

PUBLIC PERCEPTIONS AND WILLINGNESS-TO-PAY A PREMIUM FOR NON-GM FOODS IN THE US AND UK

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This study uses consumer survey data collected in the United States (US) and United Kingdom (UK) to examine the linkages between subjective risk and benefit perceptions and willingness-to-pay a premium for non-genetically modified (non-GM) foods. While UK consumers were significantly more willing to pay a premium to avoid GM foods than US consumers, risk and benefit perceptions clearly translated into behavioral intentions as measured with willingness-to-pay in both countries. More importantly, this paper establishes that risk perception exerts a greater impact on willingness-to-pay than benefit perception.

Key words: non-GM foods; risk and benefit perception; willingness-to-pay.

Agricultural biotechnology was hailed as a major technological breakthrough when transgenic forms of major crops appeared on the market in the mid-1990s. Since then, because of their ability to reduce pest-management costs and potentially increase yields, the adoption of biotech seeds for corn, soybean, and cotton has dramatically expanded in the United States (United States Department of Agriculture Economic Research Service [ERS], 2000). In line with the expansion in production, Hoban (1998) reported that more than 70 percent of US consumers surveyed in 1992, 1995, and 1998 supported the application of biotechnology in food production. In contrast, the situation has been dramatically different in Europe. From the beginning of the commercialization of biotech seeds, European consumers have voiced intense health and environmental concerns about foods containing genetically modified organisms (GMOs) (Zechendorf, 1998; Gaskell *et al.*, 1999). Such resistance in Europe may have caused US consumers to break their silence about GMOs in 1999. With US consumers beginning to question the credibility of the Food and Drug Administration's (FDA) approval of transgenic crops, some surveys show that GM foods have become a controversial issue in the US. For example, International Food Information Council (IFIC) surveys disclosed acceptance rates of 78% in 1997, 75% in February 1999, 63% in October 1999, and 59% in May 2000 (Priest, 2000).

Several fundamental questions arise in view of the growing concerns over the application of biotechnology in agriculture and food production. Why is there a discrepancy in public sentiments about GM foods across the US and Europe? How would consumers behave if they

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have the right to choose between GM and non-GM foods? What is the role of risk and benefit perceptions in determining consumers' behavior with regard to GM foods? This paper offers some empirical insights into these questions using consumer surveys administered in December, 2000, online in the United Kingdom (2,568 respondents) and via mail in the US (3,060 respondents). Although consumer sentiments about agrobiotechnology vary across countries within the European Union, the United Kingdom is most likely to represent the middle ground among its 15 member nations. For example, Gaskel (2000) shows that Greece, Austria, and Luxembourg belong to the group least supportive of agrobiotechnology (14%-30%), and the Netherlands, Spain, and Finland are most supportive (69%-75%). The UK is in the middle group along with Germany and Belgium (47%-50%). Hence, it seems reasonable to use the UK as a proxy for the EU. The database includes an array of variables measuring consumer acceptance, perceptions, trust of regulatory agencies, and willingness-to-pay for non-GM foods that shed light on current trends in public sentiment about agrobiotechnology. Our study first examines survey results of particular relevance to addressing the questions raised above. Then a probit regression model is developed to probe the linkages between subjective risk and benefit perceptions and willingness-to-pay a premium for non-GM foods.

Survey Design

A survey instrument was designed to measure two sets of conceptual variables of interest in this study: (1) attitudes and perceptions as related to agrobiotechnology, and (2) behavioral intentions with a focus on willingness-to-pay for breakfast cereals made of non-GM ingredients. The surveys were administered by mail in the US and online in the UK using household panels maintained by the National Panel Diary (NPD) group, a marketing consulting firm specializing in research on consumer behavior and food marketing. Survey methods which 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. Questionnaires were distributed to 5,200 households (a subsample of the NPD panel), selected across the United States by random sampling. The US sample was stratified by geographic regions, head of household age, education, and income, in line 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.

Contingent valuation (CV) questions were included in the survey instrument to assess consumers' willingness-to-pay a premium for non-GM breakfast cereals. The CV method has emerged in recent years as an important tool to address health and nutrition related issues in food markets (van Ravenswaay, 1995). Although CV is commonly used to measure consumer preferences for nonmarket (e.g., environmental) goods, we were motivated to apply CV to food demand issues, in order to measure properly the value that consumers place on reductions in chronic or infectious disease risks associated with food consumption. In our survey design, respondents were asked to consider the following situation: "Suppose that you walk into a grocery store and want to buy breakfast cereals. The grocery store carries breakfast cereals (e.g., corn flakes, frosted flakes, or corn pops) of two types: (1) made from GM crops, and (2) made from conventional non-GM crops." Further, respondents were asked to consider two scenarios: (1) the prices of breakfast cereals of both types are identical at \$4.00 per box, and (2) the price of non-GM breakfast cereals is higher when compared to that of GM breakfast cereals.

In an effort to reduce bias arising from the hypothetical nature of the CV questions, respondents were reminded that if they chose to spend more on conventional non-GM foods, they would be left with a smaller budget to spend on other grocery items. Further, to accommodate those

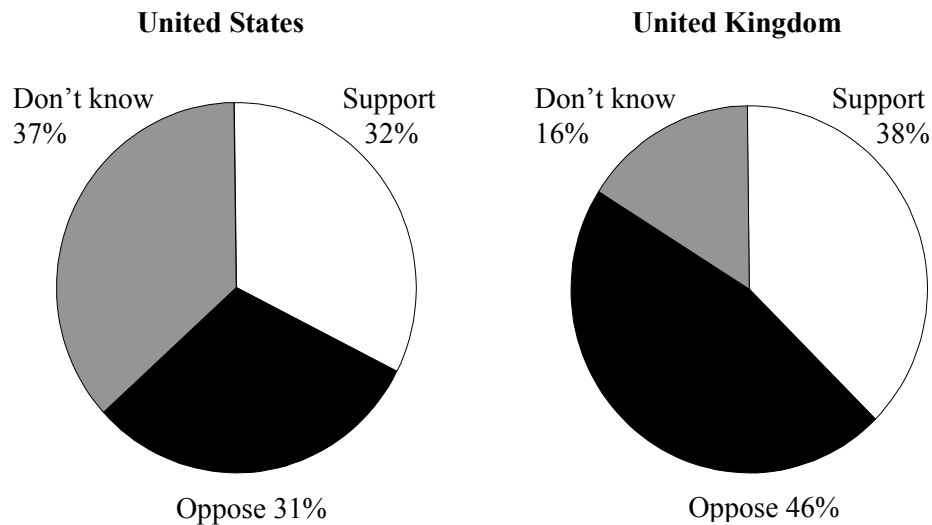
respondents who were not aware of GM issues at all, we incorporated a “Don’t Know” category in the responses to contingent valuation questions.

Survey Results

Public Acceptance

Public acceptance of agrobiotechnology was measured using a six-point Likert scale ranging from “Strongly oppose” to “Strongly support.” Unsure respondents could select the option “Don’t know.” Figure 1 shows the distribution of responses across the US and UK. Most notably, the percentage of US respondents that supports agrobiotechnology (32%) in our survey is considerably lower than the 70% reported by Hoban up to 1998. This finding corroborates the declining trend in the public acceptance rate in the US over the last few years. Yet the figure displays a key discrepancy across the US and UK. The percentage of consumers who selected “Don’t know” was substantially larger in the US (37%) than UK (16%). This result suggests that a significant segment of US consumers have not developed attitudes toward agrobiotechnology. This result has been found elsewhere (Hoban, 1998).

Figure 1: Public Acceptance of the Use of Biotechnology in Crop Production.



Note. Six-point scale ranging from “Strongly Oppose” to “Strongly Support” was used. In the pie chart “Oppose” is an aggregation of the first three categories while “Support” is for the last three categories.

It is interesting to compare and contrast the evolution of the attitudes of US consumers toward biotechnology in the pharmaceutical and food domains. Historically, public opinion in the US has been more positive about medical biotechnology than agricultural biotechnology. Our survey result mirrors this trend: 31% (46%) of US (UK) respondents were opposed to biotech foods while only 16% (18%) opposed biotech medicine, respectively. Although both biotech foods and biotech medicine are subject to regulatory oversight by the FDA, a plausible explanation for these differences stems from the extent of control mechanisms in place to enhance consumer welfare. That is, the field of biotech medicine has professional gatekeepers (i.e., physicians who command a high degree of consumer trust) that prescribe, direct, and control the consumption of such

products to benefit consumers. Moreover, the dosage and regimen associated with the consumption of biotech drugs is tailored to the needs of the individual. Such gatekeeping or tailoring activities do not exist for biotech foods. Another plausible explanation that has been advanced is that medical applications of the technology offer tangible direct benefits to consumers whereas the first generation of GM foods have offered only indirect benefits.

Distrust of regulatory agencies in the face of repeated food scares, such as “mad cow” or “foot and mouth” diseases in Europe, is often cited as a cause underlying European consumers’ negative reception of biotech foods. Our NPD database measures the degree of trust that consumers place in regulatory agencies with the following two statements: “the government ensures the safety of overall food supply,” “Do you agree/disagree?” and “the government has adequate rules and regulations specifically about GMOs,” “Do you agree/disagree?” Table 1 shows that consumers across the US and UK are more skeptical of the government’s role in assuring the safety of GM foods than general food safety. For example, 76% (48%) of US (UK) consumers endorsed the government’s role in securing the safety of general food supply, while only 25% (20%) of US (UK) consumers considered rules and regulations about GMOs adequate. More importantly, table 1 substantiates that US consumers have relatively greater confidence in regulatory agencies for securing food safety in general, and GM foods in particular, as compared to UK consumers.

Risk and Benefit Perceptions

Controversy over biotech foods stems from not only potential adverse health and environmental effects of agrobiotechnology, but also from a number of other qualitative aspects. Our survey design addressed eight risk/benefit attributes associated with agrobiotechnology encompassing: (1) health risks; (2) environmental hazards; (3) moral and ethical considerations; (4) the image of multinational corporations as the primary beneficiaries of biotechnology; (5) the growing control of multinational corporations over farming; (6) the potential for a reduction in world food shortages (increase in yields) resulting from the introduction of transgenic crops; (7) reduced use of chemicals in crop production; and (8) potential for improvements in the nutritional content of foods. Consumer perceptions about such attributes were measured using a seven-point Likert-type scale ranging from “Disagree Completely” to “Agree Completely” to “Don’t Know.” The first five attributes represent negative aspects while the latter three portray potential benefits of agrobiotechnology.

Table 1: Consumer Trust of Government in Ensuring the Safety of Foods and GMOs.

	Food Safety		Safety of GM Foods	
	US (%)	UK (%)	US (%)	UK (%)
Agree	76	48	25	20
Disagree	22	52	40	64
Don’t Know	2	0	35	16

Table 2 presents the distribution of responses to the eight questions. Overall, UK respondents showed a greater level of consensus about the negative attributes of agrobiotechnology than US respondents. About 65% of UK respondents were concerned about adverse environmental effects

resulting from agrobiotechnology. Further, 71% of UK respondents perceived multinational corporations as being the primary beneficiaries of agrobiotechnology 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).

Table 3 presents a correlation matrix among the five negative perceived attributes of agrobiotechnology. While there was no noticeable difference across the US and UK, the correlations were very high in both countries, ranging from 0.55 to 0.76. The correlation, for example, between perceptions about health and environment hazards (0.76) indicates that if respondents perceive health hazards from eating GM foods, they are also likely to perceive agrobiotechnology as posing environmental hazards. Two explanations are possible for these results. First, the high correlations accurately reveal the nature of consumer beliefs about the various attributes of agrobiotechnology. Alternatively, the high correlations may be attributed to dubious preferences resulting from differences in the attitude formation process. That is, consumers may form overall attitudes about various attributes of agrobiotechnology through a peripheral route (i.e., emotion, publicity or public opinion) instead of through a cognitive elaboration (or central route) (van Raaij, 1988; Wansink & Kim, 2001). Consequently, if a consumer develops a negative attitude toward GM foods through a peripheral route without evaluating the attributes, he/she may give responses similar across all negative attributes associated with agrobiotechnology.

Table 2: Distribution of Consumer Responses to Negative and Positive Attributes.

	United States			United Kingdom		
	Agree	Disagree	Don't Know	Agree	Disagree	Don't Know
Negative Attributes (%)						
Health Risks	26	31	43	40	37	23
Environmental Hazards	30	23	47	65	16	19
Morally Wrong	31	43	26	41	51	8
Multi_1 ^a (Image)	53	22	25	71	20	9
Multi_2 ^b (Control)	51	18	31	71	15	14
Positive Attributes (%)						
Increase in Yields	47	15	38	61	23	16
Reduced Chemical Use	42	16	42	43	35	22
Improved Nutrition	29	21	50	29	43	28

Notes. ^a Respondents responded to the following statement, “Corporations are the main beneficiaries from agricultural biotechnology, while consumers assume most of the risk.”

^b Respondents responded to the following statement, “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.”

Table 3: Correlation Matrix among the Negative Five Attributes in the US and UK.

	Health Risks	Environment Hazards	Morally Wrong	Multi_1 (Image)	Multi_2 (Control)
Health Risks	1.00 1.00				
Environment Hazards	0.76 0.66	1.00 1.00			
Morally Wrong	0.75 0.73	0.68 0.61	1.00 1.00		
Multi_1 (Image)	0.70 0.65	0.66 0.63	0.67 0.63	1.00 1.00	
Multi_2 (Control)	0.63 0.55	0.64 0.57	0.63 0.53	0.72 0.66	1.00 1.00

Notes. Numbers in the bold indicate US correlations, unbolded represent UK data.

Willingness-to-Pay

To gain insight into how consumers would behave if they were allowed to choose between GM and non-GM foods, two questions were posed in relation to the following scenario involving breakfast cereals. There are two types of cereals—one made from GM crops and one made from conventional non-GM crops. Table 4 presents the distribution of responses to the two questions. The first question asks respondents: “Which breakfast cereal would you choose if the prices of both types are identical at \$4.00 per box?” Respondents were given four options: “No preference,” “Breakfast cereals made from GM crops,” “Breakfast cereals made from non-GM crops,” and “Don’t know.” The percentage of respondents (28% vs. 25%) who either do not have a preference between GM and non-GM, or choose biotech foods, is similar between the two countries. There are, however, marked differences between the US and UK in terms of the percentage of consumers who choose non-GM (44% vs. 71%) foods and those that “Don’t know” (28% vs. 4%), suggesting a greater potential demand for non-biotech foods in the UK and greater ambivalence about GM foods in the US.

The second question asked respondents: “Would you be willing to pay a premium if it costs more to purchase conventional non-GM than GM breakfast cereals?” A comparison of consumer responses across the two questions highlights the role of premium in consumers’ decision-making regarding the purchase of nonbiotech foods (table 4). The percentage of respondents who select non-GM in the US (UK) decreases from 44% (71%) to 37% (56%) between the first and second questions, while the percentage of “Don’t know” increases from 28% (4%) to 41% (22%). These findings suggest that a premium for non-GM foods would (1) dissuade a significant portion of consumers from purchasing non-GM foods, and (2) make their preferences about GM/non-GM foods indeterminate (“Don’t know”).

Table 4. Purchase Intentions between Non-GM and GM Foods.

	United States	United Kingdom
Which would you choose when the prices are identical between GM and non-GM breakfast cereals? (%)		
Nonbiotech breakfast cereals	44	71
Biotech breakfast cereals	6	2
No preference	22	23
Don't know	28	4
Would you be willing to pay a premium when it costs more to purchase non-GM breakfast cereals? (%)		
Yes	37	56
No	22	22
Don't know	41	22

Probit Model Of Willingness-To-Pay

The above review of selected survey results provides useful insights into current trends in public sentiments about agrobiotechnology in the US and UK while illustrating marked differences across the two countries. To provide more detailed analysis of behavioral intentions with regard to non-GM foods, this section specifies a discrete choice (probit) model using the dichotomous (“yes” and “no”) responses to the second question (i.e., “Would you be willing to pay a premium if it costs more to purchase nonbiotech foods?”) as the dependent variable. In particular, our study addresses two issues with the probit model: (1) whether negative and positive perceptions about agrobiotechnology translate into behavior as measured by willingness-to-pay a premium and (2) the relative size of the impacts of such perceptions on willingness-to-pay. Accordingly, the probit model hypothesizes that the decision whether or not to pay a premium to avoid GM foods is shaped by risk and benefit perceptions about agrobiotechnology. Given the high correlations among perceived negative and positive attributes, respectively, it is difficult to distinguish the effect of a perceived attribute on willingness-to-pay from those of other attributes. Health risks (Risk) and reduction in world food shortages through increased yields (Benefit) were selected to represent negative and positive attributes, respectively. These variables were selected because they are the most frequently cited by opponents and proponents of agrobiotechnology. Further, the probit model includes two additional explanatory variables based on the expectation that consumers’ decisions whether or not to pay a premium to purchase non-GM foods are linked positively to their beliefs about the need for a labeling system (Label) and negatively with the degree of trust (Trust) consumers place in the regulatory agencies in regard to the safety of GM foods.

Three probit models of willingness-to-pay using (1) pooled data, (2) US data, and (3) UK data were estimated using the maximum likelihood method. Table 5 presents estimation results for each of the three models. The negative sign and *t*-value (3.04) of the binary variable, “Country” (US=1, UK=0), in the pooled data model validate that US consumers are less inclined to pay a

premium to buy non-GM foods as compared to UK consumers, pointing to a structural difference in willingness-to-pay between these countries. Therefore, separate models (2 and 3) as opposed to the pooled model (1) are more appropriate for our comparative analyses across the two countries.

Estimated results establish that subjective risk and benefit perceptions translate into behavioral intentions as measured by willingness-to-pay a premium. On the one hand, health risk perceptions are a significant factor motivating both US and UK consumers to pay a premium to purchase nonbiotech foods. That is, the stronger the belief that agrobiotechnology poses health risks the more likely consumers are willing to pay a premium to avoid GM foods. Benefit perceptions, on the other hand, were negatively associated with willingness-to-pay: if consumers perceive some benefits from agrobiotechnology in the form of a reduction in world food shortages, they are less willing to pay a premium for non-GM foods. Yet the association is statistically significant only in the UK case, suggesting that UK consumers' demand for non-GM foods will weaken if they perceive benefits from agrobiotechnology. As expected, there was a positive linkage between the labeling preference (Label) and willingness-to-pay a premium: if consumers consider a mandatory labeling system necessary, then they are more willing to pay a premium to purchase non-GM foods than those who do not. Consumers who distrust the ability of their respective governments to assure the safety of GM foods were more likely to pay a premium to purchase non-GM foods.

Table 5: Maximum Likelihood Estimates for Probit Models of Willingness-to-Pay in the US and UK.

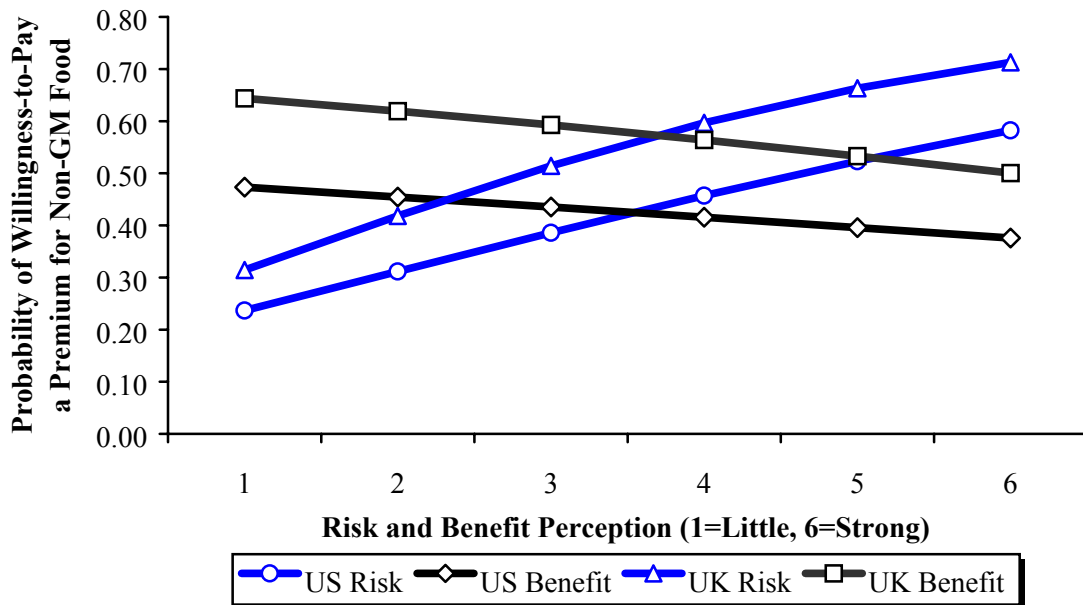
Variable	(1) Pooled Data		(2) United States		(3) United Kingdom	
	Parameter Estimates	Asymptotic <i>t</i> -ratios	Parameter Estimates	Asymptotic <i>t</i> -ratios	Parameter Estimates	Asymptotic <i>t</i> -ratios
Constant	-0.37*	-1.78	-0.60*	-2.00	-0.33	-1.14
Risk	0.23***	8.60	0.19***	4.78	0.26***	7.09
Benefit	-0.08***	-3.04	-0.05	-1.43	-0.10**	-2.73
Trust	-0.16***	-7.13	-0.15***	-4.40	-0.18***	-5.52
Label	0.18***	6.71	0.18***	4.50	0.17***	4.88
Country ^a	-0.19**	-3.04	—	—	—	—
Log-L	-1,084.00	—	-476.00	—	-605.00	—
LR (zero slopes) ^b	-601.00	—	-178.40	—	-395.80	—
pseudo-R ^b	0.26	—	0.20	—	0.30	—
No. of Obs.	2,188.00	—	839.00	—	1,349.00	—

Notes. * $P < 0.10$; ** $P < 0.05$; and *** $P < 0.01$. — not applicable. ^a Country denotes a binary variable equal to one if the respondent is from the US. ^b Critical value of chi-square with 5 degrees of freedom is 15.09 at $\alpha=0.01$.

Using the Probit estimates, simulation analysis was conducted to demonstrate the relative impacts of risk and benefit perceptions on the probability of paying more to purchase non-GM foods in the US and UK. We use simulation analysis to demonstrate the relative impacts of risk and benefit perceptions on the probability of paying more to purchase non-GM foods in the US and UK. That is, using the Probit estimates, the probability of willingness to pay a premium can be calculated across the six-point disagree/agree scale used to measure the risk/benefit perceptions. The range of changes then can be shown over the six categories. The simulation is performed by allowing risk/benefit perception variables to change over the six categories while holding other variables fixed.

Figure 2 confirms the significant and positive linkages between risk perceptions and the probability of willingness-to-pay a premium in both countries (US Risk; UK Risk). As the scale of risk perception varies from 1 (Perceive little) to 6 (Strongly perceive), the probability of willingness-to-pay a premium increases from 24% (31%) to 58% (71%) percent in the US (UK), with the difference being as large as 34% (40%). The figure also shows the negative association of benefit perception with willingness-to-pay (US Benefit; UK Benefit). With the same scale variation for benefit perception, the probability decreases from 47% (64%) to 37% (50%) in the US (UK), yielding only a 10% (14%) difference. As a consequence, the range of changes in the probabilities of willingness-to-pay differ substantially across risk and benefit perceptions, establishing that risk perception plays a more important role in consumers' purchasing decisions of non-GM foods than does their perception of benefits.

Figure 2: Simulated Effects of Risk and Benefit Perceptions on Willingness-to-Pay a Premium for Non-GMs.



Conclusions

This study has consisted of two parts: analyses of the NPD survey data and development of the probit model in an effort to advance our understanding of consumer perceptions about various aspects of agrobiotechnology and their linkages to willingness-to-pay a premium for non-GM foods in the US and UK. Our analyses of the NPD survey data confirms substantive divergences between the US and UK in two key respects: (1) perceptions about the negative aspects of agrobiotechnology and (2) the extent that consumers trust the government in securing the safety of foods, in general, and GM foods, in particular. United Kingdom consumers exhibit higher distrust of regulatory agencies and associate agrobiotechnology with negative attributes more intensely than US consumers. These insights are likely to underlie the discrepancy in the levels of public acceptance of GM foods across the US and UK.

An additional significant finding from our survey was that a greater portion of US consumers were withholding judgment about agrobiotechnology. This result was evident in consumer responses to questions asking (1) overall attitude toward agrobiotechnology, (2) perceptions about individual attributes of agrobiotechnology, and (3) willingness-to-pay a premium for non-GM foods. These differences may constitute an important share of the discrepancies in public sentiments about agrobiotechnology between the US and UK and reflect: (1) relatively less knowledge or awareness about agrobiotechnology issues on the part of US consumers, (2) greater ambivalence of US consumers about the attributes of agrobiotechnology and/or (3) a stronger belief that the potential effects of agrobiotechnology on human health or environment are intrinsically uncertain.

The core of the controversy over biotech foods is the extent to which consumers perceive benefits from agrobiotechnology relative to its risks. The role of risk and benefit perceptions in shaping willingness-to-pay a premium for non-GM breakfast cereals was evaluated. Overall, our analyses indicate that risk perception exerted a stronger influence on the willingness-to-pay for non-GM foods than did benefit perceptions in both countries. This finding suggests that addressing negative perceptions of agrobiotechnology (e.g., conducting scientific risk assessment, educating, and communicating with the public about the results of such assessment efforts) is potentially the most direct and convincing way of dealing with consumer concerns about GM foods. In reality, such strategies may prove ineffective in altering consumer perceptions because of the difficulties associated with communicating highly technical scientific results to the public.

Although it is important for the scientific community to continue its research to establish the safety of GM foods and to gain their long-term acceptance, the negative and statistically significant impact of benefit perceptions on willingness-to-pay in the UK casts hopes for altering negative reception of GM foods in Europe: promoting/educating consumers of the benefits of agrobiotechnology could offset negative sentiments about GM foods, to a certain extent. The result is particularly significant in the sense that the benefit used in this study is in the form of reduced world food shortages and most likely represents a remote (public) benefit to consumers in Europe and North America. Golden rice (with improved Vitamin A, primarily beneficial to consumers in the developing world) is a good example of offering direct benefits, while it remains to be seen what impact it will have on the GM debate. If GM food products can present direct and private benefits to consumers particularly in developed countries, they may trigger a change in the consumer reception of GM foods. In this regard, the role of the research community and agrobiotechnology industry in bringing to the market GM products offering direct benefits relevant to European consumers who most strongly demand non-GM foods is of critical importance.

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