# *Consumer Attitudes and Willingness to Pay for Genetically Modified Foods: A Cross-Country Comparison*

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The introduction of genetically modified (GM) crops to world markets has created new divisions among commodity-trading countries. The United States and Canada have great economic interest in exporting transgenic crops, however, lack of public acceptance of GM-food products in the European Union (EU), Japan, and elsewhere, have already resulted in reduced or curbed demands. Many European and Japanese consumers believe that GM foods pose a threat to human health. They fear short- and long-run consequences for their own health and that of their offspring. The Chinese-consumer response is not well documented. Consumer attitudes and behavior toward GM food products are complex and differ across cultures. A better understanding is essential for designing market strategies. We have investigated factors that affect consumer acceptance of GM food in Japan, Norway, and China, and have estimated the discounts necessary for consumers to be willing to purchase GM food or the premium consumers would be willing to pay for an enhanced GM food. We have compared consumer preferences across countries.

Mandatory labeling of GM foods has obvious implications for trade. The EU has imposed mandatory labeling for some foods that contain GM ingredients. In October 1999, the EU gave preliminary approval to a law that requires labels on all foods containing more than 1% GM ingredients. In Japan, authorities have ordered mandatory labeling for twenty-nine categories of food if they contain

GM ingredients. Since June 2001, China has required that all GM products imported for research, production, or processing have safety certificates from the agricultural ministry with assurances that they are safe for human or animal consumption, and for the environment. Since March 20, 2002, labeling has been required in China for listed transgenic products. The United States has argued that there is no health-related or scientific reason to reject GM commodities and food products, and has challenged EU's mandatory GM labeling as a non-tariff trade barrier.

The Codex committees of the World Trade Organization (WTO) are working on harmonizing international standards and resolving trade disputes associated with labeling, to promote fair trade of foods while protecting consumer health. Since different countries have different attitudes toward GM-food products, the Codex framework allows each country to develop their own standards. The challenge of Codex is to set international standards for GM-food labeling that both promote fair trade and allow consumer choice. An important issue in GM labeling policy is scientific versus consumer sovereignty. Although the scientific consensus may be that GM foods are completely safe for consumption aside from potential allergens, it may be the case that a majority of the population in a given country prefers to avoid them.

Mandatory labeling forces United States producers to segregate crops to claim food products are "GM-free," which is difficult and costly. For example, many grain elevators are not physically equipped for segretation. United States producers may lose market share because consumers can reject their GM crops.

## Related Studies

In recent years, the issue of GM labeling has received considerable attention. However, only a few published studies have included analyses of consumer willingness to pay (WTP) or willingness to accept compensation for food products that contain GM ingredients. Lusk *et al*. (2001) estimated WTP for corn chips made without GM ingredients. In their experimental study, junior- and senior-level agricultural economics students at Kansas State University indicated their WTP by exchanging a bag of GM corn chips for a bag of GM-free corn chips. They found that individuals very concerned about GM foods would be 50% more likely to be willing to pay a premium to exchange GM chips for non-GM chips than individuals with little concern for GM foods. However, their results indicated that 70% of all participants stated that they were not willing to pay a premium for non-GM chips. The average bid to exchange GM chips for non-GM chips was $0.07/oz. Still, 20% of participants were willing to pay at least $0.25/oz for the exchange, and 2% offered bids of $0.50/oz, suggesting that there is a potential niche market in the United States for non-GM products.

Baker and Burnham (2001) investigated American consumers' acceptance of GM corn flakes, and found that 30% of consumers based their purchasing

decision on GM content. Their analysis showed that cognitive variables (opinions, beliefs, knowledge) had a great influence on preference. The level of risk aversion, knowledge about genetic modification and opinion about genetic modification were highly significant in explaining the purchasing decision. Previous studies on the relationship between consumer characteristics and food-safety concerns generally found that sociodemographic variables (like education and income) performed poorly as explanatory variables for purchasing decisions regarding GM-food products. The exception was that women in general were more concerned with food safety.

Lusk *et al*. (2003) estimated consumer WTP for beef in France, Germany, the United Kingdom, and the United States using a variety of quality variables including whether the cattle had been fed GM corn. Their results suggested that the European consumers placed a much higher value on beef from cattle that have not been fed GM corn compared with consumers in the United States.

## Our Surveys

In August 2001, we conducted 400 in-person interviews in Japanese at the Seikatsu Club Consumer Cooperative (Seikyou), a grocery-store-like setting in Matsumoto City, Japan. Matsumoto is a relatively agricultural area where about 13% of the population come from farm households compared to 2% for all of Japan. Consumer cooperatives usually focus on a marketing strategy of featuring a higher level of food safety. The Seikyou has significant power in the Japanese marketplace.

In January 2002, we conducted 400 in-person interviews in Norwegian at the RIMI Liertoppen grocery store in the Oslo area, which is the most populous part of Norway and one of the main centers of economic activity. The RIMI chain of grocery stores has chosen a low-price/limited-selection niche in the market, and has thus gained significant power in the Norwegian marketplace.

In August 2002, we performed 599 in-person interviews in Chinese in Beijing. The survey was conducted at four locations: a supermarket, two outdoor markets, and one shopping area. These locations were chosen to obtain a cross-section of the local population.

The surveys solicited respondents' demographic information, their attitudes about the environment and food safety, and their knowledge and perceptions about biotechnology. Further, respondents were asked if they were willing to pay the same price for a particular GM food as for a corresponding non-GM product. In Japan, we asked about GM noodles and GM tofu; in Norway, we asked about GM bread, and GM-fed salmon; and in China, we asked about GM rice and GM soybean oil.

## Empirical Analysis

The contingent-valuation (CV) method is currently the standard approach to elicit WTP through a dichotomous choice, market-type questioning format

conducted by direct survey via telephone, mail, or face-to-face (Kanninen, 1993). Our surveys included CV questions regarding willingness to pay a premium or accept a discount to purchase GM-food products.

Consumers were first asked if they were willing to pay the same price for the GM product as for the corresponding non-GM products. If the respondent's answer was "no," (s)he was offered a percentage discount on the GM product relative to the non-GM counterpart. In China only, if the respondent's answer to the first question was "yes," the respondent was offered a percentage premium on the GM product relative to the non-GM product. For the survey in China, the discount was set at one of the following levels: 10%, 20%, 25%, 50%, or 75%. The premium for the GM rice was set at one of the following levels: 10%, 20%, 25%, 50%, or 100%. The premium for the GM soybean oil was set at one of the following levels: 5%, 10%, 20%, 25%, or 50%. Each level of discount or premium was used for one fifth of the surveys. The assignment of survey version (and thus, discount or premium) was random to the respondent. The rationale for using differing premium amounts for the GM rice versus the GM soybean oil, was that the respondent was given information regarding a *product-enhancing* attribute of the GM rice, but was not given information regarding either a *product-enhancing* or a *process-enhancing* attribute for the GM soybean oil. Hence, it was expected that those respondents willing to pay a premium for the GM product would pay more for the *product-enhancing* product than for the other.

## Econometric Models

In the standard double-bounded model, there are four possible outcomes: (1) the respondent is not willing to purchase the GM product at the same price as the non-GM product, nor at a discount relative to the non-GM product, *i.e.* "no" to both bids; (2) the respondent is not willing to purchase the GM product at the same price as the non-GM product, but is willing to purchase the GM product at the random discount offered, a "no" followed by a "yes"; (3) the respondent is willing to purchase the GM product at the same price as the non-GM product, but is not willing to purchase it at a premium, *i.e.* a "yes" followed by a "no"; (4) the respondent is willing to purchase the GM product at the same price as non-GM product and also willing to purchase at a random premium offered relative to the non-GM product, *i.e.* "yes" to both bids.

Double-bounded logit models (Hanemann *et al.*, 1991) were used in this analysis. In this model, the initial bid ($B_0$) equals zero and implies no price difference between the GM product and the non-GM product. The second bid is contingent upon the response to the first bid. It will be a discount bid ($B_D$), if the respondents answer that they would not buy the GM product at the same price as the non-GM product. If they answer that they would buy the GM product at the same price as the non-GM product, it becomes a premium bid ($B_P$).

The sequence of questions isolated the range in which the respondents true WTP for GM products relative to non-GM products lay. The second bid, $B_D$ or $B_P$, in conjunction with the response to the initial preference decision, allowed an upper bound and a lower bound to be placed on the respondent's unobservable true WTP for GM-food products.

Let $WTP_i$ denote an individual's WTP (bid function) for a GM food. The following discrete outcomes of the bidding process are observable:

$$D_g = \begin{cases} 1 & WTP_i < B_D \\ 2 & B_D \leq WTP_i < B_0 \\ 3 & B_0 \leq WTP_i < B_P \\ 4 & B_P \leq WTP_i \end{cases}$$

Respondents who indicated they would require no discount and accepted the highest premium fell into the fourth group. Those indicating no discount and a premium less than $B_P$ fell into the third group. Next, respondents who required a discount greater than or equal to $B_D$, fell into the second group. Finally, the first group contained respondents indicating the lowest WTP. Consumers in this group were not willing to purchase the GM product at the discount offered. The WTP function for GM-food products for individual $i$ is

$$WTP_i = \alpha - \rho B_i + \lambda' z_i + \varepsilon_i \text{ for } i=1,....n$$

where
$B_i$ is the ultimate bid individual $i$ faces,
$z_i$ is a column vector of observable characteristics of the individual, and
$\varepsilon_i$ is a random variable accounting for random noise and possibly unobservable characteristics.

Unknown parameters to be estimated were $\alpha$, $\rho$, and $\lambda$. Linearity in $z$ and $\varepsilon$ was assumed for all individuals. Furthermore, the distribution of the error term was assumed to follow the standard logistic distribution function with mean zero and standard deviation $\sigma = \pi / \sqrt{3}$. The bid information and other demographic information were used to estimate the magnitude of those factors that affect consumers' WTP for GM-food products and how much of a relative premium consumers will pay to purchase GM-food products.

## RESULTS

Our results for Japan showed that variables representing food safety and environmental attitudes, self-reported knowledge about biotechnology, self-

reported risk perceptions toward GM foods, income, and education all significantly increased the discount that would be required for consumers to choose GM foods. Our results indicate that Seikyou members, on average, wanted a 60% discount on GM noodles compared to non-GM noodles. For GM tofu, a 64% discount compared to non-GM tofu was necessary.

With the Norwegian data, increasing self-reported risk perceptions toward GM foods and preferences for domestically produced food both significantly increased the discount required for Norwegian consumers to choose GM foods. Our results indicate that, on average, the Norwegian consumers in our sample wanted a 49.5% discount on GM bread compared to the conventional item. For GM-fed salmon, a 56% discount compared to non-GM salmon was necessary. The reason for the higher mean required discount for salmon may be that many people were more sensitive to genetic modification associated with animals than with plants.

Interestingly, our results for China presented a very different picture. A prevailing positive opinion regarding biotechnology significantly increased consumer confidence in GM foods. In fact, Chinese consumers were willing to pay a premium for GM foods. Our results indicated that, on average, they were willing to pay 38% more for GM rice over non-GM rice. (Age significantly decreased consumers' willingness to pay a premium.) They were willing to pay a 16% premium for GM soybean oil over non-GM soybean oil. This is not surprising given that 23% of the survey respondents were very positive about the role of biotechnology in foods, and 40% of the respondents were somewhat positive. It makes sense that consumers in China, who exhibited a low perception of risk associated with GM foods (82% felt these products present little or no risk) would be willing to pay a premium for GM products.

Consumer attitudes concerning biotechnology may reflect the Chinese government's strong support of such technologies. Thus far, the controversy in Europe and Japan is not evident in China, but new regulations regarding labeling and safety testing will likely lead to increased public awareness of the application of biotechnology to agricultural products.

Why were the Chinese results so different? One possible answer lies in historical differences. The European countries and Japan gradually developed modern capitalist societies while taking great concern and pride in preserving cultural traditions. For the Chinese, history took another turn. The Cultural Revolution from 1966 to 1976 systematically tore down historical and traditional structures in the society. The past was condemned as "feudal and superstitious" (Time, 2002). The resulting vacuum was, to some extent, replaced by the communist state. Now, with a highly desired and rapid transition to capitalism and with many traditions crushed by the Cultural Revolution, the Chinese are forward-looking. Technological novelties from the rest of the world are often considered much needed improvements and not reasons for concern.

## Conclusions

The Japanese and Norwegian cultures both place a great deal of value on tradition. This worldview extends to the food they eat and give to their children. Therefore, it is not surprising that most Japanese and Norwegian consumers want to avoid GM foods. Based on the consumer responses in our studies, we would not recommend marketing GM foods to Japan and Europe. The vast majority of our Chinese respondents had a positive attitude, in general, toward science and toward the use of biotechnology in agriculture. The marketing outlook for GM foods in China is optimistic. Younger people were more willing to purchase GM-food products with product-enhancing attributes, which indicates that the Chinese market may be even more open to GM foods in the future. Additionally, government investment into biotechnology remains strong, as China works to fulfill its self-sufficiency food policies.

## Acknowledgments

We thank, without implicating, Hiromi Ouchi, Maria Loureiro, Phil Wandschneider, and Kyrre Rickertsen for helpful comments, and gratefully acknowledge financial support from the IMPACT Center at Washington State University.

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Time Magazine (2002) November 11.