Consumer Attitudes Toward Biotech Foods in China

William Lin
Agapi Somwaru
Francis Tuan
Jikun Huang
Junfei Bai

ABSTRACT. Based on a large-scale survey in 11 cities, this study employs probit and logit models to estimate the effects of various explanatory variables on the likelihood of biotech food acceptance in China. Analyses focus on biotech soybean oil, input- and output-trait biotech rice, and livestock products fed with biotech corn.

KEYWORDS. Biotech foods, consumer attitudes, China, probit models, logit models

---

William Lin (E-mail: wwlin@ers.usda.gov), Agapi Somwaru (E-mail: asomwaru@ers.usda.gov), and Francis Tuan (E-mail: ftuan@ers.usda.gov) are affiliated with the Economic Research Service, U.S. Department of Agriculture, Washington, DC. Jikun Huang (E-mail: jkhuang.ccap@igsnrr.ac.cn) and Junfei Bai (E-mail: junfei_bai@wsu.edu) are affiliated with the Center for Chinese Agricultural Policy, Chinese Academy of Sciences, Beijing, China.

Assistance from Carl Pray of Rutgers University in designing the survey questionnaire is gratefully acknowledged. The authors are also grateful for comments from D. Demcey Johnson, Fred Gale, Lorrie Mitchell, Charlie Hallahan, Mary Burfisher, Donna Roberts, Joy Harwood, Melissa Clarkson, and Wen S. Chern.

This paper benefited from discussions at the Western Coordinating Committee (WCC) Conference in East Lansing, Michigan, April 19-20, 2004; and at the 8th International Consortium on Agricultural Biotechnology Research (ICABR) in Ravello, Italy, July 8-11, 2004.

The views expressed herein are those of the authors, who do not necessarily reflect official USDA or CCAP-CAS policy.

INTRODUCTION

On January 5, 2002, China's Ministry of Agriculture (MOA) issued specific regulations for agricultural transgenic products as a follow-up to the prior general guidelines set forth in its biosafety regulations. These biotech regulations could potentially affect domestic consumption of biotech foods and may have trade implications for imported biotech products, such as herbicide-tolerant soybeans from the United States (Marchant et al., 2003).

In addition to the requirements of safety certificates for imported biotech products and MOA regulatory approvals for domestic releases of transgenic products, the regulations require labeling of biotech foods. Food products with biotech content, based on qualitative test results, must be labeled. However, labeling regulations do not guarantee that food manufacturers and retailers would use biotech products that require labeling for retail sale. Most food manufacturers in the EU and Japan have used non-biotech ingredients in their food production in order to avoid having to label under regulations being put in place in these countries.

The decision by food manufacturers and retailers to use and label biotech foods depends on consumer attitudes. If the majority of Chinese consumers are indifferent between biotech and non-biotech foods, food manufacturers and retailers are more prone to use less costly biotech ingredients and label food products accordingly. For example, soybean oil and rapeseed oil are made from biotech soybeans and rapeseeds (or canola) that are imported into China. Anecdotal evidence from food manufacturers in Shanghai suggests that consumer demand for non-biotech soybean oil is not widespread.

Despite the significant role of consumer attitudes in biotech labeling decisions and the trade implications, only a few studies have addressed this research issue in China (Li et al., 2003; Zhong et al., 2002). Previous studies focused on specific cities, such as Beijing or Nanjing. Up to now, except for an M.S. thesis (Bai, 2003) at the Center for Chinese Agricultural Policy (CCAP), Chinese Academy of Sciences (CAS) in 2003, there are no studies based on large-scale surveys of consumers in China. Bai's thesis, in general, found a low awareness of biotechnology but strong support for biotech products in China, consistent with previous studies (Li et al., 2003; Zhong et al., 2002).

The main purpose of this study is to provide a careful assessment of consumer acceptance of biotech foods in China. Specifically, the objectives are three-fold: (1) to understand consumer attitudes toward biotech foods in China based on a large-scale survey, (2) to estimate the effects of various explanatory variables on the likelihood of biotech food acceptance, and (3) to compare results obtained from various modeling approaches. Biotech foods covered in the survey include: (1) insect-resistant fruits or vegetables, (2) delayed-ripening fruits or vegetables, (3) soybean oil made from herbicide-tolerant soybeans, (4) tofu made from herbicide-tolerant soybeans, (5) noodles made from insect-resistant wheat, (6) insect-resistant rice, (7) neutraceutical biotech rice, and (8) livestock products fed with biotech corn. However, this paper focuses on biotech soybean oil, input- and output-trait biotech rice, and livestock products fed with biotech corn. At present, biotech crops commercialized in China include cotton, tomato, sweet pepper, and petunia (Gale et al., 2002). Biotech labeled soybean oil made from imported soybeans is widely available in China's large cities.

PREVIOUS RELATED STUDIES

Information obtained from previous surveys suggested that the majority of Chinese consumers have favorable opinions about the use of biotechnology in crop production, livestock and poultry products fed with biotech feed grains, and the use of biotech ingredients in processed food production. This section briefly reviews previous related studies, focusing on surveys or studies that were conducted in China.

A fall 1999 survey of consumers in 10 countries conducted by Environics International found that China's consumers were among the world's strongest supporters of the use of agricultural biotechnology (Gale et al., 2002). Nearly 80 percent of the consumers strongly favor or somewhat favor the use of agricultural biotechnology–a level of support parallel to that in the United States. Less than 10 percent of the consumers were opposed to the use of biotechnology in crop production.

A similar pattern of consumer support for the use of biotechnology emerged in an August 2002 survey of 599 consumers in Beijing (Li et al., 2003). That survey was conducted through personal interviews in four separate locations–a supermarket, two outdoor markets, and one shopping area. The survey found that China's consumers overwhelm-

ingly (99%) had little or no knowledge about biotechnology. Despite this low awareness level, consumers in Beijing had positive attitudes toward biotech foods. Nearly 70 percent of the respondents had either favorable or neutral opinions about the use of biotechnology, and less than 10 percent of them had a negative opinion.

Of the 599 respondents, 80 percent indicated that they would be willing to purchase *product-enhancing* (output-trait) biotech rice at the same price as the non-biotech rice. In the same price differential context, 73 percent of the respondents indicated that they would be willing to purchase biotech soybean oil of either a *product-enhancing* trait *or process-enhancing* (input-trait) attribute. And 16.7 percent of the respondents were not willing to purchase biotech soybean oil even with the discount (Li et al., 2003). Age is a significant determinant of consumers' willingness to pay (WTP) for the biotech rice–a higher age level significantly decreased consumers' WTP, and vice versa.

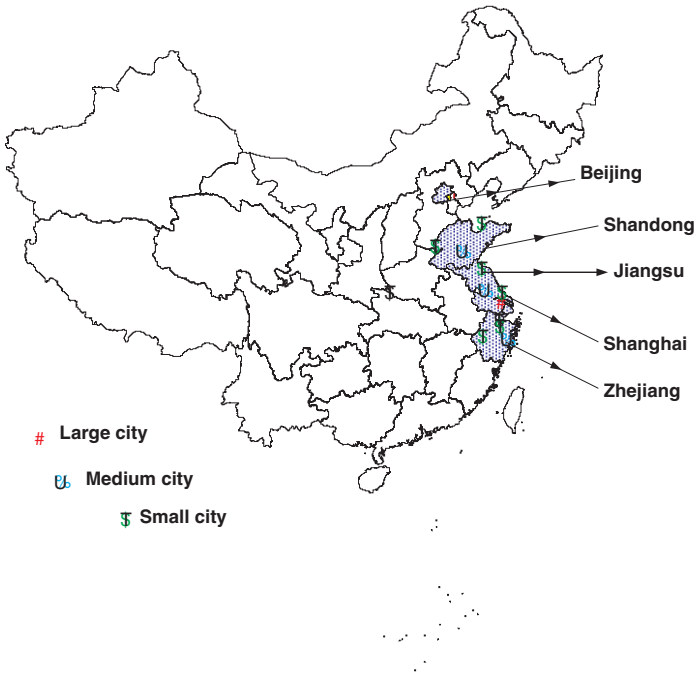
Similarly, the majority of consumers in Nanjing hadn't heard of biotech foods. Based on 480 telephone interviews in Nanjing, Zhong et al. found that nearly 60 percent of the respondents had not heard of biotech foods. Many consumers had heard of biotechnology, but had little or no knowledge about this technology. Only about 11 percent of the respondents indicated that they had heard of the technology and knew something about it. Consumers who had heard of biotechnology and knew something about it tended to have more positive attitudes toward this technology than those who had just learned about it. Consumers who had heard about the technology (including those who knew something about it) found themselves to be more willing to buy biotech foods (42.7%), up from 39.0 percent for consumers who had never heard of biotechnology. In addition, older respondents tended to more readily accept biotech foods, and men tended to accept biotech foods more readily than women.

Consumers who were aware of biotechnology tended to be more likely to have positive attitudes toward biotech foods in some parts of Asia. Consumer surveys conducted in China, India, and the Philippines suggest that these more knowledgeable consumers believed biotechnology reduces pesticide use, which is beneficial to human health and the environment (Asian Food Information Center, 2004). In contrast, another survey found that respondents from Japan and Taiwan were not as supportive of biotech foods as in the United States (Chern and Rickertsen, 2002).

THE CONSUMER ATTITUDES SURVEY

In fall 2002, a sample of 1,100 consumers was selected by using a combination of stratified and random samplings. First, all samples were taken from five provinces or municipalities along China's east coast–Beijing, Shandong, Jiangsu, Zhejiang, and Shanghai–where income, education, awareness of biotechnology, and population density are higher than in interior areas (Figure 1). Consumer attitudes toward biotech foods in these five provinces can serve as an indicator of future trends in China's consumer preferences. Second, samples were stratified according to the size of the cities selected from each province (Table A-1, Appendix A). Large cities include Beijing and Shanghai, while medium cities include Jinan, Nanjing, and Ningbo. Small cities cover Dezhou, Weihai, Yancheng, Nantong, Shaoxing, and Jinhua. Third, survey samples in each city within an age limit (from 16 to 80) were ran-

FIGURE 1. The Distribution of Survey Samples Across Five Provinces or Municipalities in China



domly selected–55 for small cities, 110 for medium cities, and 220 for large cities.

The questionnaire for this large-scale survey was initially developed and revised several times by analysts of the CCAP-CAS in Beijing, and the Economic Research Service. The questionnaire was also pre-tested. The survey was jointly conducted by the CCAP-CAS and China's National Bureau of Statistics through personal interviews at household sites. The questionnaire covers household demographic and socio-economic characteristics and the degree of awareness of, and attitudes toward, biotech foods. Other than biotech soybean oil, delayed ripening tomato and cucumber mosaic virus resistant sweet peppers, which are currently commercialized or made from imported soybeans, the questionnaire characterizes others as potential biotech food products that could be introduced in the future.

Major socio-economic indicators for the 1,005 usable responses (including those who have never heard of biotech foods), are shown in Table 1. Demographic variables of the selected samples are generally representative of the entire population in the selected cities (Bai, 2003). Table A-1 shows a comparison of demographic indicators between population and sample by city or province. Average household sizes of selected samples closely match those for the sample cities, particularly in Beijing and Shandong. Gender (male relative to female) ratios of selected samples are lower than that for the entire city or province population, especially for Beijing, Shandong, and Zhejiang. More male residents probably were not at home than female residents during survey visits to households. Per capita monthly disposable incomes from selected samples in Beijing, Shandong, and Jiansu are comparable with those for the sample city populations, although the former are 12.9-percent and 10.3-percent lower than the latter in Zhejiang and Shanghai, respectively. A direct comparison of average age and average education years between sample and population cannot be made due to a lack of such statistics in *China Statistical Yearbook 2003* (National Bureau of Statistics of China, 2003).

Awareness of Biotech Foods

The survey found that about two-thirds of urban consumers in the survey region had heard of biotech foods, about 10 percentage points lower than the level of awareness about biotechnology reported for the United States (International Food Information Council, 2003). Consumers who had never heard of biotech foods and those who had only

TABLE 1. Summary Statistics for Demographic and Perception Variables

Variable	Mean	Standard deviation	Minimum	Maximum
Gender	0.41	0.49	0 (female)	1 (male)
Age	46.55	12.47	16	80
Education (yrs)	11.08	2.94	1	18
Household size	2.98	0.76	1	7
Monthly per capita disposable income (rmb)	844.19	416.12	100	3003
Residing city: (%)				
Small city	30.3	0.46	0	1
Medium city	29.9	0.46	0	1
Large city	39.8	0.49	0	1
Occupation: (%)				
Government	3.18	0.42	0	1
State enterprises	19.10	0.42	0	1
Commercial	26.57	0.44	0	1
Unemployed	8.46	0.28	0	1
Retired & others	25.77	0.28	0	1
Role of food shopping: (%)				
Major decisionmaker	57.51	0.49	0	1
Co-decisionmaker	15.22	0.36	0	1
Little or no role	27.26	n.a.	0	1
Awareness of biotech foods: (%)				
Never heard of	33.4	0.46	0	1
Heard of (< 3 yrs)	42.5	0.49	0	1
Heard of (> 3 yrs)	24.1	0.43	0	1
Never heard of	33.4	n.a.	0	1
Occasionally	43.7	n.a.	0	1
Frequently	22.9	n.a.	0	1
Health condition: (%)				
Better than average	38.1	0.49	0	1
About average	47.3	0.50	0	1
Worse than average	7.2	0.26	0	1

heard of it on an *occasional* basis, together accounted for 77 percent of all respondents. Only about 23 percent of respondents indicated that they had *frequently* heard of biotech foods.

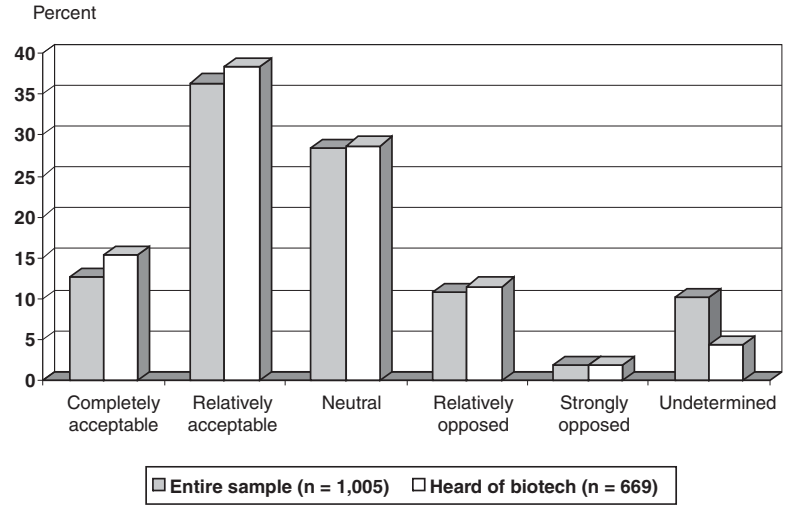
Of the respondents who indicated that they had heard of biotech foods, lengths of time of awareness averaged 2.65 years. About 80 percent of these respondents indicated that they had never heard of biotech foods, or had heard of them for no more than three years. A great majority (90%) of the respondents who had heard of biotech foods relied on their information from mass media, such as television, radio, newspaper, and magazine. However, awareness does not necessarily imply correct knowledge about biotechnology. Many of the respondents who had heard of biotech foods, ranging from 26 percent to 54 percent, incorrectly answered questions related to biotechnology. This is consistent with another finding from this survey that about 40 percent of all respondents did not know the types of biotech foods that are available in the marketplace.

Biotech Food Acceptance

A majority of China's urban consumers were supportive of biotech foods, that is, they found biotech foods to be strongly or relatively acceptable. This pro-biotech group of consumers accounted for 46-67 percent of all respondents, depending on the kind of biotech foods. In contrast, 5-15 percent of urban consumers were strongly or relatively opposed to biotech foods. About a third of the consumers had either a neutral opinion or simply could not specify their attitudes toward biotech foods. Figure 2 shows the pattern of consumer attitudes toward biotech soybean oil in China, which is generally applicable to other biotech foods (Bai, 2003). Limiting survey samples to those who have heard of biotech foods significantly lowered the percent undetermined, which was then translated into more support for biotech foods. Relative to those who have never heard of biotech foods, survey data suggest that consumers who have heard of biotech foods tend to be slightly more supportive of biotech foods.

The above consumer attitudes toward biotech foods were expressed without any regard for the price differential between biotech and non-biotech foods. In the context of the price differential, the survey found that a majority of Chinese urban consumers–58.3-74.1 percent–were willing to purchase biotech foods if food prices were the same, depending on the kind of biotech foods. An even greater majority–67.0-80.9 per-

FIGURE 2. Consumer Attitudes Toward Biotech Soybean Oil in China



cent–were willing to purchase biotech foods if a 10-percent price discount was offered to them.

In the case of output-enhancing biotech rice, about 6-10 percent more consumers were willing to purchase neutraceutical biotech rice than for input-trait biotech rice, depending on the price differential. In contrast, a smaller percentage was willing to purchase livestock products fed by biotech feeds. A small but significant minority–about 20 percent–of urban consumers were not willing to purchase biotech foods regardless of any price discounts. In the cases of biotech soybean oil and input-trait rice, the percentages were 22.7 and 18.0, respectively.

Length of Awareness and Acceptance

While an increase in awareness about biotech foods led to a stronger acceptance of these products, the length of time that consumers have heard about biotech foods also plays a significant role in China's consumer acceptance of these products. Survey data indicated that consumers were more willing to purchase biotech foods if they had heard about them for less than three years. However, the willingness declines if the length of awareness exceeds three years. For example, in the case of

biotech soybean oil, while 57.7 percent of consumers who have not heard of biotech foods were willing to purchase biotech foods, the percentage increased to 62.8 for those who have been aware of the products for less than three years. However, only 55.0 percent of consumers were willing to purchase these products if they have heard of biotech foods for more than three years, a percentage not much different from those who have never heard of biotech foods.

METHODOLOGY

Consumer acceptance of biotech foods can be attributed to demographic and socio-economic variables, awareness of biotech foods, trust in the accuracy of information from media, perception of the government's ability to address issues arising from biotech development, and consumers' health conditions. How does each of the explanatory variables contribute to the likelihood of accepting biotech products?

A starting point of modeling consumer acceptance of biotech foods is the use of ordered probit model that ranks consumers' response into the following sequential order: (1) strongly acceptable, (2) relatively acceptable, (3) neutral, (4) relatively unacceptable, and (5) strongly unacceptable (Greene, 1990). This probit model follows the conceptual framework initiated by Marschak and then implemented, for the first time, to food consumption by Lancaster. A special case of the multinomial logit model is binary probit model, where the response variable (that is, whether to accept biotech foods) is expressed in terms of qualitative answers, "yes" or "no."

Bai's thesis at the CCAP-CAS in Beijing used ordered probit model to estimate the effects of various explanatory variables on consumer acceptance of biotech foods. This study also used a binary probit model to estimate the likelihood of purchasing biotech foods under different price differential assumptions between biotech and non-biotech foods that is attributable to various explanatory variables. The price differential assumptions considered in Bai's study included (1) no price discount for biotech foods, and (2) a 10-percent price discount.

As a second modeling approach, the above probit model is extended to include the use of an *instrumental variable* method (Maddala, 1997; Berndt, 1991; Greene, 1990). This approach recognizes that, while access to mass media would raise consumer awareness of biotech foods, media access also influences consumer attitudes toward these products. This is especially true in China where mass media is strictly con-

trolled by the government. As a result, the *awareness* variable in the conventional acceptance equation becomes interdependent with the error term, which gives rise to biased estimates (Maddala, 1997). To address this methodological issue, a regression equation for the *awareness* of biotech foods is first estimated. Then predicted values of the *awareness* variable obtained from the first-stage probit analysis are used as an instrumental variable to replace the actual values in estimating the second-stage acceptance equation (Berndt, 1991; Feldstein and Flemming, 1971).

Finally, this study applies a *Generalized Polytomous Logit (GPL)* model to handle the *non-ordered* choices of biotech foods and explore the dynamic trends of choices (Greene, 1990; Kennedy, 1992; Long, 1997; Stokes et al., 1998). The GPL model is more general and flexible in the sense that it accounts for all possible nominal response outcomes of the dependent variable without requiring a reference group. This is done sometimes to avoid the parallel regression assumption that is embedded in the ordered probit model (Long, 1997). Even though our analyses are based on an opinion survey, the use of GPL model allows us to validate the robustness of the previous two model specifications.

RESULTS OF MODEL I: PROBIT ANALYSIS

This paper presents estimated probit model results from Bai's thesis–an ordered probit model to estimate consumers' willingness to accept biotech foods and binary probit model to estimate the likelihood of consumers' willingness to purchase biotech foods without price discount. Probit models employed in Bai's thesis are specified in the following general form:

$$Z = \alpha + \beta_1 GENDER + \beta_2 AGE + \beta_3 EDU + \beta_4 INCOME + \beta_5 GOV + \beta_6 COM + \beta_7 UNEMPL + \beta_8 WFOOD + \beta_9 MIDCITY + \beta_{10} SMALLCITY + \beta_{11} HEAL\_BT + \beta_{12} HEAL\_OK + \beta_{13} HEAL\_WS + \beta_{14} MAJ\_DEC + \beta_{15} CO\_DEC + \beta_{16} C\_DATE + \beta_{17} HEAR\_N + \beta_{18} HEAR\_L + \beta_{19} C\_ENV + \beta_{20} BELINF + \beta_{21} C\_POV + v$$

Definitions and measurement units for these variables are presented in Table 2.

Overall, demographic variables, such as gender and age, do not have significant statistical effects on the acceptance of the selected biotech foods (except for livestock products fed with biotech corn; Table 3). This finding is consistent with recent studies by Hossain et al. (2002) and

TABLE 2. Definitions and Measurement Units of the Explanatory Variables

Variable	Definition and unit
GENDER	1 = male
	0 = female
AGE	years
EDU	ditto
INCOME	Per capita annual disposable income (1,000 rmb)
SHH	Per capita annual disposable income in Shanghai (1,000 rmb)
GOV	1 = an occupation of working for the government or state-run enterprises
COM	1 = an occupation of working for corporations or proprietary enterprises
UNEMPL	1 = unemployed
WFOOD	1 = an occupation of working for food processors
OTHER	1 = other occupations
BIGCITY	1 = residing in a large city
MIDCITY	1 = residing in a medium city
SMALLCITY	1 = residing in a small city
HEAL_BS	1 = excellent health condition
HEAL_BT	1 = better-than-average health condition
HEALTH_OK	1 = about average health condition
HEALTH_WS	1 = worse-than-average health condition
MAJ_DEC	1 = major decisionmaker for household food purchases
CO_DEC	1 = co-decisionmaker for household food purchases
NON_DEC	1 = little involvement in household food purchasing decisions
C_DATE	1 = paying close attention to the expiration date in food label
HEAR_N	1 = have never heard of biotech foods
HEAR_S	1 = have heard of biotech foods for less than 3 years
HEAR_L	1 = have heard of biotech foods for over 3 years
C_ENV	1 = caring for environmental protection
BELINF	1 = have trust in the accuracy of media information
C_POV	1 = attention being given to disadvantaged groups by the government
NONOIL	1 = not consuming soybean oil in the household

TABLE 3. Estimated Ordered Probit Model Results on Consumer Acceptance of Biotech Foods (n = 1,005)

Item	Biotech soybean oil	Input-trait biotech rice	Neutraceutical biotech rice	Livestock products fed with biotech corn
GENDER	−0.043	−0.051	−0.033	−0.144
	(0.52)	(0.63)	(0.40)	(1.77)*
AGE	0.004	0.004	0.005	0.006
	(1.24)	(1.19)	(1.50)	(1.85)*
EDU	0.006	−0.007	0.015	0.006
	(0.45)	(0.53)	(1.09)	(0.42)
INCOME	−0.012	−0.017	−0.020	−0.006
	(1.47)	(2.10)**	(2.38)**	(0.69)
SHH	0.009	0.003	−0.005	−0.001
	(1.01)	(0.41)	(0.54)	(0.17)
GOV	0.091	0.155	0.091	0.139
	(1.00)	(1.70)*	(1.00)	(1.53)
COM	−0.030	0.170	0.085	0.075
	(0.26)	(1.45)	(0.72)	(0.65)
UNEMPL	0.248	0.198	0.134	0.261
	(1.90)*	(1.52)	(1.02)	(2.01)**
WFOOD	0.054	0.206	0.168	−0.028
	(0.43)	(1.64)*	(1.33)	(0.23)
MIDCITY	0.171	0.154	0.182	0.160
	(1.69)*	(1.55)	(1.81)*	(1.60)*
SMALLCITY	0.313	0.282	0.258	0.307
	(3.00)***	(2.73)***	(2.49)**	(2.98)***
HEAL_BT	−0.141	−0.177	0.030	−0.187
	(1.01)	(1.27)	(0.22)	(1.35)
HEAL_OK	−0.154	−0.175	0.040	−0.222
	(1.08)	(1.23)	(0.28)	(1.68)*
HEAL_WS	−0.325	−0.384	−0.151	−0.379
	(1.72)*	(2.03)**	(0.80)	(2.01)**
MAJ_DEC	−0.066	−0.162	−0.013	−0.076
	(0.74)	(1.81)*	(0.14)	(0.85)
CO_DEC	−0.033	−0.043	0.086	0.118
	(0.30)	(0.39)	(0.77)	(1.07)
C_DATE	−0.169	−0.087	−0.101	−0.129
	(1.35)	(0.69)	(0.80)	(1.03)
HEAR_N	−0.291	−0.331	−0.317	−0.273
	(3.60)***	(4.09)***	(3.90)***	(3.39)***
HEAR_L	−0.283	−0.430	−0.310	−0.351
	(2.70)***	(4.09)***	(2.95)***	(3.35)***
C_ENV	0.052	0.111	0.148	−0.049
	(0.32)	(0.68)	(0.90)	(0.30)
BELINF	0.186	0.251	0.257	0.142
	(2.45)**	(3.35)***	(3.41)***	(1.91)*
C_POV	0.230	0.114	0.312	0.133
	(2.15)**	(1.08)	(2.93)***	(1.26)
NONOIL	−0.614	n.a.	n.a.	n.a.
	(5.70)***			

Figures in parentheses are absolute values of t-ratio.
* Statistically significant at 10% level of significance.
** Statistically significant at 5% level of significance.
*** Statistically significant at 1% level of significance.

Chern and Rickertsen (2002). While education plays little role in determining consumers' acceptance of biotech foods in China, per capita annual disposable income is a significant factor affecting the acceptance of biotech rice of both input and output traits.

Among the occupation variables, the status of employment has a more significant impact on the acceptance of biotech soybean oil and livestock products fed with biotech corn. The size of consumers' residing cities is a significant variable for acceptance of the biotech foods. Mid- and small-city consumers are more supportive of the use of biotech foods than large-city consumers. The impact is particularly pronounced for small-city consumers. In addition, trust in the accuracy of media information contributed to a higher acceptance of biotech foods. Similarly, those who believed that the government cares about disadvantaged groups had the same preference, possibly because they thought the government can better handle issues relating to biotech development. In contrast, consumers were less willing to accept biotech foods if their health conditions were worse than the average.

Awareness of biotech foods is another significant variable in explaining the likelihood of the acceptance. Beta-coefficients for all selected biotech foods are highly significant. Relative to those who have never heard of biotech foods, consumers with less than three years of awareness are more supportive of biotech foods (Table 3). However, relative to those who have heard of biotech foods for less than three years, consumers who have been aware of biotech foods for more than three years showed a decrease in accepting biotech foods.

Table 4 shows model results for consumer willingness to purchase biotech foods under the assumption that the price for biotech foods is the same as for non-biotech foods, and that only consumers who have heard of the products (n = 669) are likely to purchase them. Similar patterns emerge in terms of the array of explanatory variables that determine consumers' willingness to purchase biotech foods. The size of the residing cities, again, plays a very important role in consumers' willingness to purchase these products. However, in contrast to results of specifying consumer acceptance as the dependent variable (Table 3), consumers who were aware of biotech foods for more than three years generally had the same likelihood of purchasing biotech foods as those whose awareness was less than three years (Table 4). This is especially true for biotech soybean oil, neutraceutical biotech rice, and livestock products fed with biotech corn. In the case of input-trait biotech rice, consumer awareness of more than three years would lead to a decline in the willingness to purchase biotech foods (Table 4).

TABLE 4. Estimated Binary Probit Model Results on Consumer Willingness to Purchase Biotech Foods (No Price Discount for Biotech Foods, n = 669)

Item	Biotech soybean oil	Input-trait biotech rice	Neutraceutical biotech rice	Livestock products fed with biotech corn
GENDER	−0.032	−0.004	−0.126	−0.151
	(0.26)	(0.03)	(0.96)	(1.25)
AGE	0.005	0.007	0.009	0.009
	(0.90)	(1.42)	(1.76)*	(1.81)*
EDU	0.002	−0.019	0.010	0.005
	(0.09)	(0.89)	(0.47)	(0.24)
INCOME	−0.024	−0.014	−0.015	−0.010
	(2.06)**	(1.23)	(1.25)	(0.87)
SHH	0.021	0.015	0.008	0.006
	(1.82)*	(1.25)	(0.68)	(0.57)
GOV	0.069	0.117	0.079	0.202
	(0.54)	(0.90)	(0.58)	(1.61)*
COM	0.086	0.370	0.238	0.167
	(0.50)	(2.03)**	(1.26)	(1.00)
UNEMPL	0.164	0.072	0.219	0.357
	(0.79)	(0.34)	(0.96)	(1.74)*
WFOOD	0.007	0.154	0.460	−0.069
	(0.04)	(0.77)	(2.01)**	(0.37)
MIDCITY	0.372	0.390	0.376	0.394
	(2.51)**	(2.61)***	(2.42)**	(2.74)***
SMALLCITY	0.531	0.459	0.529	0.518
	(3.39)***	(2.93)***	(3.20)***	(3.43)***
HEAL_BT	−0.069	−0.104	0.105	−0.154
	(0.30)	(0.43)	(0.43)	(0.68)
HEAL_OK	−0.097	−0.248	0.065	−0.170
	(0.41)	(0.99)	(0.26)	(0.73)
HEAL_WS	−0.572	−0.681	−0.408	−0.656
	(1.84)*	(2.14)**	(1.27)	(2.12)**
MAJ_DEC	−0.230	−0.205	−0.285	−0.261
	(1.68)*	(1.47)	(1.95)*	(1.97)**
CO_DEC	−0.273	−0.207	−0.220	−0.195
	(1.66)*	(1.23)	(1.25)	(1.21)
C_DATE	−0.272	−0.322	−0.190	−0.099
	(1.28)	(1.45)	(0.83)	(0.49)
HEAR_L	−0.111	−0.296	−0.089	−0.126
	(0.88)	(2.32)**	(0.66)	(1.01)
C_ENV	−0.460	−0.112	−0.210	−0.266
	(1.73)*	(0.43)	(0.77)	(1.07)
BELINF	0.257	0.262	0.274	0.206
	(2.20)**	(2.23)**	(2.24)**	(1.83)*
C_POV	0.615	0.275	0.564	0.436
	(3.72)***	(1.67)*	(3.37)***	(2.71)***
NONOIL	−0.689	n.a.	n.a.	n.a.
	(4.20)***			
Constant	0.357	0.592	−0.129	−0.217
	(0.69)	(1.12)	(0.24)	(0.43)

Figures in parentheses are absolute values of t-ratio.
* Statistically significant at 10% level of significance.
** Statistically significant at 5% level of significance.
*** Statistically significant at 1% level of significance.

RESULTS OF MODEL II: INSTRUMENTAL VARIABLE APPROACH

Regression equations for the awareness of biotech foods–one for up to three years and the other for longer than three years–are first estimated through a first-stage probit model. Explanatory variables include consumers' demographic and socio-economic variables, size of the residing city, as well as access to mass media (MDACCESS), including TV, radio, newspaper, and magazine. Access to mass media is the single, most important variable affecting consumer awareness of biotech foods (Table 5). In addition, large-city consumers would likely be more aware of biotech foods for longer than three years than small- and medium city consumers. However, this advantage for large-city consumers

TABLE 5. Estimated Probit Model Results on Awareness of Biotech Foods

Explanatory variable	Awareness of less than three years	Awareness of longer than three years
GENDER	−0.0227	0.1334
	(0.24)	(1.36)
AGE	0.0014	−0.0012
	(0.34)	(0.29)
INCOME	−0.0042	0.0179
	(0.40)	(1.72)*
EDU	0.0197	−0.0359
	(0.23)	(0.34)
EDU^2	−0.0027	0.0043
	(0.71)	(0.98)
SMALLCITY	0.0752	−0.1635
	(0.57)	(1.23)
MIDCITY	0.2035	−0.3466
	(1.58)	(2.63)***
MDACCESS	1.8913	1.0785
	(16.43)***	(8.95)***
SHH	0.0188	−0.0224
	(1.72)*	(2.09)**
WFOOD	0.0979	--
	(0.47)	

Figures in parentheses are absolute values of t-ratio.
* Statistically significant at 10% level of significance.
** Statistically significant at 5% level of significance.
*** Statistically significant at 1% level of significance.

was not apparent for short-term awareness. Higher per-capita disposable income was positively associated with awareness longer than three years. Including the square term of the education variable (EDU^2) makes a few explanatory variables more statistically significant, with expected signs.

The second-stage model on acceptance of biotech foods was estimated through ordered probit analysis using predicted values of the awareness variable from the first-stage awareness equation. The instrumental variable is chosen so that it is highly correlated with the *awareness* variable but not correlated with the error term in the acceptance equation. In this context, access to media serves as an instrument which affects both awareness and acceptance of biotech foods. Table 6 shows estimated model results for the four biotech foods. Major findings from Bai's thesis, by and large, remain intact. Income (for biotech rice), status of employment, the size of residing cities, awareness level of biotech foods, and trust in the accuracy of media information remain important factors affecting the acceptance of biotech foods. Small and mid-city consumers were more willing to accept biotech foods than large-city consumers.

Results of the *instrumental variable* approach show larger beta-coefficients of the awareness variable for all the four biotech foods than those obtained from the conventional probit model, where actual values of the awareness variable are used in estimating the likelihood of consumer acceptance of biotech foods. For example, in the case of biotech soybean, the coefficient of the awareness variable from *instrumental variable* is 2.55 times greater than that obtained from the conventional approach. However, standard errors of the coefficients obtained from the *instrumental variable* are larger than those obtained from the conventional approach.

Table 7 shows marginal effects of the explanatory variables that are statistically significant at least at the 10% level of significance on the probability of accepting biotech foods. The marginal effects are the impacts of a per-unit change in explanatory variables on the probability of accepting biotech foods in China, measured at mean values of the dependent and explanatory variables. In general, consumers who were aware of biotech foods (for less than three years), had better trust in the accuracy of media information, and lived in small cities, were more likely to accept biotech foods. In contrast, higher income slightly lowered the probability of accepting input- and output-trait biotech rice. For example, awareness raised the likelihood of accepting biotech soybean

TABLE 6. Estimated *Instrumental Variable* Model Results on Consumer Acceptance of Biotech Foods (n = 1,005)

Explanatory variable	Biotech soybean oil	Input-trait biotech rice	Neutraceutical biotech rice	Livestock products fed with biotech corn
GENDER	−0.003	−0.038	−0.061	−0.133
	(0.04)	(0.45)	(0.72)	(1.60)
AGE	0.004	0.002	0.005	0.005
	(1.16)	(0.68)	(1.31)	(1.50)
EDU	0.018	−0.018	−0.002	0.005
	(1.00)	(0.47)	(0.08)	(0.26)
INCOME	−0.006	−0.015	−0.021	−0.005
	(0.75)	(1.79)*	(2.47)***	(0.58)
GOV	0.103	0.116	0.086	0.111
	(1.07)	(1.20)	(0.87)	(1.16)
COM	0.002	0.006	−0.002	0.002
	(0.03)	(0.06)	(0.03)	(0.02)
UNEMPL	0.274	0.196	0.160	0.269
	(2.06)**	(1.46)	(1.19)	(2.03)**
WFOOD	0.122	0.334	0.398	−0.024
	(0.79)	(2.13)**	(2.50)**	(0.16)
MIDCITY	0.078	0.130	0.238	0.154
	(0.80)	(1.37)	(2.48)**	(1.64)*
SMALLCITY	0.264	0.277	0.272	0.317
	(2.78)***	(2.95)***	(2.86)***	(3.41)***
HEAL_OK	−0.033	−0.014	0.020	−0.067
	(0.45)	(0.18)	(0.26)	(0.91)
HEAL_WS	−0.193	−0.226	−0.197	−0.188
	(1.35)	(1.59)	(1.37)	(1.32)
MAJ_DEC	−0.049	−0.153	−0.011	−0.074
	(0.55)	(1.72)*	(0.12)	(0.84)
CO_DEC	−0.028	−0.064	0.062	0.093
	(0.26)	(0.58)	(0.56)	(0.85)
C_DATE	−0.186	−0.085	−0.087	−0.149
	(1.49)	(0.67)	(0.69)	(1.19)
HEAR_S	0.704	0.439	0.142	0.418
	(2.74)***	(1.71)*	(0.55)	(1.65)*
HEAR_L	−0.660	−0.069	0.735	−0.070
	(1.16)	(0.12)	(1.29)	(0.12)
C_ENV	0.054	0.071	0.132	−0.040
	(0.72)	(0.95)	(1.73)*	(0.53)
BELINF	0.206	0.290	0.282	0.152
	(2.71)***	(3.87)***	(3.71)***	(2.03)*
NONOIL	−0.564	n.a.	n.a.	n.a.
	(5.37)***			

Figures in parentheses are absolute values of t-ratio.
* Statistically significant at 10% level of significance.
** Statistically significant at 5% level of significance.
*** Statistically significant at 1% level of significance.

TABLE 7. Marginal Effects–Change in the Probability of Accepting Biotech Foods Associated with Explanatory Variables

Explanatory variable	Biotech soybean oil	Input-trait biotech rice	Neutraceutical biotech rice	Livestock products fed with biotech corn
INCOME	--	−0.0001	−0.0001	--
UNEMPL	0.0008	--	--	0.0011
WFOOD	--	0.0004	0.0004	--
MIDCITY	--	--	0.0013	0.0024
SMALLCITY	0.0023	0.0020	0.0015	0.0054
MAJ_DEC	--	−0.0018	--	--
HEAR_S	0.0179	0.0074	--	0.0162
C_ENV	--	--	0.0017	--
BELINF	0.0041	0.0049	0.0037	0.0054
NONOIL	−0.0018	--	--	--

oil by 1.79 percent, and by 0.74-1.62 percent for the acceptance of input-trait biotech rice and livestock products fed with biotech corn.

RESULTS OF MODEL III: THE GPL MODEL

We investigate the consumer attitudes toward biotech foods in China by applying a Generalized Polytomous Logit (GPL) function to handle the three discrete non-ordered choices: supportive (completely and relatively), neutral, opposed (completely and relatively) (Greene, 1990; Kennedy, 1992; Long, 1997; Stokes et al., 1998). The generalized logits for a three-level nominal where the consumer exhibits three different categories of attitudes as follows:

$$\begin{aligned} \text{logit}_{\text{hij1}} &= \frac{\log\left(\eta_{hij1}\right)}{\log\left(\eta_{hij3}\right)} \\ \text{logit}_{\text{hij2}} &= \frac{\log\left(\eta_{hij2}\right)}{\log\left(\eta_{hij3}\right)} \end{aligned} \tag{1}$$

where response category 3 is the reference category, h, i, and j reference the explanatory variables, and η_{hijk} is the probability of the kth choice.

The model applies to all logits *simultaneously*, accounting for every combination of the explanatory variables as follows:

$$\text{logit}_{\text{hijk}} = a_k + X_{hij}\beta_k \quad (2)$$

where k indexes denote consumer attitudes toward biotech foods. The matrix X_{hij} is the set of explanatory variables for the hijth group. This model accounts for each response by estimating separately the intercept (α_k) and the set of regression parameters (β_k) for all explanatory variables. That is, in the GPL model specification, we estimate simultaneously, as a panel, multiple sets of parameters for both the intercept and the explanatory variables. The interpretation of GPL parameter estimates is not very straightforward, as both dependent and explanatory variables are mostly categorical. To facilitate the interpretation of the model parameters, we use the estimated probabilities to calculate *odds ratios* (Makki and Somwaru, 2001).

Table 8 presents the maximum likelihood analysis of variance results, which summarize the main effects of the GPL model using all observations in the sample for soybean oil as a prototype. The likelihood ratio statistic indicates the goodness of fit of the model, while the chi-square values indicate the significance of the explanatory variables. The likelihood ratio statistic for the model has a value of 346.66 with 308 degrees of freedom, indicating a good fit (probability = 0.0638).

The hypothesis to be tested is that consumer attitudes toward biotech soybean oil in China are affected by: the size of the city where they live, their health concerns, how long they have been aware of biotech foods, their trust in media, trust in government on this issue, their attitude towards the environment, and if they pay attention to expiration date, as an indicator of their behavior as conscious consumers. The results presented in Table 8 reveal a strong relationship between these variables and categories of work as captured by the Wald Chi-Square values.

Table 9 presents the parameter estimates for the models, along with the t-ratio values to indicate the statistical significance of the estimated parameters. The negative sign of the coefficients indicates that probability of the reference choice (in this case, supportive) would be increased at the expense of that for neutrality. The size of the estimated coefficients suggest that attention being given to expiration dates on food labels, the size of the residing city, and trust in media and government variables have the largest effect on both logits. We also estimated generalized logits for a five-level nominal response (see Appendix B).

TABLE 8. Generalized Multinomial Logit Model

Variable	degrees of freedom	Chi-Square	Pr > Chi-Square
Intercept	2	37.57	<.0001
Residency	4	13.79	0.008
Health condition	4	3.82	0.4306
Heard in the last 3 years	2	10.05	0.0066
Trust in media	2	6.76	0.0341
If government cares	2	18.01	0.0001
Environmental concerns	2	4.86	0.0879
Expiration dates	2	5.28	0.0715
Likelihood ratio	308	346.66	0.0638

TABLE 9. Estimated Generalized Multinomial Logit Results on Consumer Acceptance of Biotech Soybean Oil (n = 1,005)

	Logit (Neutral/Supportive)			Logit (Opposed/Supportive)		
Parameter	Coefficient		t-ratio[a]	Coefficient		t-ratio[a]
Intercept	a1	−1.658	6.053***	a2	−0.368	2.316***
Residency (small size city)	b1	−0.484	2.635***	b2	0.095	0.872
Residency (medium size city)	b3	0.331	2.169***	b4	−0.192	1.773***
Health condition (health worse)	b5	0.281	1.156	b6	−0.025	0.135
Health condition (health ok)	b7	−0.241	1.470	b8	0.076	0.650
Heard in the last 3 years	b9	0.267	2.316***	b10	−0.118	1.356
Trust in media	b11	−0.226	1.955***	b12	−0.176	2.231***
If government cares	b13	−0.255	2.377***	b14	−0.297	4.063***
Environmental concerns	b15	0.127	1.008	b16	−0.126	1.589*
Expiration dates	b17	−0.519	2.102***	b18	−0.171	1.326

[a]Figures are absolute values of t-ratio.
* Statistically significant at 10% level of significance.
** Statistically significant at 5% level of significance.
*** Statistically significant at 1% level of significance.

Odds ratios facilitate interpreting the estimated parameters. For example, using the parameter estimates of the neutral/supportive logit, the odds of being supportive over neutral by those living in medium city (b_3) vs. large city ($-b_1-b_3$) is:

$$\frac{e^{b_3}}{e^{-b_1-b_3}} = 1.19$$

This indicates that consumers who live in medium cities are 1.19 times more likely to be neutral over supportive than consumers who live in large cities.

CONCLUSIONS

This study reaffirms that Chinese consumers' awareness level of biotech foods has remained low. About three-fourths of the urban consumers have never heard of biotech foods or have heard of them on an occasional basis. Only slightly more than 20 percent of consumers indicated that they frequently heard of biotech foods.

Despite this low level of awareness, a great majority of China's consumers had favorable or neutral attitudes toward biotech foods. Only 5-15 percent of urban consumers were strongly or relatively opposed to biotech foods. Relative to those who have never heard of biotech foods, survey data suggest that consumers who have heard of biotech foods tended to be slightly more supportive of biotech foods. This effect was particularly apparent for consumers who have been aware of biotech foods for less than three years.

There are many similarities in results obtained from three different modeling approaches. The size of consumers' residing cities played a key role in affecting the acceptance of biotech foods. Mid- and small-city consumers are more supportive of the use of biotech foods than large-city consumers, with the impact being particularly pronounced for small-city consumers. In addition, consumers tended to be less willing to accept biotech foods if their health conditions were worse than the average. Those consumers who trusted the accuracy of media information were also more willing to accept biotech foods. It seems plausible that dissemination of accurate information to consumers through mass media would enhance the acceptance of biotech foods.

All the models reaffirm that awareness of biotech foods plays a key role in explaining the likelihood of acceptance for all selected biotech foods. Relative to those who have never heard of biotech foods, consumers with less than three years of awareness are more supportive of the products. However, the effect of increased acceptance is not significant if the length of awareness is greater than three years. This finding suggests that if China's government would like to promote the acceptance of biotech foods, targeting the dissemination of information to consumers with the least exposure or awareness (less than three years

familiarity) would be a more effective strategy to achieve the objective than a program across the board.

The GPL model results, in general, validate the robustness of the probit model and the instrumental variable approach. The instrumental variable approach, which corrects bias caused by the interdependence of the awareness variable and the error term in the acceptance equation, yields larger effects of the awareness variable on the likelihood of accepting biotech foods. However, efficiency of the coefficient is shown to be lower than the conventional probit model. Both the GPL and instrumental variable approach found that consumer awareness, the size of residing city, trust in media and government, and attention being given to expiration dates on food labels are most significant variables in affecting the consumer acceptance of biotech foods in China.

Widespread acceptance of biotech foods by urban consumers in China has important implications for the decision by Chinese food manufacturers and retailers to use and label biotech foods, as well as for export of U.S. biotech products to China. Because a great majority of China's consumers had favorable or neutral attitudes toward biotech foods, this study's findings suggest that consumers' positive attitudes toward biotech foods would pave the way for many food manufacturers and retailers to use less costly biotech ingredients and label products accordingly. This decision to label biotech products would, by and large, facilitate the export of China-approved biotech products (such as herbicide-tolerant soybeans) from the United States to China without incurring additional expenses in segregating biotech from non-biotech products.

REFERENCES

Asian Food Information Center. *Attitude to Food Biotechnology: The Philippines, China and India*. Prepared by: Isis Research, Jan. 12, 2004.

Bai, J. "Consumers' Acceptance of and Willingness to Buy Genetically Modified Foods in Urban China," M.S. thesis, Center for Chinese Agricultural Policy, Chinese Academy of Sciences, Beijing, China, June 2003.

Berndt, Ernst R. *Econometrics: Classic and Contemporary*, Addison-Wesley Publishing Company, 1991.

Chern, W.S. and K. Rickertsen, "Consumer Acceptance of GMO: Survey Results from Japan, Norway, Taiwan, and United States," A Working Paper, Sept. 2002.

Feldstein, Martin S. and John S. Flemming, "Tax Policy, Corporate Saving and Investment Behaviour in Britain," *Review of Econometric Studies*, 38: 415-434. Oct. 1971.

Gale, F., W. Lin, B. Lohmar, and F. Tuan. "Is Biotechnology in China's Future?" in *China's Food and Agriculture: Issues for the 21th Century*, Fred Gale (ed.), AIB No. 775, Economic Research Service, USDA, April 2002.

Greene, W. *Econometric Analysis*. Macmillan Publishing Company, New York, 1990.

Hossain, F., O. Benjamin, A. Adesoji, S. Brian, and W. Hallman. "Consumer Acceptance of Food Biotechnology: Willingness to Buy Genetically Modified Food Product," A Working Paper, Food Policy Institute, June 2002.

International Food Information Council. "IFIC Survey: Support for Food Biotechnology Stable Despite News on Unrelated Food Safety Issues," IFIC Background, March 8, 2004.

Kennedy, Peter. *A Guide to Econometrics*. The MIT Press, Cambridge, MA 02142, 1992.

Lancaster, T. "Grouping Estimators on Heteroscedastic Data," *Journal of the American Statistical Association*, March 1968.

Li, Q, K.R. Curtis, J.J. McCluskey, and T.I. Wahl. "Consumer Attitudes Toward Genetically Modified Foods in Beijing, China," *AgBioForum*, 5(4): 145-152, 2003. Available on the website: http://www.agbioforum.org.

Long, J. S. *Regression Models for Categorical and Limited Dependent Variables*. New Delhi: Sage Publications, 1997.

Maddala, G.S. *Econometrics*, McGraw-Hill Book Co., 1977.

Makki, S. and A. Somwaru. *Asymmetric Information in the Market for Yield and Revenue Insurance Products*, Technical bulletin no. 1892, ERS-USDA, April 2001.

Marchant, M.A., C. Fang, and B. Song. "Issues on Adoption, Import Regulations, and Policies for Biotech Commodities in China with a Focus on Soybeans," AgBioForum, 5(4): 167-174, 2003. Available on the website: http://www.agbioforum.org.

Marschak, J. "Binary Choice Constraints on Random Utility Indicators," In *Stanford Symposium Mathematical Methods in the Social Sciences.* (K. Arrow, ed.). Stanford Univ. Press, Stanford, California, 1960.

National Bureau of Statistics of China. *China Statistical Yearbook 2003*, China Statistics Press, July 2003.

Stokes, M. E., C. S. Davis, and G. G. Koch. *Categorical Data Analysis Using the SAS System*. SAS institute, 1998.

Zhong, F., M. Marchant, Y. Ding, and K. Lu (2002). "GM Foods: A Nanjing Case Study of Chinese Consumers' Awareness and Potential Attitudes," *AgBioForum*, 5(4):136-144. Available on the website:http://www.agbioforum.org.

SUBMITTED: July 2004
FIRST REVISION: October 2004
SECOND REVISION: November 2004
ACCEPTED: January 2005

APPENDIX A. Comparison of Demographic Indicators Between Population and Sample by City or Province

TABLE A-1. Demographic Indicators of Population vs. Sample by City or Province, 2001 or 2002*

Item	Unit	Beijing	Shandong	Jiansu	Zhejiang	Shanghai	Total
Year-end total population	10,000	1382.1	9044.6	7358.9	4608.9	1613.4	24008.0
Sample-city population	10,000	1021.4	2007.9	2097.3	981.7	1250.4	7358.7
Percent	%	73.90	22.2	28.5	21.3	77.5	30.7
Usable sample size	1	200	200	205	200	200	1005
Average household size							
Sample city	1	3.03	3.06	3.05	2.96	3.00	n.a.
Sample	1	3.04	3.05	3	2.92	2.9	2.99
Gender ratio (male:female)							
Entire city or province		0.98:1	1.01:1	1.00:1	1.02:1	0.99:1	n.a.
Sample		0.59:1	0.58:1	0.92:1	0.68:1	0.82:1	0.71:1
Ave. age	1						
Entire city or province		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sample		49.51	40.34	46.66	45.81	50.45	46.55
Ave. education years	years						
Entire city or province		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Sample		11.73	11.49	10.56	10.32	11.33	11.08
Per capita monthly disposable income	RMB						
Sample city		1039	635	682	976	1073	n.a.
Sample		1044.6	669.9	717.5	849.9	962.2	844.2

*Data on year-end total population, average household size, and average age are figures of 2001, while data on average age, average education years, and per capita monthly disposable income are those of 2002.
n.a. = Not available.
Source: National Bureau of Statistics of China, *China Statistical Yearbook 2003*; CCAP survey.

APPENDIX B

Generalized Multinomial Logit Model Five Response

Variable	degrees of freedom	Chi-Square	Pr > Chi Sq
Intercept	4	81.23	<.0001
Residency	8	15.93	0.0434
Health condition	8	5.38	0.7166
Heard in the last 3 years	4	10.22	0.0369
Trust in media	4	16.16	0.0028
If government cares	4	18.4	0.001
Environmental concerns	4	8.16	0.086
Expiration dates	4	7.61	0.1071
Likelihood ratio	616	520.43	0.9979

Estimated Generalized Multinomial Logit Results on Consumer Acceptance of Biotech Foods (n = 1,005) Five Response

	Logit (Opposed/Supportive)			Logit (Relative Opposed/ Supportive)			Logit (Neutral/Supportive)			Logit (Relative Supportive/ Supportive)		
	Coefficient		Std. error	Coefficient		Std. error	Coefficient		Std. error	Coefficient		Std. error
Intercept	a1	−2.161	0.7062***	a2	−0.086	0.372	a3	1.378	0.2744***	a4	1.537	0.2684***
Residency (small size city)	b1	−0.926	0.5364**	b2	−0.369	0.2316*	b3	0.130	0.169	b4	0.046	0.171
Residency (medium size city)	b5	0.250	0.415	b6	0.355	0.2016*	b7	−0.185	0.164	b8	0.013	0.162
Health concerns (health_worst)	b9	−0.077	0.755	b10	0.539	0.358	b11	0.158	0.315	b12	0.235	0.314
Health concerns (health_ok)	b13	−0.117	0.466	b14	−0.395	0.228	b15	−0.051	0.191	b16	−0.165	0.191
Health concerns (health_better)	b17	0.155	0.299*	b18	0.233	0.154	b19	−0.160	0.129	b20	−0.055	0.127
Heard in the last 3 years	b21	−0.795	0.302	b22	0.033	0.153	b23	−0.037	0.120	b24	0.187	0.121
Trust in media	b25	−0.411	0.2756***	b26	−0.255	0.143	b27	−0.320	0.114	b28	−0.029	0.115
If government cares	b29	−0.284	0.301	b30	0.014	0.173	b31	−0.289	0.132	b32	−0.207	0.133
Environmental concerns	b33	−0.193	0.562	b34	−0.284	0.3263***	b35	0.080	0.2235***	b36	0.312	0.217
Expiration date	b37	−0.248	0.554	b38	−0.326	0.320	b39	0.072	0.210	b40	0.287	0.204**