AgBioForum, 5(4): 145-152. ©2002 AgBioForum.

Consumer Attitudes Toward Genetically Modified Foods in Beijing, China

Quan Li, Kynda R. Curtis, Jill J. McCluskey, and Thomas I. Wahl
Washington State University

A consumer survey in Beijing, China, was conducted in August 2002. Although the majority of surveyed consumers reported that they had little or no knowledge of biotechnology, their attitudes toward genetically modified (GM) foods was generally positive, especially for GM foods with product-enhancing attributes. Using dichotomous choice contingent valuation methodology, Chinese consumers' willingness to pay (WTP) for GM rice and GM soybean oil in our sample was positively affected by respondents' positive opinion toward GM foods for both products and by higher levels of self-reported knowledge for soybean oil. However, for GM rice, WTP was negatively affected by the respondent's age—the older respondents were less likely to choose GM rice. These results imply that, unlike Europe and Japan, there is a potential market for GM foods in China. GM food producers and exporters can use this information to design effective marketing strategies.

Key words: China, biotechnology, genetically modified foods, soybean oil, rice, contingent valuation.

Introduction

According to a recent survey of attitudes towards biotechnology, Chinese consumers appear to favor the use of biotechnology to grow pest-resistant crops requiring fewer chemicals (Environics International, 1999). In contrast, European and Japanese consumers worry about potential human and environmental effects. As a result of consumer concerns, many processors and retailers do not accept genetically modified (GM) ingredients for their food products in order to maintain consumer confidence. Countries such as Japan, Russia, South Korea, and the European Union alert consumers of genetic modification by labeling food products. More than 160 countries, including China, have signed the 2000 Cartagena Protocol on Biosafety, which includes a labeling requirement for GM products.

Although China has had a strong commitment to biotech research since the early 1990s (Gale, Lin, Lomar, & Tuan, 2002), the country has imposed regulations. The "Regulation on the Safety Administration of Agricultural GM Organisms" (published June 6, 2001) requires all GM products entering China for research, production, or processing have safety certificates from the Chinese agricultural ministry to ensure that they are safe for human consumption, animals, and the environment. As of March 20, 2002, labeling is required by the Chinese agricultural ministry's "Regulations on Labeling Agricultural GM Biological Products" for all listed GM biological products, including soybean seed, soybeans, soybean powder, soybean oil, soybean dregs, corn seed, corn, corn oil, corn powder, rapeseed, rapeseed dregs, cottonseed, tomato seed, tomato, and tomato sauce.

Implementation of these regulations has been widely reported in China's state-run media, possibly affecting attitudes towards GM products. Understanding Chinese consumers' willingness to accept GM foods and the use of biotechnology in food development will be important to understanding the potential of the Chinese market for GM food products.

The paper is organized as follows: first, previous studies of consumer attitudes with respect to food safety and biotechnology and Chinese attitudes towards GM foods are reviewed. Second, survey data and the methodology applied in this study of Beijing consumers are introduced. The empirical analyses of the data follows, where those factors that affect consumers' willingness to accept discounts or premiums to purchase GM rice and soybean oil are analyzed, and mean estimates for the willingness to accept discounts or premiums to purchase GM rice and soybean oil are presented. Finally, the major implications of this research are reviewed and concluding statements offered.

Prior Research

There are few published studies that estimate consumer willingness to pay or willingness to accept compensation for food products that contain GM ingredients. Baker and Burnham (2001) investigated US consumers' acceptance of GM corn flakes and found that that 30% of US consumers surveyed based their purchasing deci-

sions on GM content. Their analysis shows that cognitive variables (e.g., opinions, beliefs, knowledge) have a great influence on consumer preferences. The level of risk aversion, knowledge, and opinions about genetic modification are statistically significant[1] in explaining purchasing decisions. Previous studies (McCluskey, Ouchi, Grimsrud, & Wahl, in press; Mendenhall & Evenson, 2002) investigating the relationship between consumer characteristics and food safety concerns generally found that sociodemographic variables (such as education and income) perform poorly as explanatory variables for purchasing decisions regarding GM food products. The exception is that women in general are more concerned with food safety.

Lusk, Roosen, and Fox (2001) estimated consumer willingness to pay for beef in France, Germany, the United Kingdom, and the United States using a variety of quality variables, including whether the cattle were fed GM corn. Their results suggested that compared with US consumers, European consumers placed a much higher value on beef from cattle that have not been fed genetically modified corn. Noussair, Robin, and Ruffieux (2002) examined the discrepancy between European public opinion and consumers' purchasing behavior with regard to GM food products. They found that consumers were typically unaware of labels indicating GM content.

McCluskey et al. (in press), found that on average Japanese consumers were willing to purchase GM noodles at a 60% discount over non-GM noodles, and on average were willing to purchase GM tofu at a 64% discount over non-GM tofu. Consumers' attitudes toward safety, self-reported knowledge, and risk were found to be significant indicators in their overall willingness to accept GM products. Consumers in Japan—not unlike those in Europe—are highly skeptical of government regulations and responsibilities when it comes to food safety.

In 1999, Environics International surveyed consumers in 10 countries and found that China's consumers were among the world's strongest supporters of agricultural biotechnology research. In China, 79% of respondents were favorable about the use of biotechnology to grow pest-resistant crops requiring fewer chemical crop applications, which was the highest among the 10 countries under consideration (78% in the US, 63% in Japan, 36% in Britain).

1. *They are statistically significant at the 1%, 10%, and 1% levels of probability, respectively.*

Data

This study uses data collected from 599 in-person interviews in Beijing, China, in August 2002. The survey instrument was pretested with Chinese students in the United States and conducted by four Chinese nationals (in Chinese). The survey was performed in four separate locations, including a supermarket, two outdoor markets, and one shopping area. These locations were chosen to ensure a random sample encompassing a cross section of the Beijing population and to survey consumers at the same time and place where actual purchasing decisions were made, in an effort to better elicit their true preferences. Respondents were randomly selected with the criterion that the interviewer was to solicit every third consumer that came into the survey area. Every respondent was given a gift pack of green tea (worth approximately $.65 in Chinese yuan) or a bottled cola drink (worth $.50 in Chinese yuan) as a reward for participating in the survey.

The summary statistics of the demographic variables and information and perception variables for the survey are presented in Tables 1 and 2, respectively. The majority of the 599 Beijing respondents were the primary food shoppers of the household (69%) and female (63%). Seventy-four percent of those shoppers purchased groceries two or more times per week. The majority of the respondents were in their late 30s or early 40s, with a mean age of 38.8 years—slightly higher than the overall average age in China (30 years). The household income reported in the survey ranged between 10,000 yuan (US$1,200) and 25,000 yuan (US$3,038) for the 2001 fiscal year, compared to the Chinese average income in 2001 of 16,619 yuan (US$2,201).[2] The average education level of the respondents was equivalent to a high school graduate, which is above the Chinese average (middle school education).[3]

Empirical Analysis

The contingent valuation method (CVM) is currently the standard approach used to elicit consumers' willingness to pay (WTP) using a dichotomous choice ques-

2. *Because survey respondents typically are reluctant to divulge information regarding income, respondents were asked to place themselves in income intervals, rather than state their exact income amount, in order to obtain a higher response rate. The exchange rate used is 8.23 yuan/US$.*
3. *The average Chinese household income of 2001 is calculated from China Statistical Yearbook 2002, and the average education is from China Statistical Yearbook 2002.*

Table 1. Summary statistics for demographic variables.

Variable	Description (coding)	Distribution of survey responses	
Age	1 if ≤ 39 years	50%	Mean = 38.8
	0 if > 39 years	50%	Std. dev. = 13.9
Female	1 if female	63.6%	
	0 if male	36.4%	
Shopper	1 if main shopper	68.8%	
	0 otherwise	31.2%	
Education	primary school or illiteracy	7.2%	Coding for estimation:
	junior secondary school	26.4%	0 if primary school, illiteracy, secondary school, or refuse;
	senior secondary	38.7%	1 if 2-year college, 4-year university or graduate.
	2-year college	16.0%	
	4-year university	9.2%	
	graduate	1.7%	
	refuse	0.8%	
Children	1 if children in household	61.1%	
	0 otherwise	38.9%	
Income	<10,000 yuan	12.2%	Coding for estimation:
	10,000-25,000 yuan	38.2%	0 if less than average income;
	25,000-40,000 yuan	24.9%	1 if above average income.
	40,000-55,000 yuan	12.7%	
	55,000-70,000 yuan	4.7%	
	>70,000 yuan	3.2%	
	refuse	4.1%	
Employment status	Full time employed	49.7%	Coding for estimation:
	Part time employed	15.7%	1 if full time employed;
	Unemployed	5.2%	0 if otherwise
	Housemaker	2.8%	
	Retired	18.2%	
	Refused	2.1%	
	Student	6.3%	
Family size	Number of people in household		Mean = 3.946
			Std. dev. = 12.343

tioning format conducted by direct survey via telephone, mail, or face-to-face. There are typically two types of bidding procedures used in the CVM: the single-bounded and double-bounded dichotomous choice models (Kanninen, 1993). The single-bounded model approach recovers the bid amount as a threshold by asking only one dichotomous choice question (Hanemann, Loomis, & Kanninen, 1991). The statistical efficiency of this approach can be improved by use of the double-bounded model, which engages in two bids. However, the double-bounded approach has also been critically evaluated. Hanemann, Loomis, and Kanninen (1999) note that "there is also some bias in going from a single- to a double-bounded format, because there is some evidence that some of the responses to the second bid are inconsistent with the first bid" (p. 382). They conclude that even if the double-bounded approach produces some bias, "the experience to date suggests that the bias is in a conservative direction and is greatly outweighed by the gain in efficiency in terms of minimizing overall mean squared error" (p. 388).

This survey included contingent valuation questions regarding willingness to pay a premium or accept a discount to purchase soybean oil made from GM soy and GM rice. Soybean oil and rice products used in this study are appropriate for examination, because these products are consumed frequently.

The respondents were first asked if they were willing to pay the same price for GM soybean oil and GM rice as for the corresponding non-GM products. If the respondent's answer to this question was "no," a follow-up question would be asked, where the respondent was offered a percentage discount on the GM product relative to the non-GM product. If the respondent's answer to the first question was "yes," a follow-up question would be asked where the respondent was offered a percentage premium on the GM product relative to the non-GM product. The discount was set at one of the following levels: 10%, 20%, 25%, 50%, and 75%. The pre-

Table 2. Summary statistics for consumer information and perception variables.

Variable	Description (coding)	Distribution of responses
Safety	Importance of food safety vs. food price (scale from 1 to 10 where 1 = food safety all important; 10 = food price all important)	Mean = 3.47 SD = 2.20
Risk	Risk associated with GM foods (1 if high risk; 0 if little risk, no risk, or don't know)	
	high risk	7.8%
	little risk	27.5%
	no risk	25.0%
	don't know	39.7%
Opinion	Opinion about use of biotechnology (1 if favorable or neutral opinion, 0 if negative opinion or don't know)	
	favorable opinion	61.6%
	neutral opinion	6.9%
	negative opinion	9.3%
	don't know	22.2%
Knowledge	Self-reported knowledge about biotechnology (1 if high or little knowledge, 0 if no knowledge)	
	high knowledge	1.0%
	little knowledge	44.9%
	no knowledge	54.1%
Label	1 if GM labeling very important, 0 if somewhat or not very important	
	very important	61.9 %
	somewhat important	27.9%
	not very important	10.2%
Import	1 if prefers domestic to imported foods, 0 otherwise	
	prefers domestic to imported foods	84.5 %
	otherwise	15.5%

mium for the GM rice was set at one of the following levels: 10%, 20%, 25%, 50%, and 100%. The premium for the GM soybean oil was set at one of the following levels: 5%, 10%, 20%, 25%, and 50%. Each level of discount or premium was used for one fifth of the surveys. That is, 120 of the 599 surveys had a 10% discount/premium for GM rice; another 120 surveys had a 20% discount/premium for GM rice; and so on. The assignment of survey version (and thus, discount or premium) was random to the respondent. The rationale for using different premium amounts for the GM rice versus the GM soybean oil is that the respondent was given information regarding the *product-enhancing* attribute of GM rice, but was given no information regarding either a *product-enhancing* or a *process-enhancing* attribute for the GM soybean oil. Hence, we 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. (See survey questions in the Appendix for a complete description of the willingness to pay questions. A complete survey is available upon request from the authors.)

Of the 599 respondents, 80% said that they would be willing to purchase the genetically modified rice at the same price as the non-GM rice. Furthermore, 43.9% of consumers in the sample stated that they would be willing to purchase the GM rice at a premium over the price of the non-GM rice (the "yes, yes" group), while 37.4% of all respondents said they would not be willing to pay a premium (the "yes, no" group). Only 4.7% of all respondents were not willing to purchase GM rice at the same price as non-GM rice, but were in fact willing to purchase GM rice at a discount from the non-GM rice price (the "no, yes" group). The rest of the respondents (14.0%) were not willing to purchase the GM rice even with the discount (the "no, no" group). For additional statistics on the distribution of responses over various discounts and premiums, see Tables 3 and 4.

In the case of the GM soybean oil, 73% of the respondents said that they would be willing to purchase the genetically modified soybean oil at the same price as the non-GM soybean oil. Furthermore, 39.6% of all consumers in the sample stated that they would be willing to purchase the GM soybean oil at a premium over the price of the non-GM soybean oil (the "yes, yes" group), while 34.4 % would not pay a premium (the "yes, no" group). Alternatively, 8.5% of all respondents were not willing to purchase the GM soybean oil at the same price as the non-GM soybean oil and were willing to purchase the GM soybean oil at a discount from non-GM soybean oil (the "no, yes" group). And 16.7% of the respondents, were not willing to purchase the GM soybean oil even with the discount (the "no, no" group)[4].

Econometric Model

In our double-bounded model there are four possible outcomes: (a) the respondent is not willing to purchase the GM product at the same price as non-GM product, nor at a discount relative to the non-GM product (i.e., "no" to both bids); (b) the respondent is not willing to

4. *For GM soybean oil, 0.8% of the respondents did not respond.*

Table 3. Range and distribution of response rates to the randomly assigned discount.

	Discount	GM rice	GM soybean oil
Yes to discount	**10%**	1.2%	1.8%
	20%	0.8%	1.8%
	25%	0.7%	1.2%
	50%	1.2%	1.7%
	75%	0.8%	2.0%
No with premium		14.0%	16.7%
Total		18.7%	25.2%

Table 4. Range and distribution of response rates to the randomly assigned premium.

	GM rice		GM soybean oil	
	Premium		Premium	
Yes to premium	**10%**	11.0%	**5%**	9.3%
	20%	9.5%	**10%**	9.7%
	25%	10.7%	**20%**	8.0%
	50%	6.2%	**25%**	8.3%
	100%	6.5%	**50%**	4.3%
No with premium		37.4%		34.4%
Total		81.3%		74.0%[a]

[a] *0.8% of the respondents did not respond for GM soybean oil.*

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 (i.e., a "no" followed by a "yes"); (c) the respondent is willing to purchase the GM product at the same price as non-GM product, but is not willing to purchase it at a premium (i.e., a "yes" followed by a "no"); or (d) the respondent is willing to purchase the GM product at the same price as non-GM product and also willing to purchase the GM product at a random premium offered relative to the non-GM product (i.e., "yes" to both bids).

The model most applicable to examine the outcomes of our survey is the standard double-bounded logit model (Hanemann et al., 1991). 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 GM product at the same price as non-GM product. If they answer that they would buy GM product at the same price as non-GM product, it becomes a premium bid (B_P).

The sequence of questions isolates the range of respondents' true willingness to pay for GM products relative to non-GM products. The second bid (B_D or B_P), in conjunction with the response to the initial preference decision, allows 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 GM food products. The following discrete outcomes (D_g) of the bidding process are observable:

$$D_g = \begin{cases} \text{group 1} & WTP_i < B_D \\ \text{group 2} & B_D \le WTP_i < B_0 \\ \text{group 3} & B_0 \le WTP_i < B_P \\ \text{group 4} & B_P \le WTP_i \end{cases} \quad (1)$$

Respondents who indicated they would require no discount and accepted the highest premium fall into the fourth group (D_4). Those indicating no discount and premium less than B_P fall into the third group (D_3). Next, respondents who required a discount greater than or equal to B_D fall into the second group (D_2). Finally, the first group (D_1) contains respondents indicating the lowest WTP. Consumers in this group are not willing to purchase the GM product at the discount offered. The WTP function for GM food products for individual i is

$$WTP_i = \alpha - \rho B_i + \lambda' z_i + \varepsilon_i \text{ for } i=1,\ldots.n \quad (2)$$

where B_i is the ultimate bid individual i faces, z_i is a column vector of observable characteristics of the individual, ε_i is a random variable accounting for random noise and possibly unobservable characteristics. Unknown parameters to be estimated are α, ρ, and λ. Linearity in z and ε is assumed for all individuals. Furthermore, the distribution of the error term is assumed to follow $\varepsilon \sim G(0,\sigma^2)$, where $G(0,\sigma^2)$ denotes a cumulative distribution function with mean zero and variance σ^2. Under these assumptions, the choice probabilities for individual i can be characterized as

$$prob(D=j)=\begin{cases} G(\tilde{\alpha}-\tilde{\rho}B_D+\tilde{\lambda}'z), \text{ for j=1} \\ G(\tilde{\alpha}-\tilde{\rho}B_0+\tilde{\lambda}'z)-G(\tilde{\alpha}-\tilde{\rho}B_D+\tilde{\lambda}'z), \text{ for j=2} \\ G(\tilde{\alpha}-\tilde{\rho}B_P+\tilde{\lambda}'z)-G(\tilde{\alpha}-\tilde{\rho}B_0+\tilde{\lambda}'z), \text{ for j=3} \\ 1-G(\tilde{\alpha}-\tilde{\rho}B_P+\tilde{\lambda}'z), \text{ for j=4} \end{cases} \quad (3)$$

Thus, the log-likelihood function becomes:

$$L = \sum_i \left\{ \begin{array}{l} I_{D_i=1} \ln G(\tilde{\alpha} - \tilde{\rho} B_{Di} + \tilde{\lambda}' z_i) \\ + I_{D_i=2} \ln[G(\tilde{\alpha} - \tilde{\rho} B_{0i} + \tilde{\lambda}' z_i) - G(\tilde{\alpha} - \tilde{\rho} B_{Di} + \tilde{\lambda}' z_i)] \\ + I_{D_i=3} \ln[G(\tilde{\alpha} - \tilde{\rho} B_{Pi} + \tilde{\lambda}' z_i) - G(\tilde{\alpha} - \tilde{\rho} B_{0i} + \tilde{\lambda}' z_i)] \\ + I_{D_i=4} \ln[1 - G(\tilde{\alpha} - \tilde{\rho} B_{Pi} + \tilde{\lambda}' z_i)] \end{array} \right\} \quad (4)$$

where I_K is an indicator function for the event K, and $D_i=j$ denotes that the j^{th} alternative occurred. In the empirical implementation of the model, we define $G(.)$ to be the standard logistic distribution function with mean zero and standard deviation $\sigma = \pi/\sqrt{3}$. The empirical representation of Equation 2 is formulated as

$$WTP_i = \alpha - \rho B_i + \lambda_1 Children_i + \lambda_2 Education_i + \lambda_3 Age_i + \lambda_4 Knowledge_i + \lambda_5 Income_i + \lambda_6 Opinion_i + \varepsilon_i, \quad (5)$$

where B_i represents the random bid offered to each consumer, $Children_i$ is an indicator variable representing the presence of children under 18 years old in the household, $Education_i$ is an indicator variable representing the respondent's level of education, $Knowledge_i$ is an indicator variable representing the respondent's self-reported knowledge regarding biotechnology, $Income_i$ represents the respondent's reported income level, Age_i is an indicator variable representing the respondent's reported age, and $Opinion_i$ is an indicator variable representing the respondent's opinion regarding the application of biotechnology to food products.

Analysis of Willingness to Pay

Estimation results are presented in Tables 5 and 6. Results show that positive opinions regarding biotechnology significantly increase the WTP (i.e., increase the premium) for both GM products—at the 5% level of statistical significance for GM rice and very close to the 5% level for GM soybean oil. For GM soybean oil, self-reported knowledge about biotechnology increases consumers' WTP at the 10% level of statistical significance. This may indicate that self-reported knowledge was obtained from sources that were supportive of agricultural biotechnology.

Consumer attitudes concerning biotechnology reflect the Chinese government's traditionally strong support. Thus far, the level of debate occurring in Europe and Japan has not been as evident in the Chinese media, but new regulations regarding labeling and safety testing are most likely leading to increased public awareness of the application of biotechnology to agricultural products.

Table 5. Parameter estimates for willingness to pay model (GM rice).

Parameter	Variable description	Estimate	Standard error	*t*-value	*p*-value
α	Intercept	0.2958	0.2873	1.0297	0.3031
ρ	Bid***	-1.6386	0.1873	-8.7501	0.0000
λ_1	Income	0.1858	0.1599	1.1620	0.2452
λ_2	Knowledge	0.1315	0.1668	0.7884	0.4304
λ_3	Children	-0.2312	0.1590	-1.4538	0.1460
λ_4	Age**	-0.0106	0.0051	-2.0842	0.0371
λ_5	Education	0.0988	0.1886	0.5238	0.6004
λ_6	Opinion**	0.4044	0.1743	2.3196	0.0203

Note. Single (*), double(**) and triple asterisks (***) denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 6. Parameter estimates for willingness to pay model (GM soybean oil).

Parameter	Variable description	Estimate	Standard error	*t*-value	*p*-value
α	Intercept	0.0270	0.2809	0.0961	0.9234
ρ	Bid***	-2.5569	0.2637	-9.6960	0.0000
λ_1	Income	0.1977	0.1581	1.2501	0.2113
λ_2	Knowledge*	0.2837	0.1665	1.7037	0.0884
λ_3	Children	-0.1364	0.1562	-0.8734	0.3825
λ_4	Age	-0.0056	0.0051	-1.1042	0.2695
λ_5	Education	-0.1175	0.1829	-0.6422	0.5208
λ_6	Opinion*	0.3373	0.1758	1.9188	0.0550

Note. Single (*), double(**) and triple asterisks (***) denote statistical significance at the 10%, 5% and 1% levels, respectively.

For GM rice, age level significantly decreased the consumers' WTP (i.e., increased the required discount) at the 5% level of statistical significance. The survey questions regarding GM rice contained information about product-enhancing attributes—specifically, that GM rice contains additional vitamins. Younger people were more accepting of biotechnology, which is the

same reaction found in previous studies (McCluskey et al., in press; Chern & Rickertsen, 2001) of consumer attitudes toward GM foods.

The level of education, income, and the presence of children under age 18 in the household were not statistically significant in either case. These results are consistent with studies by Baker and Burnham (2001), where cognitive variables performed better as explanatory variables than sociodemographic variables.

The mean willingness to pay, WTP, is commonly estimated by restricting $\lambda_i = 0$ (Hanemann et al., 1991). The empirical mean WTP can then be calculated as $-\tilde{\alpha}/\tilde{\rho}$. When we use this methodology, our results indicate that Beijing consumers on average were willing to pay a 38.0% premium for GM rice over non-GM rice, and were willing to pay a 16.3% premium for GM soybean oil over non-GM soybean oil.[5] This is not surprising, given that 61.6% of our survey respondents had a favorable opinion about the use of biotechnology in foods (Table 2). Additionally, 52.5% of respondents felt there was little or no risk associated with genetically modified foods.

The positive mean WTP for GM foods is unexpected, given studies in other countries. However, prevailing positive opinions regarding biotechnology are behind these results. The survey results indicate that only 9.3% of the respondents had a negative opinion concerning the use of biotechnology in foods, and only 7.8% associated high risk with GM foods. For each of these respective categories, 22.2% and 39.7% of respondents answered "don't know."

Why are our Chinese results so different from studies of other countries? 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. A decade of Cultural Revolution from 1966 to 1976 systematically tore down historical and traditional structures in the society. The past was condemned as "feudal and superstitious," (Beech, 2002). The vacuum remaining was to some extent replaced by the communist state. Now, with a highly desired and incredibly rapid transition to capitalism and with much of the old Chinese tradition crushed by the Cultural Revolution, the Chinese are looking forward. Technological novelties from the rest of the world are often considered much-needed improvements and not reasons for concern.

A caveat one must consider when interpreting results from a stated preference model is that differences may exist between responses from real and hypothetical valuation questions. There are findings both for and against the consistency of revealed and stated preferences (see Loureiro, McCluskey, & Mittelhammer, 2003 and Cummings, Harrison, & Rutstrom, 1995).

Conclusions

The results of this research indicate respondents to our consumer survey in Beijing, China, generally have a favorable view towards GM rice and GM soybean oil—two products that are staples of the Chinese diet. These results are contrary to those found in previous studies, particularly those conducted in Europe and Japan. However, this consumer survey is one of the first studies of GM foods conducted within China, a developing country. Results suggest that a positive opinion toward biotechnology significantly increased Beijing consumers' willingness to pay for both GM products, while for GM soybean oil solely, higher levels of consumers' self-reported knowledge also increased their willingness to pay. For GM rice, WTP was negatively affected by the respondent's age—older respondents were less likely to choose GM rice.

In general, our surveyed Beijing consumers have positive attitudes towards the use of biotechnology in agriculture, although they have little knowledge. In China, consumer attitudes towards GM foods are influenced by positive media coverage, which is controlled by the government. China is the world's fourth largest producer of biotech crops and has been a large supporter of biotech research since the 1980s. Recently, China has seen great success in their biotechnology research efforts, such as in the case of insect-resistant Bt corn.

The marketing outlook for GM foods in China is optimistic. Younger people are 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 in biotechnology remains strong, as China works to fulfill its food self-sufficiency policies. If positive government sentiment towards new food technologies continues, Chinese citizens are unlikely to

5. *95% confidence interval around this estimated mean WTP is (0.24,0.52) for GM rice and (0.01, 0.31) for GM soybean oil. These confidence intervals were calculated using the delta method, which approximates the asymptotic variance of the ratio of two random variables as (Kanninen, 1993):*

$$a\sigma^2\left(\frac{-\alpha}{\rho}\right) \cong \frac{1}{\rho^2}\left[\left(\frac{a}{\rho}\right)^2\sigma^2(\alpha) - 2\left(\frac{\alpha}{\rho}\right)\mathrm{cov}(\alpha\rho) + \sigma^2(\rho)\right].$$

change their preferences due to limited coverage of anti-GM debates abroad.

References

Baker, G.A., and Burnham, T.A. (2001). Consumer response to genetically modified foods: Market segment analysis and implications for producers and policy makers. *Journal of Agricultural and Resource Economics, 26*(2), 387-403.

Beech, H. (2002, November 4). China's next cultural revolution. *TIME* (Asia Edition), 160(18).

Chern, W.S., and Rickertsen, K. (2001). Consumer acceptance of GMO: Survey results from Japan, Norway, Taiwan and the United States. Taiwanese *Agricultural Economic Review*, *7*(1), 1-28.

Cummings, R.G., Harrison, G.W., and Rutstrom, E.E. (1995). Homegrown values and hypothetical surveys: Is the dichotomous choice approach incentive-compatible? *American Economic Review, 85*(1), 260-266.

Environics International (October 16, 1999). Biotech: Yes or no? *The Washington Post*, p. A19.

Gale, F., Lin, W., Lomar, B., and Tuan, F. (2002). Is biotechnology in China's future? In *China's Food and Agriculture: Issues for the 21st Century* (AIB-775, pp. 34-37). Washington, DC: United States Department of Agriculture Economic Research Service.

Hanemann, W.M., Loomis, J., and Kanninen, B.J. (1999). The statistical analysis of discrete response CV data. In I.J. Bateman and K.G. Willis (Eds.), *Valuing Environmental Preferences* (pp. 302-442). New York: Oxford University Press.

Hanemann, W.M., Loomis, J., and Kanninen, B.J. (1991). Statistical efficiency of double-bounded dichotomous choice contingent valuation. *American Journal of Agricultural Economics, 73*, 1255-1263.

Kanninen, B.J. (1993). Optimal experimental design for double-bounded dichotomous choice contingent valuation. *Land Economics, 69*(2), 138-146.

Loureiro, M.L., McCluskey, J.J., and Mittelhammer, R.C. (2003). Are stated preferences good predictors of market behavior? *Land Economics, 79*(1), 44-55.

Lusk, J.L., Roosen, J., and Fox, J.A. (2003). Demand for beef from cattle administered growth hormones or fed genetically modified corn: A comparison of consumers in France, Germany, the United Kingdom, and the United States. *American Journal of Agricultural Economics, 81*(1), 16-29.

McCluskey, J.J., Ouchi, H., Grimsrud, K.M., and Wahl, T.I. (in press). Consumer response to genetically modified food products in Japan. *Agricultural and Resource Economics Review.*

Mendenhall, C.A., and Evenson, R.E. (2002). Estimates of willingness to pay a premium for non-GM foods: A survey. In V. Santaniello, R.E. Evenson, and D. Zilberman (Eds.), *Market Development for Genetically Modified Foods*. Trowbridge, UK: CABI Publishing.

National Bureau of Statistics of China (2002). *China Statistical Yearbook 2002*, no. 21. Beijing: China Statistics Press.

Noussair, C., Robin, S., and Ruffieux, B. (2002). Do consumers not care about biotech food or do they just not read the labels? *Economic Letters, 75*, 47-53.

Appendix: Questions Used to Elicit Consumers' Willingness to Pay

1. Scientists at universities are developing genetically engineered rice, which contains additional vitamins. Would you be willing to purchase this rice if it were offered at the same price as non-genetically modified rice? [If yes, go to question 3.]
2. Would you be willing to purchase this rice if it were offered at a price that is XX less than non-genetically modified rice? [Go to question 4.]
3. Would you be willing to purchase this rice if it were offered at a price that is XX more than non-genetically modified rice?
4. Would you be willing to purchase soybean oil made with genetically modified soybeans if it were offered at the same price as oil with non-genetically modified soy beans? [If yes, go to question 6.]
5. Would you be willing to purchase genetically modified soybean oil if it were offered at a price that is XX less than soybean oil with non-genetically modified soybeans?
6. Would you be willing to purchase genetically modified soybean oil if it were offered at a price that is XX more than soybean oil with non-genetically modified soybeans?

Authors' Note

Quan Li and Kynda R. Curtis are Ph.D. candidates at Washington State University, Pullman, WA. Jill J. McCluskey is an assistant professor in the Department of Agricultural and Resource Economics and Food Policy Fellow of the International Marketing Program for Agricultural Commodities and Trade (IMPACT) Center, Washington State University. Thomas I. Wahl is a professor in the Department of Agricultural and Resource Economics and Director, IMPACT Center, Washington State University. The authors gratefully acknowledge financial support from the IMPACT Center at Washington State University.