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Role of Product Benefits and Potential Risks in Consumer Acceptance of Genetically Modified Foods

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This study examines the role of product benefits and potential risks in consumer acceptance of genetically modified (GM) foods. The study analyzes consumer willingness to consume three meat products that confer specific benefits with an inherent risk. Results indicate that respondents who were provided both the product benefit and risk information were less likely to consume the three GM food products than those who were only provided the product benefit information. Results also suggest that males are consistently more likely to consume the three GM products than females. Those who take the time to read food labels were also consistently less likely to consume the three products considered in this study. Differences in social or political values (i.e., conservative or liberal) and trust in private and public entities were not significant factors affecting consumers' willingness to accept GM foods.

Key words: consumer benefits, genetically modified foods, logistic model, perceived risks, willingness to consume.

Introduction

Proponents of agricultural biotechnology view its application as the gateway to the future of food production. This application has the potential to make available a wide variety of products with nutritional, environmental, and economic benefits. Despite this, genetically modified (GM) foods have received mixed regulatory and public acceptance in the United States and elsewhere (Hallman, Adelaja, Schilling, & Lang, 2002). Although public officials are embroiled in a debate about risks and benefits of the technology, consumer acceptance of GM foods remains a critical factor that will help determine the future of this technology.

Transgenic crops entered the US food and feed system without evoking major public resistance. In surveys conducted in 1992, 1995, and 1997, Hoban (1998) found broad approval among US consumers for the application of biotechnology in food production. In the United States, negative reactions to transgenic food products seem to be limited to consumer interest and advocacy groups that are overtly anti-GM (Nelson, 2001). Research shows a divergence in attitudes between consumers and scientists about the health and environmental risks associated with GM products (Josling, Unnevehr, Hill, & Cunningham, 1999; Miranowski, 1999). The divergence stems from the public concerns over the long-term safety and risks associated with genetically modified foods on human health and environment. On the other hand, scientists argue that as long as biotech discoveries are deemed sound, acceptance of GM food products is assured. However, it has been argued that technological progress alone will not lead to widespread consumer acceptance of GM foods—an issue that biotechnology industry has largely overlooked (Krueger, 2001).

Responding to public concerns about the potential risks to people and the environment, most countries have introduced regulations on the use of genetic technologies (Engel, Schauzu, Klein, & Somogyi, 1995). Until recently, Europe had a moratorium to prevent any GM crops from entering the food chain (Grossman & Endres, 2000). India and Brazil still refuse to approve GM products. Food and beverage manufacturers and retailers in the UK voluntarily agreed to adopt labeling of food products containing GM soya and corn protein; some UK retailers removed all GM products from their shelves. Similarly, consumer concerns have made food companies like McDonalds and Frito-Lay reluctant to use transgenic food products.

Some existing studies suggest that consumer reception of GM foods is related to perceptions of risk, levels of risk aversion, knowledge of science, views about government and corporations, or various moral and ethical views (Baker & Burnham, 2001; Lusk, Daniel, Mark, & Lusk, 2001; Moon & Balasubramanian, 2001; Rousu, Huffman, Shogren, & Tegene, 2002; Van Wechel, Wachenheim, Schuck, & Lambert, 2003). Further, Frewer, Howard, and Shepherd (1998), Frewer (2003), and Scholderer and Frewer (2003) have investigated the effect of information on risks of GM food production on consumer acceptance of the technology in a social psychology framework. Other studies have also

estimated consumer willingness to pay for meat produced with GM ingredients (Lusk, Roosen, & Fox, 2003; Tonson & Schroeder, 2003), while others have dealt with consumer demand for GM foods with benefits, as in this study (Bredahl, 2001; Lusk, 2003; Lusk, Moore, House, & Morrow 2002; Scholderer & Frewer, 2003).

Public debate has focused not only on the risks and benefits associated with biotechnology, but also on social, moral, and ethical issues. Proponents emphasize the potential benefits to society in terms of improved products that will deliver distinct benefits to mankind. On the other hand, opponents often view biotechnology as an unnecessary interference with nature that has unknown and potentially disastrous consequences (Nelson, 2001). This study examines consumers' willingness to consume GM food products under two scenarios: (a) when they are presented with only the benefit of the product; and (b) when they are presented with both benefit and potential risk of the product in question. Recent research on public attitudes toward biotechnology indicates that consumer acceptance can rely on factors such as type of product (e.g., whole or processed food) and the organisms involved (i.e., plant- or animal-based products; Hallman et al., 2002; Hamstra, 1998). This study compares the willingness to consume three types of meat products: (a) meat products from animals (cows and chickens) fed on GM corn or soybeans; (b) beef from cows that are genetically modified to yield meat with less fat and cholesterol; and (c) meat products from animals (cows and chickens) that are genetically modified to prevent food poisoning. For simplicity in subsequent discussion, product (a) will also be called a GM product, although it is not so technically. The goal of this study is to develop a more meaningful understanding of consumer acceptance of food biotechnology by identifying the factors that drive their willingness or unwillingness to consume.

Survey Methodology, Variable Definition, and Empirical Model

We analyze consumer's willingness to consume GM foods within the random utility discrete choice model. The logit model and its extensions have been widely used in modeling discrete choice problems in marketing, consumer behavior, and other areas of applied economics research (Green, 2002; Train, 2002).[1]

A survey instrument was developed to collect information on public perceptions of biotechnology and their acceptance of genetically modified food products. One section of the survey was designed to gather information on the socioeconomic and value characteristics of the respondents, including age, gender, ethnicity, education, income, family size, employment status, religious practice, and social/political views. The survey also elicited respondents' views about trust in scientists, government, medical practitioners, consumer advocacy groups, farmers, universities, and industry. In another part of the survey, each respondent was asked 11 basic questions related to science and genetics. The number of correct responses was used to obtain an objective measure of an individual's knowledge of science.

A polling firm was commissioned to conduct the nationwide telephone survey in the United States between February 27, 2003, and April 1, 2003.[2] Targeting the noninstitutionalized US adult (18 years or older) civilian population, a random proportional probability sample was drawn from more than 97 million telephone-equipped households in the contiguous 48 United States. US Census Bureau population estimates determined the distribution necessary for proportionate geographic coverage. The target sample size of 1,200 allowed for a sampling error rate of ±3%.[3] Using a computer-assisted telephone interview (CATI), 1,201 telephone surveys were completed, with an average cooperation rate of 65% for both versions of the survey.[4]

At the end of the survey, we asked the respondents if they were interested in further participation through a mail survey. Those who agreed received a five-dollar incentive for their additional participation. This research presents data from the 380 mail surveys (57.5%) that were returned. The mail survey asked respondents to state their willingness to consume GM food products representing a broad food category and conferring spe-

1. *A longer version of the paper, detailing the conceptual and empirical framework, is available from the authors.*

2. *Interviewing was not conducted on March 21 and 22 due to the start of Operation Iraqi Freedom and the coverage it was receiving on television.*

3. *The sampling error associated with a nationwide sample of 1,200 people is approximately ±3% with a 95% confidence interval. This means that if 50% of the respondents gave a particular response, the likely percentage of the entire adult population should be 47–53% 95 out of 100 times.*

4. *The cooperation rate is the percentage of completed interviews (1,201) over completed interviews (1,201) plus refusals (636). A more rigid calculation of response rate, defined as the percentage of completed interviews (1,201) over total numbers in-frame telephone number (3,120), yields a response rate of 38.5%.*

cific benefits with inherent potential risk. In this respect, the risk part captures the disutility the consumer derives from the adverse consequences associated with GM foods. A brief introduction informed participants that the genetic modification would have no impact on taste, look, appearance, or price of the product. Half of the respondents were told only about the benefit of the GM product (191), and the other half were told about both the benefit and the potential risk of the product (187). Thus, in the case of meat products from cows and chickens fed on GM corn or soybeans, the respondents were asked: "Suppose cows or chickens are fed genetically modified corn or soybeans that are grown using less pesticide or herbicide. However, because the pesticide or herbicides are built into the plants, there is a chance that insects that feed on them could be harmed. Please state your willingness to consume meat products from these cows and chickens." A binary dependent variable, *EATGM*, was defined by assigning a value of 1 if the respondent was willing to consume these products and 0 otherwise. A similar procedure was used to create a dependent variable (i.e., *EATGM*) for the other food products with other risks and benefits.

The explanatory variables included in the empirical models are: (a) demographic variables—age, gender, race, education, knowledge of science, and region; (b) economic variable—income; and (c) value attributes—social/political view, religion, and trust that the government, scientists, consumer advocacy groups, industry, universities, and medical practitioners have the respondent's best interest in mind in regard to GM food. These explanatory variables were selected based on the existing literature on consumer choice as well as the findings of recent studies on public attitudes toward biotechnology.

The specific definitions of the independent variables used in this study and the rationale for their inclusion in the empirical model are listed below and in Table 1.

Table 1. Descriptive statistics of variables.

Variable	Description	Mean	SD
BEEPEST	1 if respondent was willing to consume meat products from cows or chickens fed on GM corn or soybeans, 0 otherwise (unwilling to consume such products)	0.68	0.47
BEEHORM	1 if respondent was willing to consume beef products with less fat/cholesterol, 0 otherwise (unwilling to consume such products)	0.52	0.50
POISMEAT	1 if respondent was willing to consume meat products from cows or chickens that have lower chance of food poisoning, 0 otherwise (unwilling to consume such products)	0.49	0.50
MALE	1 if respondent is male, 0 if female	0.44	0.50
RISK	1 if response to both stated product risk and benefit questions on willingness to consume, 0 otherwise (respondent answered only the benefit question)	0.51	0.50
LOWSCORE	1 if respondent correctly answered fewer than 6 (out of 11) basic questions on biological science, 0 otherwise	0.24	0.43
MIDSCORE[a]	1 if respondent correctly answered between 7 to 9 (out of 11) basic questions on biological science, 0 otherwise	0.38	0.49
HISCORE	1 if respondent correctly answered more than 9 (out of 11) basic questions on biological science, 0 otherwise	0.38	0.48
GMDISCUS	1 if respondent participated in GM debates, 0 otherwise	0.48	0.50
ORGBUY	1 if respondent buys organic food regularly, 0 otherwise	0.16	0.37
LABELTIM	1 if respondent takes time to read the label contents, 0 otherwise	0.68	0.47
AGLT34	1 if respondent is younger than 35 years old, 0 otherwise	0.25	0.43
AGE35_44	1 if respondent is aged 35–44 years, 0 otherwise	0.22	0.42
AGE45_54	1 if respondent is aged 45–54 years, 0 otherwise	0.25	0.43
AGE_A55[a]	1 if respondent is older than 55 years old, 0 otherwise	0.28	0.45
BHSCHOOL[a]	1 if respondent's education is below high school, 0 otherwise	0.04	0.20
HSCHOOL	1 if respondent has a high school education, 0 otherwise	0.29	0.46
SCOLLEGE	1 if respondent has a college education (including graduate degree), 0 otherwise	0.25	0.43
COL_GRAD	1 if respondent has a four-year college and graduate degree, 0 otherwise	0.42	0.49
SRELIG	1 if respondent attends church at least once a week to several times a month, 0 otherwise	0.72	0.45
LIBERAL	1 if respondent identifies himself/herself as liberal, 0 otherwise	0.19	0.39

Table 1. Descriptive statistics of variables. (continued)

Variable	Description	Mean	SD
CENTRIST	1 if respondent identifies himself/herself as conservative, 0 otherwise	0.54	0.50
CONSERV[a]	1 if respondent identifies him/herself in between, 0 otherwise	0.27	0.44
WHITE	1 if respondent is white (Caucasian), 0 otherwise	0.87	0.34
BLACKAFR	1 if respondent is African American, 0 otherwise	0.06	0.25
OTH_RACE[a]	1 if respondent is other race, 0 otherwise	0.07	0.25
INCLT25	1 if respondent's household income is less than $25,000, 0 otherwise	0.18	0.39
INC25_50	1 if respondent's household income is $26,000–50,000, 0 otherwise	0.27	0.45
INC51_75	1 if respondent's household income is $50,000–74,000, 0 otherwise	0.26	0.44
INC_A75[a]	1 if respondent's household income is greater than $75,000, 0 otherwise	0.28	0.45
WEST	1 if respondent resides in western states, 0 otherwise	0.24	0.43
MID_WEST[a]	1 if respondent resides in Midwest, 0 otherwise	0.29	0.46
SOUTH	1 if respondent resides in southern US, 0 otherwise	0.31	0.46
NOR_EAST	1 if respondent resides in north eastern US, 0 otherwise	0.16	0.36
TRU_IND	1 if respondent can trust industry (tell truth, provide useful information, has expertise, and protect society) on GM issues, 0 otherwise	0.46	0.50
TRU_GOV	1 if respondent can trust government (tell truth, provide useful information, has expertise, and protect society) on GM issues, 0 otherwise	0.58	0.49
TRU_SCI	1 if respondent can trust scientists (tell truth, provide useful information, has expertise, and protect society) on GM issues, 0 otherwise	0.81	0.39
TRU_MED	1 if respondent can trust medical professionals (tell truth, provide useful information, has expertise, and protect society) on GM issues, 0 otherwise	0.74	0.44

[a] *Variable is the base group.*

Risk. This dummy variable was assigned the value of 1 if the respondent answered the willingness to consume a product question with both the benefit and risk of the product stated; and 0 otherwise. The sample was split into half (i.e., 50% of each responding to each side of the question).

Trust in government. The dummy variable *TRU_GOV* was assigned a value of 1 if the individual somewhat or strongly agreed with the statement: "The federal government will tell the truth, has the expertise to make a competent judgment, will do what is right for society, and could be a useful source of information about GM food products" and 0 otherwise. Approximately 58% of the responses fell in category 1; the remaining 42% fell in category 0.

Trust in industry. The dummy variable *TRU_IND* was assigned a value of 1 if the individual somewhat or strongly agreed with the statement: "The biotechnology industry will tell the truth, has the expertise to make a competent judgment, will do what is right for society, and could be a useful source of information about GM food products" and 0 otherwise. Approximately 46% of the responses fell in category 1; the remaining 54% fell in category 0.

Trust in scientists. The dummy variable *TRU_SCI* was assigned a value of 1 if the individual somewhat or strongly agreed with the statement: "Scientists engaged in biotechnology research will tell the truth, have the expertise to make a competent judgment, will do what is right for society, and could be a useful source of information about GM food products" and 0 otherwise. Approximately 81% of the responses fell in category 1; the remaining 17% fell in category 0.

Trust in medical professionals. The dummy variable *TRU_MED* was assigned a value of 1 if the individual somewhat or strongly agreed with the statement: "The medical professionals will tell the truth, have the expertise to make a competent judgment, will do what is right for society, and could be a useful source of information about GM food products" and 0 otherwise. Approximately 74% of the responses fell in category 1; the remaining 26% fell in category 0.

Participation in GM debates. The dummy variable *GMDISCUS* was assigned a value of 1 if the respondent

had previously discussed biotechnology, genetic engineering, or genetic modification with anybody and 0 otherwise. Approximately 48% of the responses fell into category 1; the remaining 52% fell into category 0.

Organic food purchases. The dummy *ORGBUY* was assigned a value of 1 if the respondent frequently or always bought organic food over nonorganic and 0 otherwise. About 16% of the respondents belonged to the group that bought organic foods; 84% did not regularly buy organic food.

Importance of GM labeling. The dummy *LABELTIM* was assigned a value of 1 if the respondent, when shopping, takes time to look at labels to see if genetically modified ingredients are listed and 0 otherwise. About 68% of the respondents belonged to group 1; the remaining 32% fell into category 0.

Age. Three age groups are identified, as follows: below 35 years (*AGELT34*), 35–54 years (*AGE35_54*), and 55 years or older (*AGE_A55*). About 22% of the respondents are identified to be in *AGELT34,* 47% *AGE35_54*, and 31% *AGE_A55*.

Income. Four different (annual) household income levels were identified, as follows: below $25,000 (*INCLT25*), $26,000–50,000 (*INC25_50*), $50,000–74,000 (*INC51_75*), and $75,000 or more (*INC_A75*). About 18% of the respondents belonged to *INCLT25*; 27% belonged to *INC25_50*; 26% belonged to *INC51_75*; and the remaining 28% belonged to *INC_A75* groups. No a priori assumption is made about the effect of income on individual acceptance of GM food products.

Gender. The dummy variable *MALE* was assigned a value of 1 if the respondent was male and 0 if she was female. The sample of respondents falling in category 1 was 42% and the rest was 58%. No a priori assumption is made regarding the effect of gender variation on the dependent variable.

Race. Respondents were classified on the basis of their reported race as follows: *WHITE* if the respondent was White (Caucasian), *BLACKAFR* if the respondent was African American, and *OTHER_RACE* if the respondent was another race (Native American, Hispanic, or Asian or Pacific Islander). About 87% of the respondents were white, 6% were African American, and 7% belonged to other races. There were no a priori expectations of the effects of race on the dependent variable.

Social/political view. As discussed earlier, biotechnology is often opposed on grounds of its potential negative impacts on the environment and farm structure as well as on the Third World (Nelson, 2001). Because conservatives and liberals often disagree on these issues, respondents' social or political views were included in the empirical model as an independent variable. Respondents were classified based on their self-reported social/political views as follows: conservative (*CONSERVE*), liberal (*LIBERAL*), and centrist (*CENTRIST*; i.e., between liberals and conservatives). About 27% of the respondents were identified as conservatives, 18% as liberals, and the remaining 53% as somewhere in between.

Education. Four different levels of education were identified. Accordingly, the dummy variable (*BHSCHOOL*) was assigned a value of 1 if the respondent did not attain a high school diploma and 0 otherwise. A dummy *HSCHOOL* was assigned the value of 1 for those with a high school diploma and 0 otherwise. *SCOLLEGE* was assigned the value of 1 if the respondent attained a two-year college education and 0 otherwise; *COL_GRAD* was assigned to those with four years of college education and graduate education. About 5% of respondents only completed grade school or below; 29% had a high school diploma; 25% had a two-year college education; and 41% had a four-year college and graduate education. Although there are some indications that more educated individuals are more supportive of the use of biotechnology in agriculture (e.g., Hill, Stanisstreet, Boyes, & O'Sullivan, 1998), the evidence thus far is not conclusive.

Religion. As has been discussed earlier, some are opposed to the use of biotechnology based on moral, ethical, and religious grounds. Such opposition is not specific to any particular religion. Rather, it reflects on an individual's broad religious and ethical view about on the use of transgenic technology. To examine the potential impact of such views on the willingness to buy GM foods, we included respondents' religion as an independent variable, which was measured by their attendance at church or similar houses of worship. The dummy variable *SRELIG* was assigned a value of 1 if the individual regularly (i.e., several times a month or more) attended church (or other house of worship) and 0

otherwise. About 72% of the respondents fell into category 1; the remaining 28% fell into category 0.

Knowledge of science. Survey-based studies on public perceptions of biotechnology have found evidence that respondents' knowledge of science (relating to biotechnology) is related to their acceptance of transgenic technology (Sheehy, Legault, & Ireland, 1998). To explore this issue, consumers' knowledge of science was included as an independent variable in the empirical model. To obtain an objective measure, survey participants were asked to correctly answer a set of 11 questions. These answers were evaluated and used to measure their basic understanding of science. Three different knowledge levels were identified, as follows: *LOWSCORE* (representing fewer than six correct responses), *MIDSCORE* (7–9 correct responses), and *HIGHSCORE* (10 or more correct responses). About 17% of the respondents fell into category 1, 43% into category 2, and 39% into category 3.

Region. In order to explore potential regional differences in consumers' willingness to buy GM food products, respondents were classified into four groups by defining four regional dummy variables: *NOR_EAST*, *SOUTH*, *MID_WEST*, and *WEST*. No a priori assumptions were made about regional differences in consumers' willingness to consume GM foods.

In the empirical analysis, the following model is specified to examine the probability that an individual consumer would be willing to consume a specific GM food product:

$$EATGM = \beta_0 + \beta_1 MALE + \beta_2 RISK + \beta_3 LOWSCORE + \beta_4 HIGHSCORE + \beta_5 GMDISCUS + \beta_6 ORGBUY + \beta_7 LABELTIM + \beta_8 AGLT34 + \beta_9 AGE35\_44 + \beta_{10} AGE45\_54 + \beta_{11} HSCHOOL + \beta_{12} SCOLLEGE + \beta_{13} COL\_GRAD + \beta_{14} SRELIG + \beta_{15} LIBERAL + \beta_{16} CENTRIST + \beta_{17} WHITE + \beta_{18} BLACKAFR + \beta_{19} INCLT25 + \beta_{20} INC25\_50 + \beta_{21} INC51\_75 + \beta_{22} WEST + \beta_{23} SOUTH + \beta_{24} NOR\_EAST + \beta_{25} TRU\_IND + \beta_{26} TRU\_GOV + \beta_{27} TRU\_SCI + \beta_{28} TRU\_MED + \varepsilon, \quad (1)$$

where the variables are as defined earlier.

A logit model is estimated for each of the three GM meat products using maximum likelihood (ML) estimation. The model summary statistics, β coefficients (along with their *t* ratios), and the marginal effects were obtained by using the software package LIMDEP (Limdep Version 8.0 User's Manual, 2002).

Empirical Results

Table 2 presents results on the marginal effects along with their associated *t* ratios, prediction success, and *p* values of the variables for each of the GM food products.[5]

Meat Products from Animals Fed GM Corn or Soybeans

Of the 312 respondents who answered the question relating to the willingness to consume meat products from cows and chickens fed on GM corn or soybean, 211 (68%) were willing to consume (*EATGM* = 1), and the remaining 101 (32%) were unwilling to consume meat products from cows and chickens fed on GM corn or soybeans (*EATGM* = 0). Coefficients of *MALE*, *GMDISCUS*, *SCOLLEGE*, *WHITE*, *BLACKAFR*, and *TRU_GOV* were positive and statistically significant at the 10% or 5% level. Similarly, the statistically significant (at 10% or lower level) negative coefficients were *RISK*, *LOWSCORE*, *LABELTIM*, and *AGE35_44*. The estimated marginal effects of these statistically significant independent variables (Table 2) suggest that respondents who based their consumption decision on the stated benefit and risk were 21% less likely to consume these meat products than others. Those individuals who take time to read labels when shopping were 25% less likely to consume these products than those who do not read labels. Those in the middle age range (35–44) were 15% less likely to consume these products than those above 55 years old. Respondents who had low scores in the biological questions were 17% less likely to consume these products than those who received middle scores (*MIDSCORE*).

Males were 13% more likely to consume beef and poultry fed on GM corn and soybeans than females; individuals with some college education were 20% more likely to consume beef and poultry fed on GM corn or soybeans than those with below high school education. Similarly, individuals who had discussed GM issues with others were 11% more likely to consume these products than others. Whites and African Americans were 27% and 17% more likely to consume these products, respectively, than respondents of other races (Hispanic and Asian or Pacific Islander). Respondents

5. *The estimated logistic model results are available from the authors upon request.*

Table 2. Estimated marginal effects of independent variables on willingness to consume.

	Less pesticides/herbicides: may harm insects feeding on corn or soy (cows and chicken fed on GM corn or soybean)			Less fat/cholesterol: may elevate certain hormones (GM cows)			Lower chances of food poisoning: may elevate certain hormones (GM cows and chickens)		
	Marginal effect	*t* ratio	*p* value	Marginal effect	*t* ratio	*p* value	Marginal effect	*t* ratio	*p* value
Constant	0.003	0.01	0.99	-0.217	-0.70	0.49	-0.400	-1.31	0.19
MALE	0.128	2.27	0.02	0.199	2.83	0.00	0.145	2.06	0.04
RISK	-0.205	-3.68	0.00	-0.351	-5.52	0.00	-0.343	-5.51	0.00
LOWSCORE	-0.165	-1.92	0.06	-0.079	-0.83	0.40	-0.051	-0.56	0.57
HISCORE	-0.041	-0.62	0.54	-0.022	-0.28	0.78	-0.006	-0.08	0.94
GMDISCUS	0.108	1.81	0.07	-0.120	-1.60	0.11	-0.042	-0.57	0.57
ORGBUY	-0.087	-1.03	0.30	-0.240	-2.46	0.01	-0.204	-2.17	0.03
LABELTIM	-0.251	-4.82	0.00	-0.200	-2.70	0.01	-0.206	-2.81	0.01
AGLT34	-0.004	-0.05	0.96	0.083	0.84	0.40	0.127	1.33	0.18
AGE35_44	-0.149	-1.60	0.11	-0.045	-0.44	0.66	0.026	0.26	0.79
AGE45_54	-0.040	-0.49	0.63	0.056	0.58	0.56	0.010	0.10	0.92
HSCHOOL	0.170	1.41	0.16	0.328	1.95	0.05	0.350	2.05	0.04
SCOLLEGE	0.196	1.82	0.07	0.087	0.44	0.66	0.248	1.35	0.18
COL_GRAD	0.164	1.16	0.24	0.087	0.43	0.67	0.230	1.19	0.23
SRELIG	0.038	0.56	0.57	0.004	0.05	0.96	0.015	0.19	0.85
LIBERAL	0.014	0.15	0.88	-0.057	-0.50	0.62	-0.114	-1.07	0.28
CENTRIST	-0.093	-1.38	0.17	-0.112	-1.30	0.19	-0.009	-0.11	0.91
WHITE	0.274	2.00	0.05	0.256	1.92	0.05	0.192	1.46	0.15
BLACKAFR	0.173	2.21	0.03	0.260	1.73	0.08	0.304	2.01	0.04
INCLT25	-0.039	-0.40	0.69	-0.064	-0.56	0.57	0.029	0.26	0.80
INC25_50	-0.112	-1.30	0.20	-0.185	-1.92	0.06	-0.068	-0.71	0.48
INC51_75	0.035	0.46	0.65	-0.007	-0.07	0.94	0.112	1.19	0.23
WEST	0.059	0.82	0.41	0.052	0.53	0.59	-0.032	-0.34	0.74
SOUTH	0.045	0.65	0.52	0.031	0.34	0.73	-0.103	-1.21	0.23
NOR_EAST	0.007	0.08	0.94	0.024	0.21	0.83	-0.079	-0.74	0.46
TRU_IND	-0.034	-0.54	0.59	0.002	0.03	0.98	0.069	0.92	0.36
TRU_GOV	0.149	2.33	0.02	0.114	1.50	0.13	0.089	1.19	0.23
TRU_SCI	0.019	0.23	0.82	0.100	1.00	0.32	0.018	0.19	0.85
TRU_MED	0.037	0.53	0.60	0.168	2.03	0.04	0.206	2.67	0.01

	Beef/poultry			Beef			Beef/poultry		
	Predicted			Predicted			Predicted		
Actual	**0**	**1**	**Total**	**0**	**1**	**Total**	**0**	**1**	**Total**
0	52	49	101	116	35	151	118	42	160
1	21	190	211	35	126	161	45	107	152
	73	239	312	151	161	312	163	149	312
Prediction success rate			78%			78%			72%

who trust the government to tell the truth, have GM expertise, provide useful source information, and protect society on GM issues were 15% more likely to consume GM products than others.

GM Beef with Less Fat and Cholesterol

Of the 312 respondents who responded, 161 (52 %) respondents were willing to consume (i.e., *EATGM* = 1) and the remaining 151 (48%) were not willing to con-

sume GM beef with less fat/cholesterol (i.e., *EATGM* = 0). Coefficients of *MALE*, *HSCHOOL*, *WHITE*, and *TRU_MED* were positive and statistically significant; the statistically significant negative coefficients were those of *RISK*, *GMDISCUSS*, *ORGBUY*, *LABELTIM*, and *INC25_50*. The estimated marginal effects of these explanatory variables show that respondents to whom both product risk and benefits were stated were 35% less likely to consume beef with low fat or cholesterol than others. Respondents who purchased organic foods, discussed GM issues, and took time to read labels while doing food purchases were 12%, 24%, and 20% less likely, respectively, to consume such beef products than their counterparts. Similarly, individuals in the income range of $25,000–50,000 were 19% less likely to consume such products than those with annual incomes above $75,000. On the other hand, males compared to females, white people (compared to other races), those with high school education (compared to those with less than a high school education), and those who trust medical professionals were 20%, 33%, 26%, and 17% more likely, respectively, to consume such beef products.

GM Meat Products that Prevent Food Poisoning

In the case of willingness to consume meat products from genetically modified cows and chickens with a lower chance of food poisoning but may elevate certain hormones in the animal, 152 (49%) respondents were classified as willing to eat the product (*EATGM = 1*), while the remaining 160 (51%) responses were identified as unwilling to eat the product (*EATGM = 0*). The estimated marginal effects of the statistically significant coefficients suggest that males are 21% more likely to consume such meat products than females, while those who trust medical professionals were 15% more likely to consume such meat products than others. African Americans were 30% more likely to consume the meat products than those of other races. Those with high school education were 35% more likely to consume such meat products than those with below high school education. Conversely, those individuals to whom both the risk and benefit were stated, those who regularly buy organic foods, and those who read labels when purchasing food were 34%, 20%, and 21% less likely to consume such products, respectively, than their counterparts.

Across the Models

When comparing the results across the three models, a few observations come into the picture. Males were consistently more likely to consume the three products than females. Respondents who were provided the risk information were less likely to consume the three GM products than those who were only provided the benefit information of the product. Those who discussed GM issues with others were more likely to consume meat from cows and chicken fed on GM corn or soybean but less likely to consume GM cows. Respondents who buy organic foods regularly were less likely to consume GM cows or chickens. In addition, those who take the time to read food labels were consistently less likely to consume the three products considered in this study.

Social or political values (i.e., conservative or liberal) and trust in public and private entities (i.e., industry, government, scientists, medical professionals) do not seem to be very important determinants of consumers' willingness to accept GM foods. Similarly, household incomes do not seem to have a strong influence, as it is only statistically significant in the beef with less fat and cholesterol model. There is also no evidence of regional effects on the willingness to consume the GM products examined in this study.

Concluding Remarks

As scientific advances in molecular genetics continue to make their way into the production of food and fiber products, consumer acceptance of food biotechnology is likely to remain one of the critical factors that will influence how society organizes its food system. Scientific advances alone will not ensure the absolute acceptance of genetically modified food products in the marketplace. The results of this study suggest that respondents who were presented both product benefits and potential risks were less likely to consume the three GM products than those who were presented only the product benefit. This finding may signify the greater weight that consumers tend to put on the risk side as opposed to the benefit side of the GM product. The implications of this finding are related to those found in other studies (e.g., Lusk et al., 2002; Rousu et al., 2002; Van Wechel et al., 2003). Although this finding is intuitive, it is important to note that our respondents were explicitly instructed to assume that the prices of these products are not affected by the GM technology. It is quite possible that their valuations of the GM products would change if prices were different. For example, it would be important to know how much lower priced a GM meat must be so that consumers with the risk information would become indifferent to consuming GM meat. In addition, individuals may behave differently in hypothetical and nonhypo-

thetical environments. A study using experiments in nonhypothetical environments could provide additional information about consumers' willingness to consume GM products. Although these areas were beyond the scope of the survey conducted for this study, these are indeed important topics for future research.

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