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**Consumers' Trust in Government and Their Attitudes towards Genetically
Modified Food: Empirical Evidence from China**

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1. Introduction

Despite the potential to bring enormous benefits of agricultural biotechnology to welfare of the world, its applications have faced great challenges in recent years. One of the biggest challenges is consumer's perception and acceptance of genetically modified food (GMF). Many recent studies showed that consumers' concerns about GMF are rising (Gaskell et al., 1999; Macer, 2001; Lusk et al, 2003). Consequently, several major U.S and European food manufacturers and retailers have declared that they would accept only non-GM crops. Various strict regulations on GMF commercialization and marketing in many developed and developing countries further fueled this challenge.

Because of the importance of consumers' attitudes toward GMF on agricultural biotechnology development in the future, understanding factors influencing consumer's acceptance of GMF is critical. The existing literatures indicate that there are many factors that might affect consumer's acceptance of GMF. These include consumers' knowledge about GMF (Gaskell et al 1999; Lin et al., 2005), the nature of debates in the media (Kalaitzandonakes, et al., 2004), their trust in government's ability to manage the GMF (Moon and Balasubramanian, 2004), and many others related to individual characteristics (Hallman, et al., 2002; House, et al., 2004).

Among various factors affecting consumer's acceptance of GMF, the impacts of consumer's trust in government has increasingly received great attentions. For example, Gaskell et al. (1999) claimed that consumers' trust in government could substitute their knowledge on GMFs, which may partly explain the higher acceptance of GMFs for consumers in the U.S than those in EU. Several recent studies in EU and U.S point out that trust in government plays an important role in shaping public attitudes about GMFs, largely via their links to risk perceptions (Moon and Balasubramanian 2001; Hossain and Onyango, 2004; Curtis et al., 2004). Some empirical studies in China also confirmed the important roles of trust in government in affecting consumers' acceptance to GMF (Bai, 2003; Lin et al., 2005).

Accurately quantifying impact of consumers' trust in government on their GMF attitudes is difficult because researchers often encounter their difficulties in empirical estimations, particularly, the endogenous problem of many explanatory variables in determining consumers' attitudes. For example, the food regulations issued by government and some incidents such as mad cow disease crisis, can affect both the consumers' attitudes towards GMF and their trust in government management. Empirical estimation of the impacts of consumers' trust in government would be bias and inconsistent if one would not well consider the endogenous problem (Wooldrige, 2002). Unfortunately, none of existing studies has appropriately taken into consideration of this endogenous issue in their empirical studies.

The overall goal of this study is to empirically quantify the impact of consumers' trust in government on their attitudes towards GMF in China. The analysis is based on a randomly selected urban household sample collected by the authors in 2002 and 2003 in 11 cities of China. The paper is organized as the follows. In the next section the data collection process and the samples are described. Statistical analysis of Chinese consumers' attitudes towards GMF and consumers' trust in government are discussed in the third section. The fourth section presents the models and the results of their empirical estimations. Several concluding remarks are provided in the last section.

2. Survey Method and Sample Description

The households for this study were randomly selected from the Urban Household Income and Expenditure Survey (UHIES) samples conducted by the National Bureau of Statistics of China (NBSC).¹ NBSC's UHIES' samples are carefully designed to represent whole urban population in each region. We conducted 2 round surveys in the same 11 cities of North and East China with 1005 households in 2002 and 1000 households in 2003. The in-person and in-house interviews were conducted by the authors and professional enumerators from each provincial branch of NBSC.

¹ North and East China account for about 40% of the national population and nearly half of China's urban consumers. Eleven cities spread over these 2 regions. They include two mega-size cities (Beijing and Shanghai), three large cities (Nanjing of Jiangsu province, Jinan of Shandong province, and Ningbo of Zhejiang province) and six small cities (Dezhou and Weihai in Shandong province, Yancheng and Nantong in Jiansu province, and Shaoxing and Jinghua in Zhejiang province). Total samples under NBSC's UHIES in above 11 cities are 2300.

Since NBSC usually changes one-third of its UHIES sample, only 666 households were interviewed in both 2002 and 2003 surveys. The other 339 samples were dropped by NBSC, and were not interviewed in 2003 as we had difficulty to find them. Instead, we added 334 households randomly selected from UHIES's new samples in the same cities in 2003. Because our survey in 2002 did not include key instrumental variables designed to deal with endogenous problem of consumer's trust in government, in our 2003 survey we added a set of these variables for both new samples (334) in 2003 and the old samples (666) that were interviewed in 2002. So the effective samples used in this study is 1666 (666 in 2002 and 666+334 in 2003). Huang et al. (2005) showed that there is no statistically difference in all variables between the randomly dropped samples (339) by NSBC and the samples used in this study, and the sample used in this study well represent the consumers in our studied urban areas.

3. Consumers' acceptance of GMFs and their trust in government

Consumers' attitudes towards GMFs

Since consumers' attitudes towards GMFs may differ among foods or traits, in this study we asked consumers' acceptance of five individual GMFs. Our survey shows that consumer's acceptant levels of the nutritionally improved GM rice, the pest-resistant GM rice and fruit/vegetable are very similar, and they are evidently higher than the other two GM foods (Table 1). The rate of acceptance (including both strongly and relatively acceptance) for nutritionally improved GM rice reached 67%, a similar rate (66%) was found for both pest-resistant GM rice and GM fruit/vegetable

(Table 1). The pork fed by GM maize received the lowest acceptant rate (49%, the last row of Table 1), which is consistent with the findings in other countries where GM livestock often recorded relatively lower rates of acceptance (Hallman et al., 2002). Table 1 also shows that the disapprove rate of GMF in urban China is quite low. Only 6-12% consumers said they strongly or relatively oppose GMF.

Compared with many other countries, the acceptance of GMFs in China is rather high. For example, consumers' acceptance rate of "nutritionally improved GM rice" was reported to be 51% in Japan and 46% in the UK (FAO, 2004), which are about 20 percentage points lower than that in China. Because the consumer's neutral attitude to GMF can also be interpreted as no preference on non-GMF over GMF, analysts often grouped these consumers into those who accept GMF. If we account for this, Chinese consumers' acceptance rate to nutritionally improved GM rice reached as high as 89%, which is almost the highest one that has been found in the world. Even in the U.S, the consumers' acceptance rate of GMF was only arranged from 59% (IFIC, 2004) to 50% (Hallman et al., 2003).

Consumers' trust in government and their attitudes towards GMF

In this study, consumers' trust in government is measured by their evaluation of government's efforts paid to disadvantaged groups. Each respondent was asked to select one of the following five answers: great effort, moderate effort, little effort, lack of effort, and no effort. The "great effort" is used as proxy for "strongly trust" in

government and “no effort” is proxy for “strongly do not trust”. The survey results show that the majority of urban Chinese consumers trust in government. 12% consumers feel strongly trust in government, and 40% consumers feel relatively trust in government. Consumers who feel relatively and strongly distrust in government only account 11% and 2%, respectively.

As we would expect, consumers’ attitudes towards GMF are positively associated with their trust in government. For all five GMFs examined in this study, consumers’ acceptance rates consistently increase with the rise of their trust in government (Table 2). The average acceptance rate for consumers strongly trust in government is 73%, while the corresponding number for consumers who strongly distrust in government was only 55%, which was 17% lower.

The positive relationship between consumers’ trust in government and their acceptance towards GMF has been confirmed by other questions asked during the survey. For example, more than 80% of interviewees positively responded to the following question: if GMFs’ safety has been tested by government before they were authorized for commercialization, can this increase your confidence to GMFs? Since GMF was introduced to consumers only at the late of 1990’s, some consumers might have no much knowledge on this novel food. But, if the consumers trust in government, their worries about GMF may decrease. Many interviewees have clearly expressed this opinion in our survey.

Models and result discussions

Model specification

To examine the effects of consumers' trust in government on their attitudes towards GMF, we have to control other factors that also simultaneously affecting consumers' attitudes. The general model is specified as the follows:

$$A_{it} = f_l(B_{it}, T_{it}, H_{it}, S_{it}, v_{lit}) \quad (1)$$

where, the dependent variable, A_{it} , is consumers' attitudes towards GMFs. The explanatory variable, B_{it} , is consumers' trust in government with 1 for "trust" (including both strong and relatively trust in government) and zero otherwise. T_{it} is the time dummy with 1 for year 2003. H_{it} is a vector of respondent's individual characteristics, including gender, age, education, occupation, and a dummy with value of 1 for those attended the survey in 2002 and zero for others. S_{it} represents respondent's family characteristics, including per capita income, the size of residential city, dummies for whether the family has a child under ten years old, and whether there is family member(s) has ever experienced food allergic in the past.

There are several reasons to believe that consumers' trust in government is endogenous to the model specified in equation (1). As we have mentioned earlier, some factors that are not included in the model can simultaneously affect consumers' trust in government and their attitudes towards GMF, omitting these variables will lead to the endogenous problem of trust in government. Another reason for the endogeneity of

the variable is that consumers' attitudes towards GMF may also have impacts on consumers' trust in government's management in food industry. For example, for those consumers who strongly oppose GMF, if government authorizes the commercialization of GMF, they may feel very disappointed and further damage their trust in government. To deal with these endogenous problems, we need appropriate instrumental variables that can effectively explain the variations of consumers' trust in government. In this study, the following auxiliary model is specified:

$$B_{it} = f_2 (IV_{it}, T_{it}, H_{it}, S_{it}, v_{2it}) \quad (2)$$

where IV_{it} , is instrumental variables, that include: the years that the respondent has been a member of Chinese Community Party member, a dummy variable for those households with lay-off family member(s) in the past 3 years, and frequency of water cut-off (measured as times per month in his/her home).

Because of the nature of A_{it} variables, ranging from 1 (strongly oppose GMF) to 5 (strongly acceptance), ordered probit model is used to estimate parameters in equation (1). In equation (2), B_{it} is binary (zero or one) variable, probit model is used to estimated this equation. Equations (1) and (2) are simultaneously estimated based on the data discussed in section 2.

Results

The results of econometric estimations of system equations (1) and (2) for the consumers' acceptance of different GMFs are presented in Tables 3 and 4. Table 3

shows the regression results for two varieties of GM rice, and Table 4 are the results for pest-resistant GM fruit/vegetable, GM soybean oil, and Pork fed by GM maize.

The results show that the parameters for all three instrumental variables have expected signs and are statistically significant in 1% or 5% levels for each of five GMFs (Tables 3 and 4). The longer the respondent has been a member of the Chinese Community Party member the more he/she trusts in the government. For the family has member(s) laid off in last three years, his/her trust in government is significantly lower. The trust in government also declines with the increase of frequency of water supply cut-off in the family. Since these instrumental variables have significant impacts on consumers' trust in government and they seem have no means to impact consumers' acceptance of GMF directly, we believe all of these variables can be used as good instrumental variables in this analysis. The parameters for other factors in consumers' trust in government also have expected signs (Tables 3 and 4).

All estimated parameters of consumers' trust in government in consumer's acceptance towards GMF equations have expected positive sign and are statistically significant in 4 of the studied 5 GMFs. These results confirm to our hypothesis that consumers' trust in government is critically important in determining their attitudes towards GMFs. This may also partially explain the higher acceptance of GMF in China than many other countries as their trust in government is relatively high.

Other main factors affecting consumers' attitudes towards GMF include income, the resident location (size of city), and consumers' information on GMFs. Income has significantly negative impacts on consumers' acceptance towards GMF (Tables 3 and 4). This finding is consistent with the previous findings in many other studies (Lin et al., 2004). Our study also finds that consumers in larger cities tend to have lower acceptance of GMF than those in the smaller cities. The parameters for those consumers who interviewed in 2002 and therefore have more information on GMFs have positive and significant signs, which may suggest that information and knowledge on GMF are important in determining their acceptance of GMFs.²

To test the potential estimation bias resulted from endogenous problem associated with consumers' trust in government, we also estimated equation (1) independently. A summary of results is presented in Table 5, which shows that the parameters of consumers' trust in government are much smaller in the models that do not consider the endogenous problem. This implies that previous studies (Moon and Balasubramanian 2001; Hossain and Onyango, 2004; Curtis et al., 2004) may underestimate its impact of consumers' trust in government on their acceptance towards GMF.

Concluding Remarks

This study shows that the consumers' acceptance of GMF is high in urban China. The

² Note that all numerators provided neither any favor nor un-favor information on GMF during the surveys, and were trained to be neutral during the survey.

number of consumers who clearly indicated opposing GMF is small, accounted for only about 6-12%. Similar to many studies in other countries, consumers more approve GM food crops than GM meats even the livestock is fed by GM feed. There are also many consumers, about 25% to 40%, who are either neutral towards or undetermined attitudes on GMFs. This may suggest that the trends of key determinants of consumers' attitudes towards GMF will shape China's market for GMF in the future.

Among many factors, consumers' trust in government is found to have significantly positive impact on their acceptance of GMFs, which has important implications for any government who wants to pursue the development of GMFs. This is, as the best of our knowledge, the first study on the impact of consumers' trust in government to their attitudes towards GMFs with considering the endogeneity of this variable. Moreover, we show that fail to consider the endogeneity of consumers' trust in government will lead to underestimation of its impacts on consumers' acceptance of GMFs.

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Table 1. Consumers' acceptance towards the specific GM foods (percent)

	Acceptance Rate					Undeter- mined
	Strongly acceptable	Relatively acceptable	Neutral	Relatively opposed	Strongly opposed	
Pest-resistant GM fruit/vegetable	26	42	21	5	1	5
Oil from GM soybeans	15	39	31	8	1	6
Disease-or pest-resistant GM rice	26	42	20	6	1	5
Nutritionally improved GM rice	27	40	22	5	1	5
Livestock fed by GM maize	15	34	32	10	2	7

Table 2. Consumers' acceptance of different GM foods by degree of consumers' trust in government (percent).

	Acceptant rate ¹ excluding samples with undetermined attitudes					
	Pest-resistant GM fruit or vegetable	Oil from GM soybeans	Disease-or pest-resistant GM rice	Nutrition improved GM rice	Livestock fed by GM maize	Average acceptable rate (%)
Strongly trust	79	70	80	78	60	73
Relatively Trust	74	59	72	72	53	66
Neutral	71	52	69	71	51	63
Relatively Distrust	67	51	68	61	43	58
Strongly distrust	65	54	53	59	46	55

Note¹: The acceptable includes both strongly and relatively acceptable. The samples distributions are 206 (Strongly trust), 268 (relatively trust), 575 (neutral), 177 (relatively distrust), and 40 (strongly distrust).

Table 3: Estimation results of consumers' trust in government and their acceptance of GM rice.

	Disease-or pest-resistant GM rice		Nutrition improved GM rice	
	Trust in government	Acceptance	Trust in government	Acceptance
Years of being CCP member	0.008 (2.59)***		0.008 (2.59)***	
With laid-off family member	-0.159 (-2.24)**		-0.177 (-2.48)**	
Occurrence of water cut-off per month in the family	-0.251 (-2.33)**		-0.258 (-2.40)**	
Trust in government		0.852 (1.65)*		0.727 (1.45)
Year	0.038 (0.42)	0.147 (1.97)**	0.035 (0.38)	-0.08 (-1.06)
Attendance of 2002 survey	-0.126 (-1.39)	0.045 (0.61)	-0.131 (-1.44)	0.177 (2.36)**
Gender	-0.109 (-1.6)	0.034 (0.57)	-0.117 (-1.71)*	0.052 (0.87)
Age	0.014 (4.31)***	-0.003 (-0.59)	0.014 (4.27)***	-0.001 (-0.12)
Education	0.004 (-0.3)	-0.028 (-1.75)*	0.004 (0.3)	0.009 (0.89)
Monthly per capita income	0.137 (2.37)**	-0.122 (-2.16)**	0.136 (2.35)**	-0.187 (-3.32)***
Worked in government agents or public sectors	0.287 (3.35)***	0.067 (0.72)	0.277 (3.22)***	0.113 (1.23)
Retired	0.264 (2.26)**	-0.07 (-0.64)	0.253 (2.16)**	-0.001 (-0.05)
Live in big cities	0.187 (2.24)**	-0.199 (-2.46)**	0.178 (2.14)**	-0.266 (-3.29)***
Live in medium cities	0.173 (2.07)**	-0.141 (-1.83)*	0.174 (2.08)**	-0.215 (-2.77)***
With Family member experienced food allergic	0.07 (0.68)	-0.018 (-0.21)	0.052 (0.51)	-0.011 (-0.13)
With kids under 10 years old	-0.014 (0.16)	0.024 (0.32)	0.013 (0.14)	0.018 (0.25)
Constant	-0.868 (-3.70)***	-	-0.847 (-3.61)***	-
Observations	1587	1587	1588	1588

Note: * significant at 10%, ** significant at 5%, and *** significant at 1%.

In the equation for consumers' acceptance of GM food, there are four constant terms, and we did not list them in this table.

Table 4: Estimation results of consumers' trust in government and their acceptance of GM fruit/vegetable, GM soybean oil, and pork fed by GM maize.

	The pest-resistant GM fruit/vegetable		Oil from GM soybeans		Pork fed by GM maize	
	Trust in government	Acceptance	Trust in government	Acceptance	Trust in government	Acceptance
Years of being CCP member	0.007 (2.49)**		0.007 (2.49)**		0.008 (2.59)***	
With laid-off family member	-0.146 (-2.04)**		-0.146 (-2.04)**		-0.159 (-2.24)**	
Occurrence of water cut-off per month in the family	-0.25 (-2.33)**		-0.25 (-2.33)**		-0.251 (-2.33)**	
Trust in government		1.344 (1.88)*		1.006 (1.89)*		1.109 (2.15)**
Year	0.022 (0.24)	0.18 (2.38)**	0.022 (0.24)	0.153 (2.05)**	0.038 (0.42)	0.005 (0.021)
Attendance of 2002 survey	-0.119 (-1.32)	0.137 (1.82)*	-0.119 (-1.32)	0.138 (1.87)*	-0.126 (-1.39)	0.204 (2.73)***
Gender	-0.11 (-1.61)	0.109 (1.81)*	-0.11 (-1.61)	0.109 (1.86)*	-0.109 (-1.6)	0.056 (0.95)
Age	0.015 (4.57)***	-0.01 (-2.03)**	0.015 (4.57)***	-0.001 (-0.13)	0.014 (4.31)***	-0.003 (-0.68)
Education	0.004 (0.36)	-0.002 (-0.24)	0.004 (0.36)	0.001 (0.01)	0.004 (0.3)	0.005 (0.5)
Monthly per capita income	0.134 (2.32)**	-0.215 (-3.75)***	0.134 (2.32)**	-0.199 (-3.54)**	0.137 (2.37)**	-0.199 (-3.50)***
Worked in government agents or public sectors	0.297 (3.45)***	0.031 (0.32)	0.297 (3.45)***	0.094 (0.99)	0.287 (3.35)***	0.022 (0.24)
Retired	0.284 (2.44)**	-0.107 (-0.94)	0.284 (2.44)**	-0.031 (-0.28)	0.264 (2.26)**	-0.163 (-1.47)
Live in big cities	0.193 (2.31)**	-0.242 (-2.89)***	0.193 (2.31)**	-0.25 (-3.04)***	0.187 (2.24)**	-0.366 (-4.47)***
Live in medium cities	0.175 (2.09)**	-0.255 (-3.23)***	0.175 (2.09)**	-0.133 (-1.71)*	0.173 (2.07)**	-0.316 (-4.06)***
With Family member experienced food allergic	0.037 (0.37)	0.073 (0.85)	0.037 (0.37)	-0.02 (-0.24)	0.07 (0.68)	-0.146 (-1.69)*
With kids under 10 years old	0.014 (0.16)	0.029 (0.39)	0.014 (0.16)	-0.072 (-1.01)	-0.014 (-0.16)	0.007 (0.09)
Constant	-0.927 (-3.93)***	-	-0.927 (-3.93)***	-	-0.868 (-3.70)***	-
Observations	1589	1589	1589	1589	1546	1546

The note is same as Table 4.

Table 5. Comparison of the estimated parameters of consumers' trust in government between the models with and without consideration of its endogenous problem.

Estimated parameters of trust in government	Pest-resistant GM fruit or vegetable	Oil from GM soybeans	Disease-or pest-resistant GM rice	Nutrition improved GM rice	Livestock fed by GM maize
Without considering endogeneity	0.105 (2.48)**	0.199 (3.61)***	0.654 (5.56)***	0.123 (2.21)**	0.123 (2.21)**
Considering endogeneity	1.344 (1.88)*	1.006 (1.89)*	0.852 (1.65)*	0.727 (1.45)	1.109 (2.15)**

Note: * significant at 10%, ** significant at 5%, and *** significant at 1%.