocery stores" and 6 represents extremely bothered (EB). The unknown parameter vector, **$**, in equation (3) was estimated using LIMDEP software. The specific empirical models were estimated for US sample, UK sample, and ALL samples. Two sets of estimates were obtained for each sample group. In the first set (Model 1), only the variables related with perceived positive and negative attributes of agro-biotechnology were included. In the second set, socio-demographic variables were added. The following were the specific empirical regression models:

<u>Model 1</u>: ATTITUDE = b_{10} + b_{11} HEALTH RISKS + b_{12} ECO HAZARDS + + b_{13} MORALLY WRONG + b_{14} CORPORATION + + b_{15} CONTROL + b_{16} REDUCE SHORTAGE + b_{17} IMPROVE ENVIRONMENT + + b_{18} NUTRITION + e

<u>Model 2</u>: ATTITUDE = b_{20} + b_{21} HEALTH RISKS + b_{22} ECO HAZARDS + + b_{23} MORALLY WRONG + b_{24} CORPORATION + b_{25} CONTROL + b_{26} REDUCE SHORTAGE + b_{27} IMPROVE ENVIRONMENT + b_{28} NUTRITION + b_{29} GENDER + b_{210} AGE + b_{211} INCOME + b_{212} COLLEGE + b_{213} SCIENCE + e

As suggested by the multi-attribute model, Model 1 links negative and positive attributes to overall attitudes. The role of the perceived attributes of biotechnology combined with the role of socio-demographic characteristics in attitude formation is analyzed using Model 2.

Maximum likelihood estimates of regression models 1 and 2 are reported in Table 4. The results were further interpreted using the partial change or marginal effects of independent variables on the probabilities of six ordinal outcomes (not concerned to extremely concerned). In doing so, the independent variables other than the one being examined were held constant at their mean values. Due to space consideration, only probabilities for reporting, "extremely concerned" are shown (Table 5).

The magnitude of chi-squared values across the three sets of data (Table 4) indicated that both empirical models (Model 1 and Model 2) were highly statistically significant in explaining

the role of independent variables in shaping the attitude toward GM labeling. Also, the magnitude and significance of coefficient relating to attribute variables were almost unchanged when socio-economic variables were added in Model 2. A dummy variable, COUNTRY, was added to evaluate the difference in attitude toward GM labeling between US and UK consumers. The coefficient for the dummy variable is negative and statistically significant, which is consistent with the previous finding that US consumers were less outraged than UK consumers about the existing GM labeling practices. The partial effects analysis (Table 5) shows that US consumers were 4 to 7% less likely to report that they were "extremely concerned" by the existing GM labeling policy.

Positive and Negative Attributes of biotechnology and GM Labeling

Perceptions about the negative and positive attributes of application of biotechnology in agriculture were highly significant in determining overall attitude toward GM labeling. While perceived negative attributes caused consumers to form a negative attitude towards the existing practices of not labeling conventional foods differently from GM foods in the grocery stores, perceived benefits has helped in forming a general indifference between GM and non-GM foods, hence consumers were not concerned about the existing labeling practices. Health risks, corporations being perceived as the main beneficiaries of biotechnology, ecological hazards, multi-national corporations' control over farming, and moral issues were statistically significant (Table 4). Ability of agro-biotechnology to enhance the value of foods by improving the nutritional composition was significant in shaping an indifference attitude between GM and non-GM foods. Perceived negative attributes were more powerful in shaping negative attitude than perceived positive attributes in alleviating negative attitude toward the existing practices of

labeling GM foods. The results were similar but more accentuated among the UK consumers compared to the US consumers.

Among the five negative attributes of agro-biotechnology, potential health risks had the highest effect on shaping the attitudes towards existing practices of GM labeling across the three data sets (US, UK and ALL). The marginal effects analysis (Table 5) shows that every point increase in perceived health risk (six-point scale) resulted in more than 10% increase in the probabilities of reporting “extremely concerned” about existing labeling practices. The impact on the UK consumers was twice as much as that on the US consumers. Roosen et al. (2003) in a separate study on beef labeling reported that food safety concerns might have caused consumers to want a mandatory labeling for beef produced from cattle fed with GM crops. Hence, the perception of health risks is likely to stimulate concerns and shape attitude toward GM labeling.

Consumers who thought application of biotechnology was morally wrong were concerned that GM foods were not differently labeled from the traditional food. Moral issues were important among the overall respondents, and particularly among UK respondents. Interestingly, moral issues played insignificant role in shaping US consumers’ attitude toward existing policy of GM labeling. Previous studies have segmented consumers based on their attitude towards biotechnology. For example, Powell (1998) segmented the Canadian public into technocrats (those who supported any type of technological advancement) and traditionalists (those who were concerned primarily of moral and ethical dilemmas biotechnology could pose to society). Similarly, morality, usefulness and risk played important role in the decision by the Canadian public to endorse biotechnology (Einsiedel, 1997).

Demographics and GM labeling

None of the demographic variables emerged as statistically significant across all the three sample sets. Age, household income, and college degree were important variables in shaping the attitude toward GM labeling for overall (ALL) respondents. While gender, household income, and college degree played important role in shaping attitude among US consumers, age of the respondents was the only significant demographic variable among UK consumers.

Female respondents in the US were more concerned about the existing GM labeling in the grocery stores than the males. They were 4 % more likely to report, "Extremely concerned" by the existing practice of labeling than their male counter parts. Greater health concerns among female consumers were reported in many other studies. In a separate study, Guthrie et al.(1995) reported that females were more likely to use nutritional labels than men in making food selections. Previous studies have shown that males are less likely use food labels and find them less useful than the females. Rimal (2005) reported that a male respondent was 14 percent less likely to report that meat labels helped in purchasing meat products. In addition, males are more accepting of application of GM technology than females (Subrahmanyan and Cheng, 2000; Florkowski et al, 1994). These two factors combined together would suggest that males are less concerned about existing GM labeling than the females as found in this study.

Older respondents were more likely to be concerned about the existing GM labeling practices than the younger respondents, particularly when both US and UK consumers were pooled together in the analysis and when UK consumers were separately analyzed.

Another important determinant of attitude toward GM labeling was the educational level completed by the respondents. Past studies have revealed that those with higher education level were most accepting of GM foods (Subrahmanyan and Cheng, 2000), hence less concerned

about the existing GM labeling practices. Heiman, Just and Zilberman (2000) reported that higher levels of education and income were associated with greater support for genetically modified organism. In this study, consumers with college education were less likely to be concerned about existing GM labeling practices than those without college degree. Consumers with more years of education have higher human capital and a higher opportunity cost of time in obtaining and processing the nutrition information from food labels than those with fewer years of education. However, consumers with higher level of education are likely to obtain and process the information more efficiently than consumers with few years of education. The results of the study suggested that educated consumers were less likely to be alarmed than those with fewer years of education. Consumer education programs to improve comprehension of GM information on food labels may be necessary to enhance the acceptance of GM foods. It was also interesting to note that those with science degrees in colleges were not different from those without science degree in forming attitude toward existing GM labeling practices.

Conclusions/Implications

The study investigated attributes of agro-biotechnology and socio-demographic factors that affected public attitudes toward GM labeling in the US and UK. Descriptive statistics, mean tests, and regression analysis were conducted using data sets collected among the US and UK consumers. The regression models were based on Fishbein's multi-attribute framework.

While respondents were generally concerned about the existing labeling of food products that does not provide distinction between GM and non-GM food, UK consumers were more concerned about this practice compared to the US consumers.

Eight attributes of agro-biotechnology (five negative and three positive) were identified to be associated with the consumers' attitude toward existing practices of GM labeling. In order to separate the impact of attributes of agro-biotechnology alone on GM labeling, two specific types of models were estimated. The independent variables in the first model included only the variable representing the attributes. In the second model, socio-economic and demographic variables were added.

The empirical findings showed that the negative attributes of agro-biotechnology played dominant role in shaping the overall attitude toward GM labeling. The negative attributes may have disproportionately affected public concern about agro-biotechnology; hence their attitude toward exiting practices of GM labeling. Lack of marketing efforts by agro-biotech firms to openly communicate with the public about the benefits of GM foods before their introduction in the early 1990s may have accounted for prevailing public concern and attitude in some consumer segments, particularly females and older consumers. Several key implications for the agro-biotech industry and regulatory agencies emerge from this result.

The greater role of perceived negative attribute of biotechnology compared to positive attributes in attitude formation also carries significant implications for regulatory agencies. Transparent policies and programs that are strictly guided by scientific merit and consumer welfare are more likely to enhance trust among the consumers. A labeling system that allows consumers to make informed choices between GM and non-GM foods can potentially mitigate negative perceptions.

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Table 1: Descriptive statistics of the variables used in the analysis.

Variable	Explanation	ALL	USA	UK
CONCERN	Conventional foods are currently not labeled differently than genetically modified foods: 1=Not concerned; 6=Extremely concerned	4.36	4.15^{B}	4.57^{A}
Perceived risks of application of biotechnology in crop production:				
HEALTH RISKS	Foods based on genetically modified crops pose health hazards to consumers 1=disagree completely; 6=agree completely	3.46	3.39^{B}	3.52^{A}
ECO HAZARDS	Use of biotechnology in crop production poses hazards to natural ecosystem. 1=disagree completely; 6=agree completely	4.21	3.75^{B}	4.57^{A}
MORALLY WRONG	I believe it is morally and ethically wrong to use genetically modified ingredients to make food products. 1=disagree completely; 6=agree completely	3.23	3.29^{A}	3.26^{A}
CORPORATION	Corporations are the main beneficiaries from agricultural biotechnology, while consumers assume most risk. 1=disagree completely; 6=agree completely	4.41	4.25^{B}	4.57^{A}
CONTROL	The development and use of genetically modified seeds will negatively impact family farms by putting more control of the food supply into the hands of multinational corporations. 1=disagree completely; 6=agree completely	4.51	4.38^{B}	4.63^{A}
Perceived benefits of application of biotechnology in crop production:				
REDUCE SHORTAGE	The application of biotechnology to crop production will potentially reduce world food shortages by increasing yields. 1=disagree completely; 6=agree completely	4.11	4.18^{A}	4.03^{B}
IMPROVE ENVIRONMENT	The application of biotechnology to crop production will contribute to improving environmental quality by reducing the use of chemicals in agricultural production. 1=disagree completely; 6=agree completely	3.74	4.01^{A}	3.50^{B}
NUTRITION	Agricultural biotechnology enhances the value of foods by improving the nutritional composition. 1=disagree completely; 6=agree completely	3.27	3.58^{A}	3.02^{A}
Demographic Characteristics of the Respondents:				
GENDER	Female =1; Male=0	0.50	0.53^{A}	0.45^{B}
AGE	Age of the respondents	40.31	45.48^{A}	34.26^{B}
INCOME	Household income in ‘000 dollars	12.43	17.88^{A}	5.94^{B}
COLLEGE	1=college education; 0 otherwise	0.36	0.47^{A}	0.23^{B}
SCIENCE	1=Have a science degree from college; 0=otherwise	0.15	0.11^{B}	0.20^{A}

Note: “Don’t Know” option was included for questions relating to attitude, and risk and benefit perceptions. “Don’t Know” responses were deleted in regression analysis.

Mean tests were conducted using Tukey’s Studentized Range (HSD) test. Means with the same letters are not significantly different at "=0.05.

Table 2: Distribution of consumer responses to concern and attitude toward labeling of GMO food products (Percentage).

	All Sample			United States (United Kingdom)		
	Not concerned	*Extremely concerned*	*Don't Know*	*Not Bothered*	*Extremely Bothered*	*Don't Know*
How do you feel about the facts that conventional foods are currently not labeled differently than genetically modified foods in the grocery stores?	23.2	66.5	10.3	24.8 ^{A} (21.3 ^{B})	59.1^{B} (75.7 ^{A})	16.1 ^{A} (3.0 ^{B})

Note. Six-point scale ranging from "*Not Bothered*" to "*Extremely Bothered*" was used. In the table "*Not Bothered* " is an aggregation of the first three categories while " *Extremely Bothered* " is for the last three categories. The numbers in the parenthesis are for United Kingdom. Mean tests were conducted using Tukey's Studentized Range (HSD) test. Means with the same letters are not significantly different at **"**=0.05.

Table 3. Perceived benefits and Risks of application of biotechnology in agriculture.[1]

	All Sample			United States (United Kingdom)		
	Disagree	**Agree**	**Don't Know**	**Disagree**	**Agree**	**Don't Know**
Risks (%)						
HEALTH RISKS	33.5	32.2	34.3	30.5 ^{B} (37.2 ^{A})	25.6 ^{B} (40.1 ^{A})	43.9 ^{A} (22.7 ^{B})
ECO HAZARDS	19.7	46.1	34.2	22.7 ^{A} (16.0 ^{B})	30.3 ^{B} (65.0 ^{A})	47.0 ^{A} (19.0 ^{B})
MORALLY WRONG	46.7	35.6	17.0	43.0 ^{B} (50.9 ^{A})	31.4 ^{B} (40.7 ^{A})	24.4 ^{A} (8.1 ^{B})
CORPORATION	21.0	61.7	17.3	22.1 ^{A} (19.7 ^{B})	53.3 ^{B} (71.7 ^{A})	24.6 ^{A} (8.6 ^{B})
CONTROL	16.5	60.7	22.8	17.7 ^{A} (15.0 ^{B})	51.6 ^{B} (71.5 ^{A})	29.7 ^{A} (13.5 ^{B})
Benefits (%)						
REDUCE SHORTAGE	18.6	53.7	27.7	14.8 ^{B} (23.2 ^{A})	47.4 ^{B} (61.2 ^{A})	37.8 ^{A} (15.6 ^{B})
IMPROVE ENVIRONMENT	24.7	42.6	32.7	16.2 ^{B} (34.9 ^{A})	42.2 ^{A} (43.0 ^{A})	40.6 ^{A} (22.1 ^{B})
NUTRITION	31.6	28.8	39.6	21.2 ^{B} (43.9 ^{A})	29.0 ^{A} (28.5 ^{A})	48.8 ^{A} (27.6 ^{B})

[1]Six-point scale ranging from "Disagree completely" to "Agree completely" was used. In the table "Disagree" is an aggregation of the first three categories while "Agree" is for the last three categories.
The numbers in the parenthesis are for United Kingdom. Mean tests were conducted using Tukey process. Mean tests were conducted using Tukey's Studentized Range (HSD) test. Means with the same letters are not significantly different at **"**=0.05.

Table 4: Attitude Toward GM labeling: Maximum Likelihood Estimates of Ordered Probit Models.

Variables	All Sample		USA		UK	
	$Model_1$	$Model_2$	$Model_1$	$Model_2$	$Model_1$	$Model_2$
Constant	-0.2545*	-0.7344*	-0.2423	-0.2166	-0.5825*	-1.0844*
HEALTH RISKS	0.2662*	0.2593*	0.2328*	0.2350*	0.2799*	0.2656*
ECO HAZARDS	0.1077*	0.1192*	0.1109*	0.0944*	0.1291*	0.1395*
MORALLY WRONG	0.0619*	0.0689*	-0.0022	0.0087	0.0933*	0.0913*
CORPORATION	0.1981*	0.2018*	0.1968*	0.2134*	0.2045*	0.1959*
CONTROL	0.0822*	0.0894*	0.1441*	0.1451*	0.0568*	0.0633*
REDUCE SHORTAGE	-0.0442*	-0.0495*	-0.0291	-0.0357	-0.0460	-0.0467
IMPROVE ENVIRONMENT	-0.0315	-0.0204	-0.0150	-0.0189	-0.0268	-0.0482
NUTRITION	-0.0771*	-0.0704*	-0.0868*	-0.0832*	-0.0740*	-0.0548*
GENDER	-	0.0685	-	0.1968*	-	0.0554
AGE	-	0.0077*	-	-0.0033	-	0.0150*
INCOME	-	0.0012*	-	0.0017*	-	0.0002
COLLEGE	-	-0.1643*	-	-0.1892*	-	-0.0762
SCIENCE	-	0.0231	-	0.0421	-	0.0768
COUNTRY	-0.1301*	-0.2065*	-	-	-	-
Threshold parameters for Index						
$:_1$	0.5536*	0.5522*	0.6338*	0.6440*	0.4915*	0.4936*
$:_2$	1.0343*	1.0348*	1.1717*	1.1854*	0.9255*	0.9300*
$:_3$	1.6892*	1.6751*	1.9314*	1.9508*	1.4927*	1.5040*
$:_4$	2.5507*	2.5306*	2.8627*	2.9038*	2.3248*	2.3519*
Log Likelihood Function Value	-3039.64	-2764.26	-1373.17	-1353.38	-1638.26	-1624.94
Log Likelihood Function Value (Restricted; $=0)	-3798.57	-3482.02	-1670.98	-1661.99	-2072.32	-2072.32
Chi-squared	1517.86	1435.51	595.61	617.22	868.11	894.74

*indicates significance at "=0.10 or less

Table 5: Marginal effects of the independent variables on the probabilities of "extremely bothered" response from consumers concern about GM food labeling:

Variables	All Sample		USA		UK	
	$Model_1$	$Model_2$	$Model_1$	$Model_2$	$Model_1$	$Model_2$
HEALTH RISKS	8.71%	8.66%	5.31%	5.22%	10.57%	10.03%
ECO HAZARDS	3.53%	3.98%	2.53%	2.10%	4.87%	5.27%
MORALLY WRONG	2.03%	2.30%	-0.05%	0.19%	3.52%	3.44%
CORPORATION	6.49%	6.74%	4.49%	4.74%	7.72%	7.40%
CONTROL	2.69%	2.99%	3.28%	3.22%	2.14%	2.39%
REDUCE SHORTAGE	-1.45%	-1.65%	-0.66%	-0.79%	-1.74%	-1.76%
IMPROVE ENVIRONMENT	-1.03%	-0.68%	-0.34%	-0.42%	-1.01%	-1.82%
NUTRITION	-2.53%	-2.35%	-1.98%	-1.85%	-2.79%	-2.07%
GENDER	-	2.29%	-	4.37%	-	2.09%
AGE	-	0.26%	-	-0.07%	-	0.57%
INCOME	-	0.04%	-	0.04%	-	0.01%
COLLEGE	-	-5.49%	-	-4.20%	-	-2.88%
SCIENCE	-	0.77%	-	0.93%	-	2.90%
CODE	-4.26%	-6.90%	-	-	-	-